



TÁMOP-4.1.1.C-12/1/KONV-2012-0004

# ANIMAL BREEDING

című digitális tananyag

**Szegedi Tudományegyetem Mezőgazdasági Kar  
Állattudományi és Vadgazdálkodási Intézet**

**Mikó Józsefné Dr. Jónás Edit  
Főiskolai docens**

**2014.**

# Requirements

- Presence on lessons
- Independent and group work
- Taking notes

- Practice mark
- Lecture mark



# **CHAPTER -1**

## **Lots of things you didn't know about cows**

# Vocabulary

- Ruminant
- Bovine
- Cattle
- Dairy cattle
- Beef cattle
- Dual purpose
- Cow
- Bull
- Heifer
- Calves
- Calving

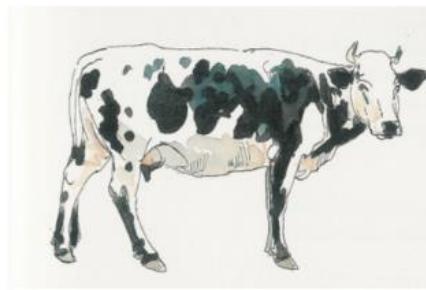
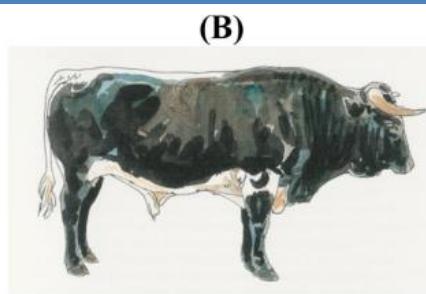
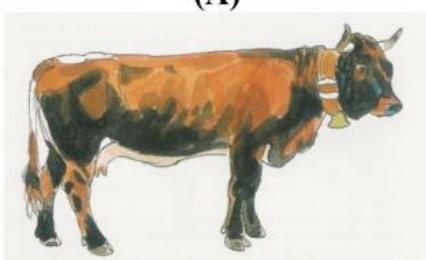
WHAT DO  
YOU CALL THE  
Boy Cows?



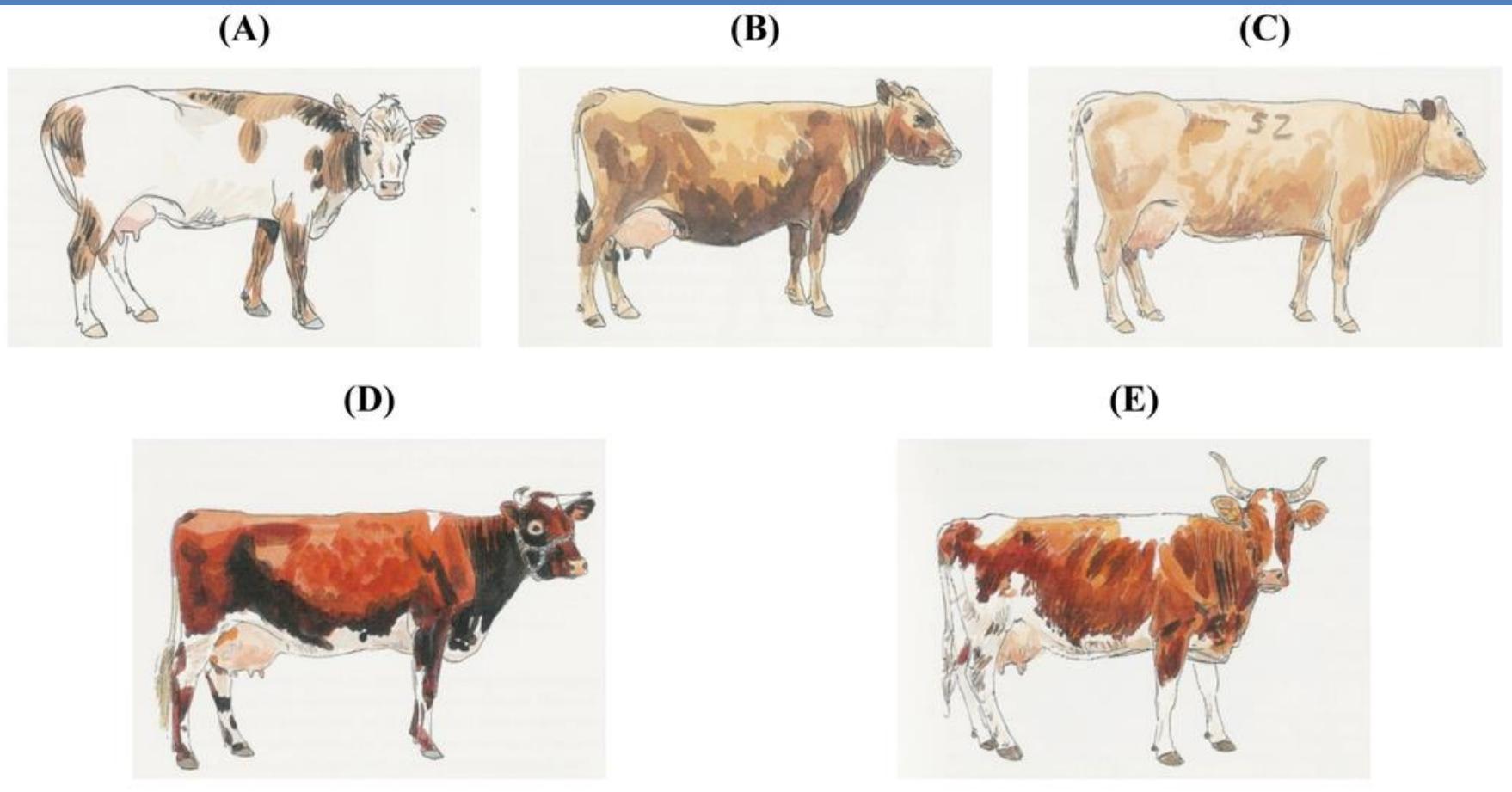
WHAT DO  
YOU CALL THE  
Boy Cows?







White-backed patterns in cattle of different origins. **(A)** Tux-Zillertaler (white finched); **(B)** Berrenda en Negro (Pinzgauer type white-backed); **(C)** Blacksided Trondheim and Nordland (color-sided); **(D)** Dagestan Mountain (white headed, color sided); **(E)** Ennstal Bergscheck (half white, color-sided) and **(F)** North Finncattle (color pointed).



**Figure 7.** Different colors and patterns in Nordic-Baltic cattle. **(A)** Icelandic; **(B)** West Finncattle; **(C)** Estonian Native; **(D)** Norwegian Red and **(E)** Swedish Red-and-White.

# Breeds of Cattle



ABERDEEN ANGUS



BEEF SHORTHORN



BELGIAN BLUE



BELTED GALLOWAY



BLONDE D'AQUITAINE



BRITISH WHITE



CHAROLAIS



HEREFORD



LIMOUSIN



LINCOLN RED



SOUTH DEVON



GALLOWAY



HIGHLAND



MURRAY GREY



RED POLL



SIMMENTAL



GLoucester



DEXTER



AYRSHIRE



LONGHORN



JERSEY



DEVON



IRISH MOILED



WELSH BLACK



DEXTER



WHITE PARK



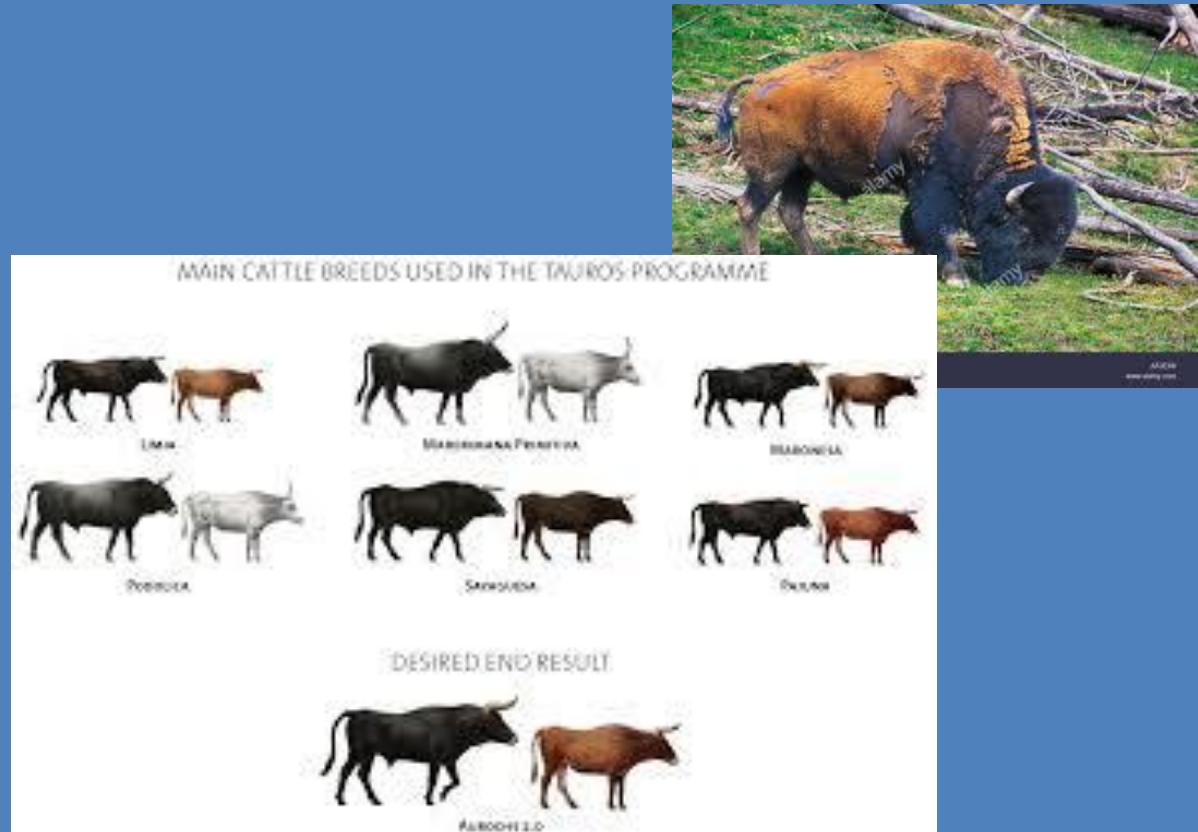
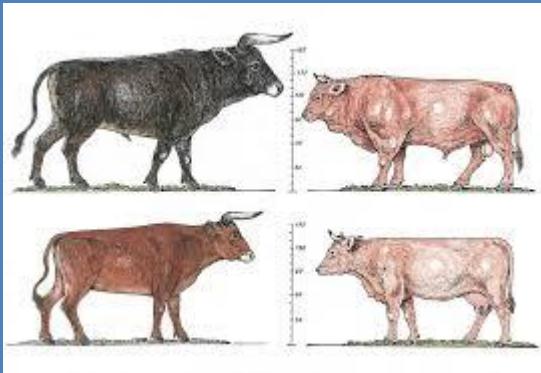
HOLSTEIN



SUSSEX

Domestic cows are descendants of wild oxen known as **aurochs**, and they were first domesticated in southeast Turkey around **10,500 years ago**.

From the original 80 progenitors, an estimated 1.3 billion cattle exist today.



In 2009 the bovine genome mapped out, the scientists discovered that cattle have about **22,000 genes; 80 percent of their genes are shared with humans.**



The word “cattle” comes from the Old French “chatel,” as in chattel, meaning property. In many parts of the world, cattle remain an indicator of economic wealth.

Female cattle are called **cows**; male cattle are called **bulls**.

Generally in the English language we have a single word that we can use to refer to both the male or female of a species — like cat or dog.

But cows are unique in that we don't have a singular noun that refers equally to an adult cow or a bull; we just have cattle, which is plural.

That said, in colloquial usage cattle are often referred to as cows.

WHAT DO  
YOU CALL THE  
Boy Cows?



WHAT DO  
YOU CALL THE  
Boy Cows?



Cows spend 10 to 12 hours a day lying down.



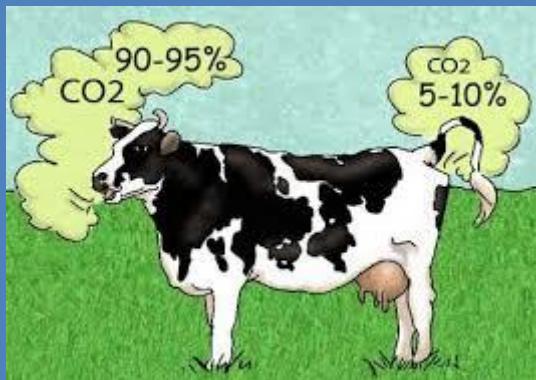
The average sleep time of a domestic cow is about four hours a day; unlike horses, they don't sleep standing up.



A dairy cow that is milking consumes around 100 pounds (45 kg) of feed each day.



When cows digest food, fermentation results in a large amount of methane; cattle produce 250 to 500 liters (and by some accounts, up to 1,000 liters) of the gas per day.



Just like dogs, cows enjoy a good rubdown, whether on the head, neck or back, as seen in this video of a cow using a "Happycow" machine.



Researchers have found that if you name a cow and treat her as an individual, she will produce almost 500 more pints of milk a year.



<https://www.youtube.com/watch?v=rKRfHoY-PRY>

A German study found that cows tend to face either magnetic north or south when grazing or resting, regardless of the sun's position or the wind's direction.



BBC Sign In News Sport Weather

**NEWS** ONE-MINUTE WORLD NEWS

**Cattle shown to align north-south**

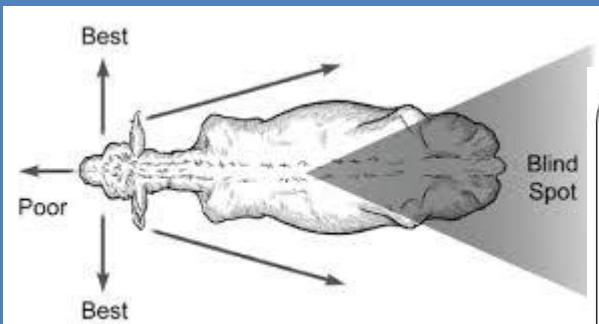
By Elizabeth Mitchell  
Science reporter, BBC News

Cattle partake in some directional grazing.

Have you ever noticed that herds of grazing animals all face the same way?

Images from Google Earth have confirmed that cattle tend to align their bodies in a north-south direction.

Cattle have almost 300 degrees of vision, with blind spots only right in front of and behind them.



## Animal Sight

- Horses and cattle can see color
- All prey/grazing animals have wide angle vision because their eyes are located on the sides of their heads.
- They have a small blind spot behind and directly in front of them

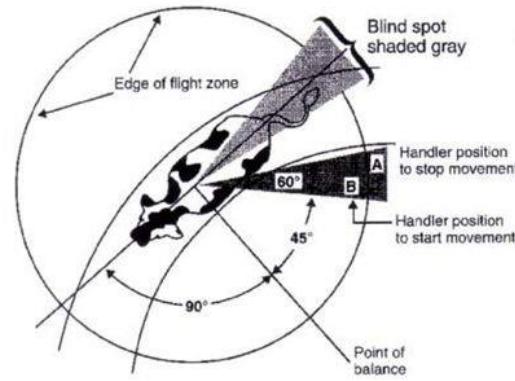


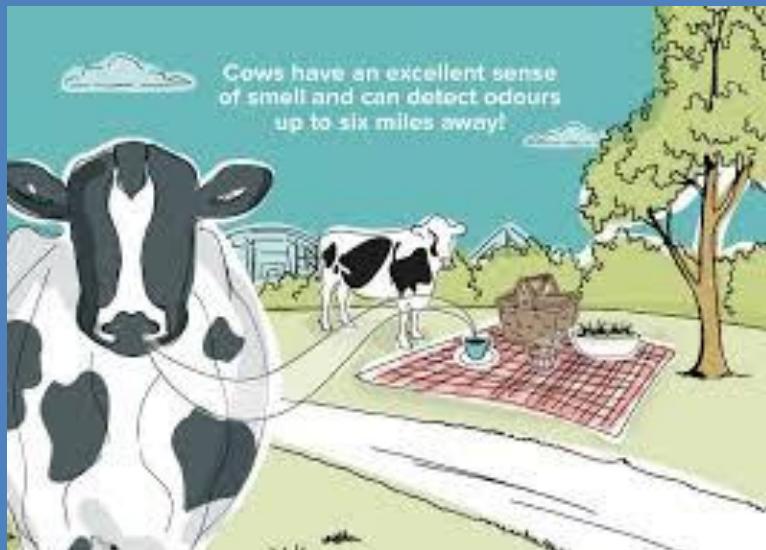
Diagram 1. Flight zone diagram.

Cattle are unable to see the color red; the red flags used by matadors only catch a bull's attention because of the movement.



<https://www.youtube.com/watch?v=2BGonopGo3k>

Cows have an excellent sense of smell and can detect odors up to six miles away.



# Homework

1. describe your country's cattle breeding
  1. Average size of cattle farms
  2. Specific breeds
2. what you know about cattle?

# Videos

- <https://www.youtube.com/watch?v=oZdiYKe4Qpo>
- <https://www.youtube.com/watch?v=xbvOeF5dddU&list=PLY7XQBihZRNubHTGO9P4neRDR8AHqcSjB&index=1>

# sources

- <https://www.mnn.com/earth-matters/animals/stories/20-things-you-didnt-know-about-cows>
- <http://www.mdpi.com/1424-2818/3/4/660/htm>



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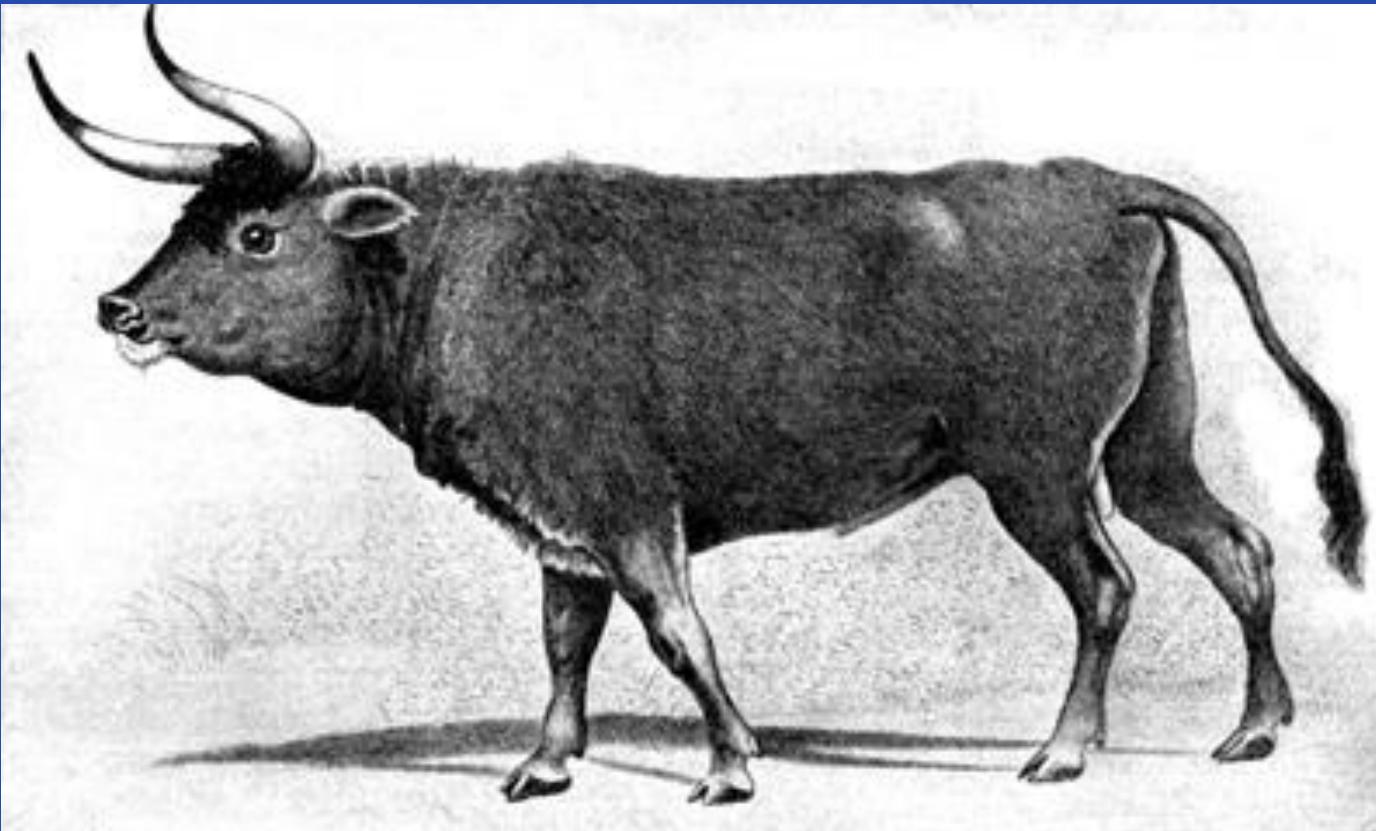


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**BEFEKTETÉS A JÖVŐBE**



# CHAPTER 1

## CATTLE DOMESTICATION

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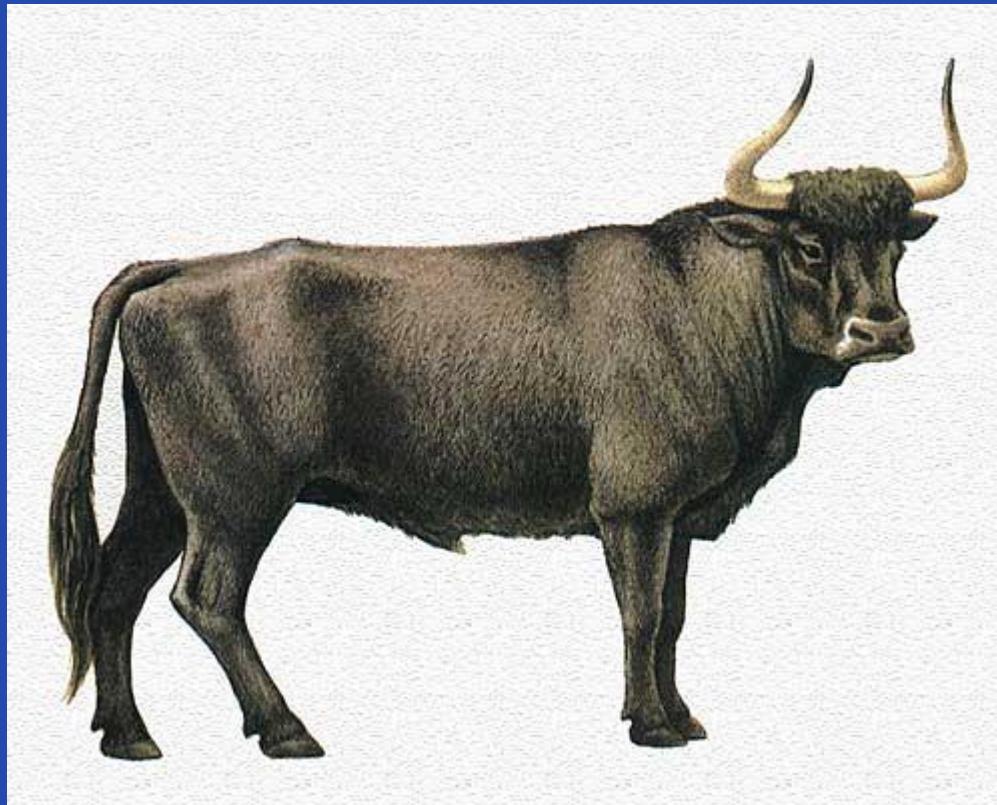
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**BEFEKTETÉS A JÖVŐBE**

- Cattle belong to an ancient and diverse group of mammals (even-toed ungulates, includes whales, hippos, ruminants, pigs, camels etc.) that first **appeared around 60 million years ago.**
- The two principal taxonomic groups of domestic cattle, *Bos taurus* (taurine cattle) and *Bos indicus* (zebu cattle) diverged from a common ancestor 250,000 years ago, and have had been associated with human civilization since Neolithic times 8,000–10,000 years ago.

All modern cattle breeds originate from large populations of the ancestral aurochs (*Bos taurus primigenius*).



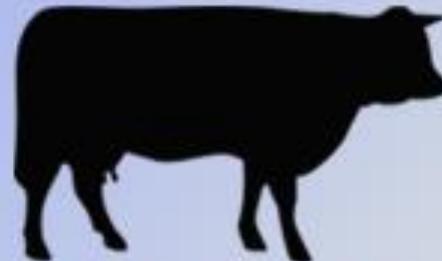
extinct

# Cattle domestication

Reason:  
agriculture or  
religion?



*Bos primigenius* (auroch, urus)  
Origin: 1.5-2 million years ago (India)



*Bos taurus* (cow)

15,000 or  
later years  
ago

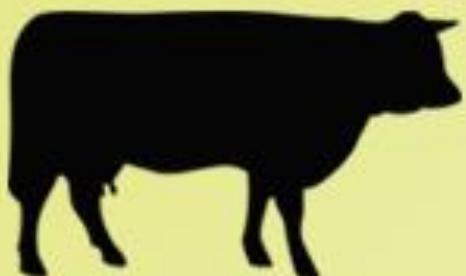
Last cow died  
in 1627 (Poland)

Domestication  
~10,000 years ago  
(Near East)



*Bos indicus* (zebu)

# *Bovinae* species



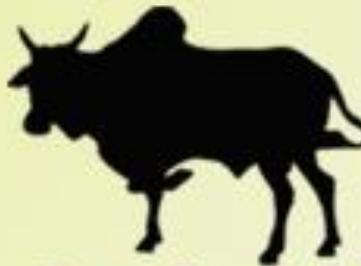
*Bos taurus* (cow)



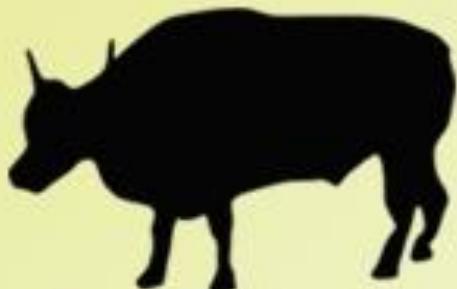
*Bos grunniens* (yak)



*Bos javanicus* (banteng)



*Bos indicus* (zebu)



*Bos gaurus* (gaur)



*Bison bonasus* (European bison)

# Some cattle species- Banteng

- Banteng, also Bali cattle, (*Bos javanicus*) inhabits various areas in Southeast Asia. They are wild as well as domesticated. Several subspecies exist. The handsome banteng largely resembles domestic cattle both in size and colour.

## Size

- Body length: 1.9 – 2.25 m
- Tail length: 65 - 70 cm
- Shoulder height: 1.55 – 1.65 m
- Weight: 600 - 800 kg



# Some cattle species

## Gaur (Bos gaurus)

- The gaur (Bos gaurus) is distributed in South Asia and Southeast Asia.
- The gaur is one of the larger of the wild cattle, and individuals can reach over two metres at the shoulder

### Size:

Shoulder height: 1.7 - 2.2 m

Body length: 2.5 - 3.3 m

Weight: 700 - 1,000 kg

<http://www.arkive.org/gaur/bos-gaurus/>



# Yak

The yak, also gayal or mithan, (*Bos grunniens*) has a dark black-brown coat, dense, wooly, and extremely shaggy.

Wild and domesticated animals exist. The distribution is believed to be limited to the Tibetan Plateau, but might extend to other regions with same climate.

## Size

Head-body length: up to 325 cm

Shoulder height: up to 200 cm

Tail length: 60 cm

## Weight

305 – 820 kg

<http://www.arkive.org/wild-yak/bos-mutus/video-00.html>



# Eurasian bison

The European bison (*Bison bonasus*), or 'wisent', is similar in appearance to its North American relative (*Bison bison*). Although smaller in size, it has the characteristic thickset body shape with a short neck and a pronounced shoulder hump. There is a longer mane of hair underneath the neck and also on the forehead. The dense coat is dark to golden brown in colour, but is less shaggy than that of the American bison. Both sexes bear short horns that project outwards and then curve up.

## Size

Length: 2.9 m (2)

Shoulder height: 1.8 - 1.95 m (2)

Weight: 600 - 1,000 kg



# Some cattle species

## American bison



# American bison

The American bison, the largest mammal in North America, once roamed the continent in vast herds and helped to shape the ecology of the Great Plains, as well as the history of the United States of America .

Length: 2.1 - 3.5 m (2)

Shoulder height: 1.5 – 2.0 m (2)

Weight: 350 – 1000 kg

<http://www.arkive.org/american-bison/bison-bison/photos.html>



# zebu (Bos indicus)

- The zebu is a species of cattle that is native to the jungles of South Asia and the Zebu is the only cattle species that can easily adapt to life in the hot tropics.
- The zebu is also known as the humped cattle as the zebu has a very distinctive hump on its upper back, located behind the head and neck of the zebu.

Size: 86-106cm

Weight: 150-200kg

Top Speed: 40km/h (25mph)

Life Span: 12-16 years

[http://www.youtube.com/watch?v=-RNk6B30yxU&feature=youtube\\_gdata\\_player](http://www.youtube.com/watch?v=-RNk6B30yxU&feature=youtube_gdata_player)



# Zebu crossbred cattle

- Santa Gertrudis
  - 3/8 zebu and 5/8 shorthorn
  - King Ranch, Texas
  - After experimental crosses of Zebu bulls and Shorthorn cows from 1910 – 1918 had proved a success, from 1918 onwards, for ten years, an extensive crossbreeding program was applied, in which several hundred, mainly A.P Borden-importation and Hudgins-bred Zebu bulls were randomly crossed with about 5000 purebred Shorthorn cows.



# Brangus

- The Brangus breed was developed to utilize the superior traits of Angus and Brahman cattle. Their genetics are stabilized at 3/8 Brahman and 5/8 Angus.
- The combination results in a breed which unites the traits of two highly successful parent breeds. The Brahman, through rigorous natural selection, developed disease resistance, overall hardiness and outstanding maternal instincts. Angus are known for their superior carcass qualities. They are also extremely functional females which excel in both fertility and milking ability.



[http://www.youtube.com/watch?v=m-nv4j8\\_zqs](http://www.youtube.com/watch?v=m-nv4j8_zqs)

# Charbray

- The Charbray breed was established in Texas USA in the 1930s when Charolais bulls from Mexico were crossed with Brahman (*bos indicus*) cows. The resulting calves weaned heavier, finished faster and carcase quality was unusually high.
- To be a registered charbray animal the breed has to range between 25% & 75% either way between charolais and brahman.



# Beefmaster Breeders United (BBU)

- Beginning in the early 1930s, Tom Lasater, the breed's founder, developed Beefmasters from a systematic crossing of Hereford, Shorthorn and Brahman cattle. His purpose was to develop cattle that were more productive than existing breeds; cattle that would produce and make money during economically hard times in the harsh environment of South Texas.



<http://www.youtube.com/watch?v=vc2CojhaTbE>

# Questions

- What is the ancestor of cattle?
- What are the bovine species?
- What are the characteristics of zebu?

# Sources:

- <http://a-z-animals.com/animals/zebu/>
- <http://www.ansi.okstate.edu/breeds/cattle/brangus/>
- <http://www.arkive.org/>
- [http://www.beefmasters.org/association\\_history.php](http://www.beefmasters.org/association_history.php)
- <http://www.charbraycattle.com.au/history.html>
- <http://www.geochembio.com/biology/organisms/cattle/#species-image>
- <http://www.santagertrudis.co.za/the-breed/history/>



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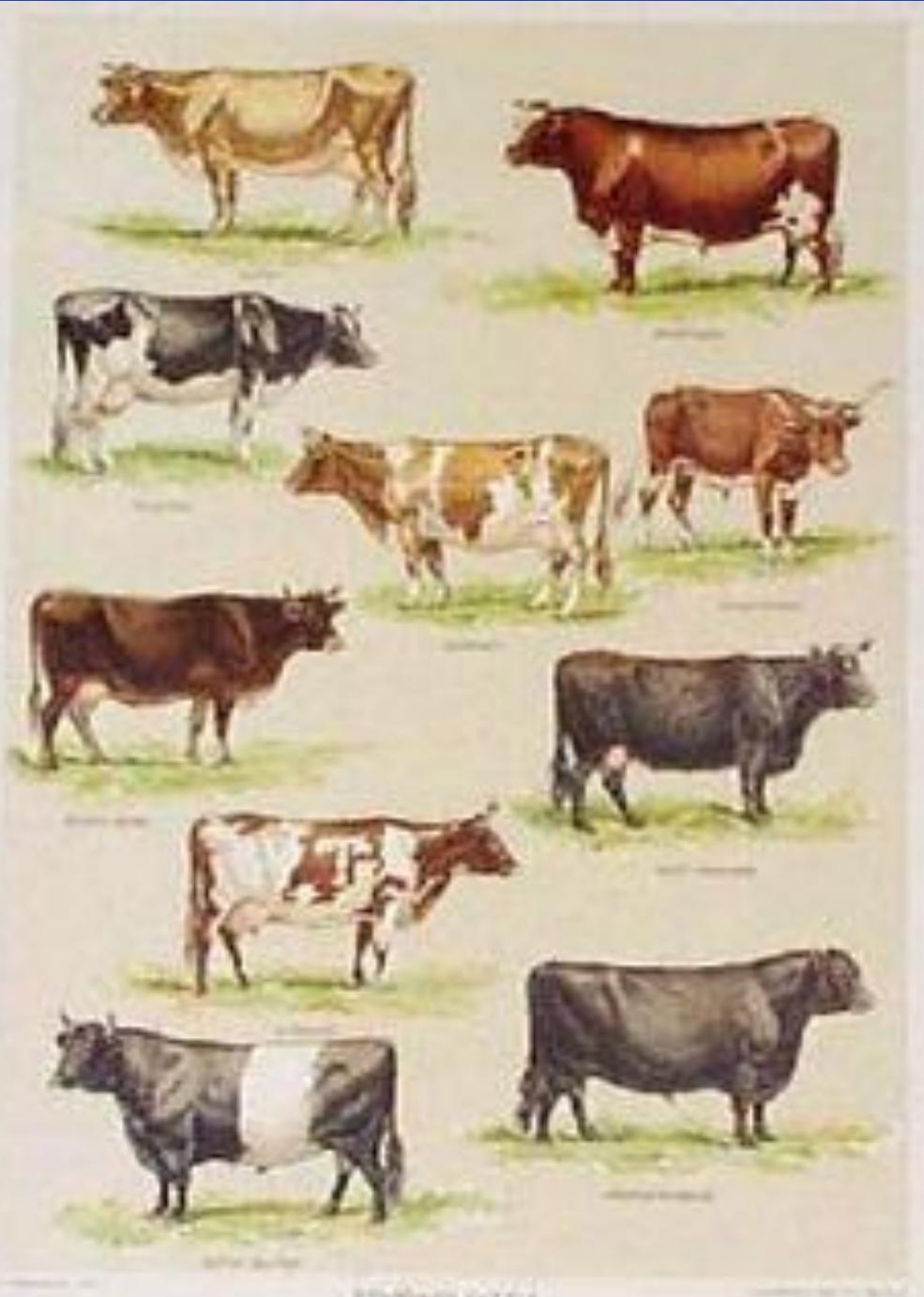


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**BEFEKTETÉS A JÖVŐBE**



# CHAPTER 2

## CATTLE

## BREEDS

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# Cattle Breeds

The factors involved in the development of varieties

- The claims against the production,
- The natural environment,
- Climate

Today, over 400 cattle breeds.

# Grouping of cattle breeds

By production:

Dairy,

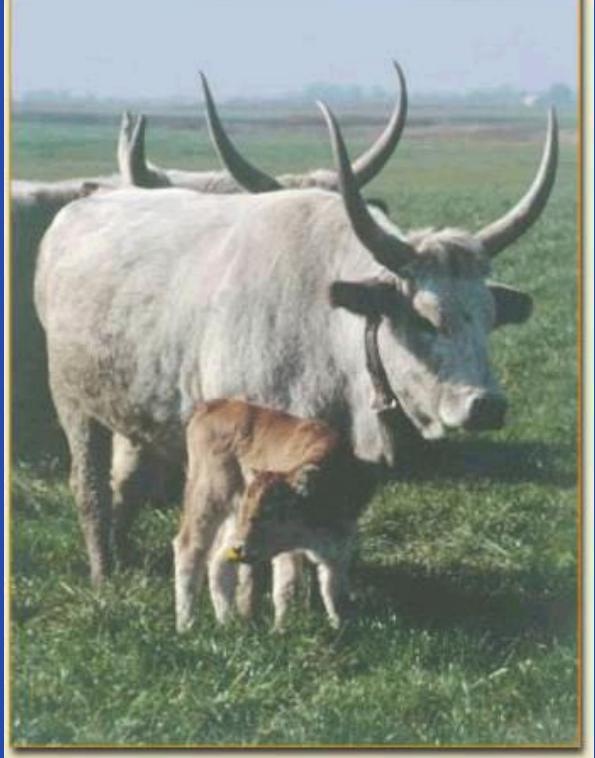
Beef cattle,

Dual Purpose

# Hungarian Grey Cattle

The 'Hungarian grey' (*Bos primigenius taurus Hungaricus*) is a real national symbol of Hungary, an animal that is indigenous to the country and is protected by law.





Cows weigh 550 to 600 kg, bulls 700 to 900 kg, with strong and tough muscles.

Their colour varies with age.

Calves are born with reddish-yellow hair, and by the age of 6-8 months they turn completely grey.

Adult animals' colour may vary from silver to cinereous.



In Hungary, national parks, the Hortobágy Non-profit Company for Nature Conservation and Gene Preservation,



# Simmental

Simmental colour varies from gold to red with white, and may be evenly distributed or clearly defined in patches on a white background.

Dual Purpose

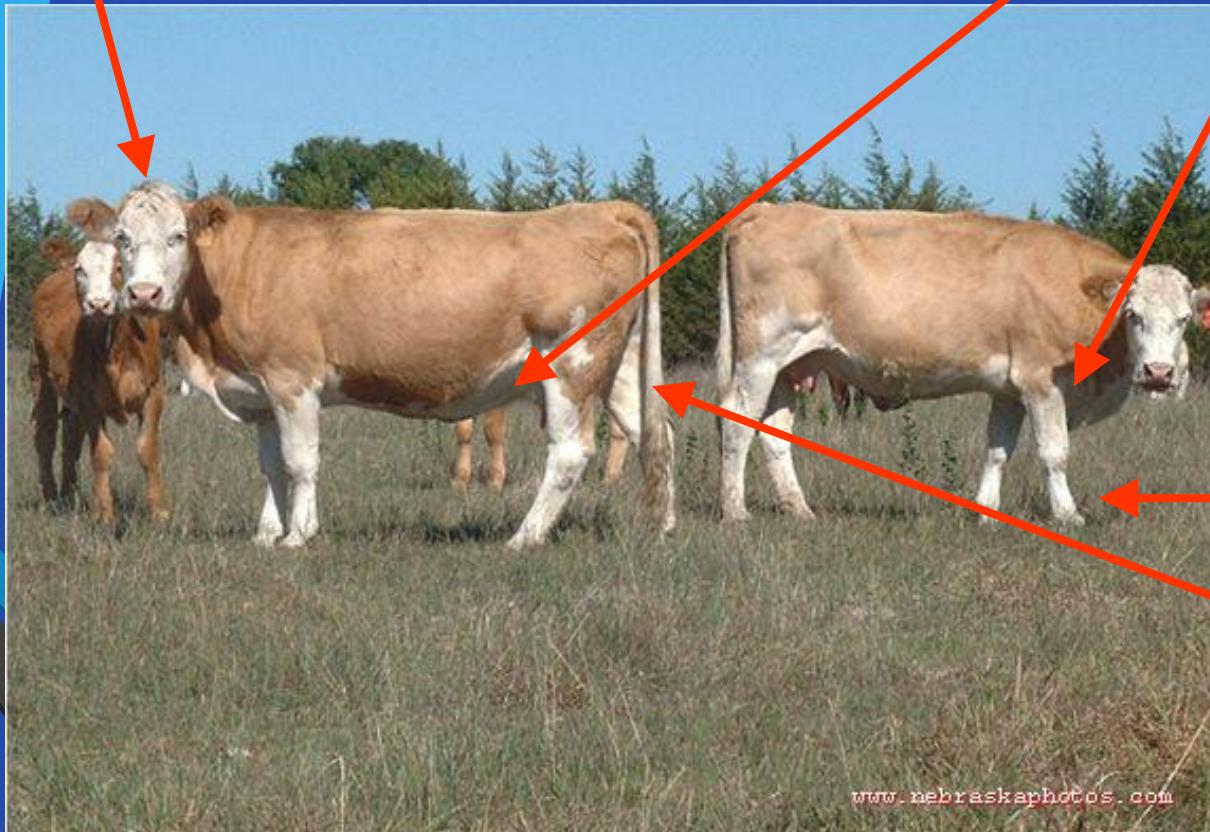


# Simmental

white

head

the lower part of the abdomen and chest



feet

The lower third  
of the tail

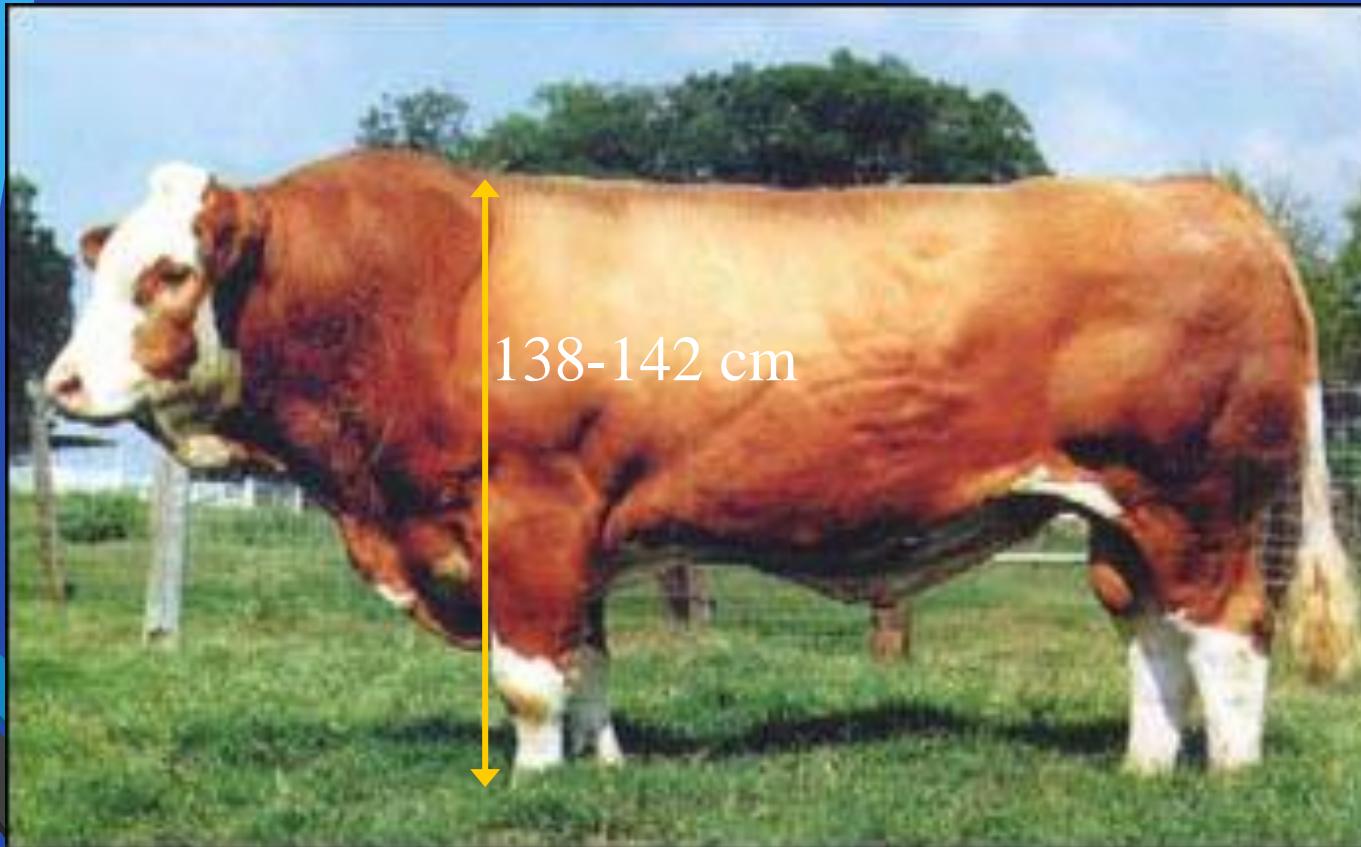
# Simmental



650-750 kg,



1100-1300 kg.



# Simmental

**Udder type is criticized!**

Milk production: 4500-5000 kg milk , 4%- fat and 3.4% protein

Meat production: 1200-1300 g / day



# Hungarian Simmental Cattle

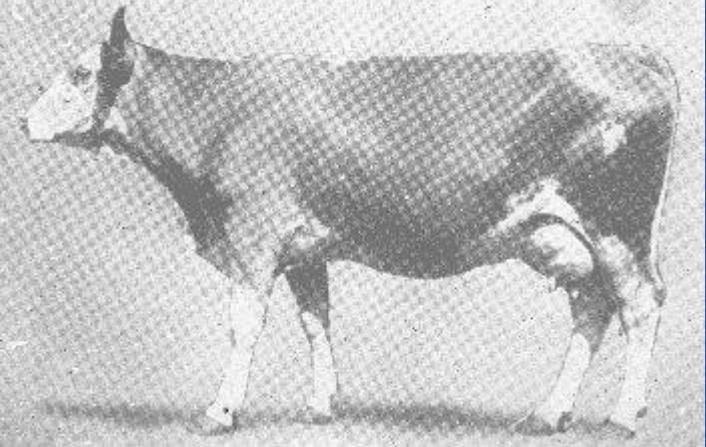
# Hungarian Simmental Cattle

Hungarian Grey Cattle **X** Simmental Cattle  
Crossbreeding program

A general increase in global demand for milk and meat.



Nowadays we do not use of cattle for draft and transport

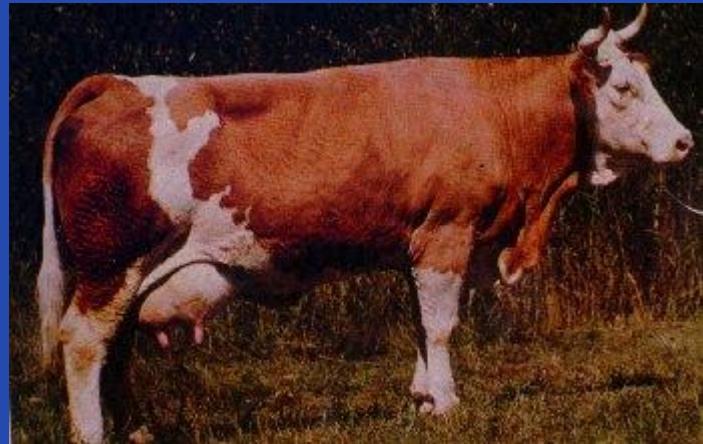


#### Size

Shoulder height: 135-140 cm

#### Weight

600-700 kg



Simmental colour varies from gold to red with white, and may be evenly distributed or clearly defined in patches on a white background.

The head is white and often a white band appears over the shoulders.

The majority have pigment around the eyes, helping to reduce eye problems which occur from bright sunlight.

# Hungarian Simmental Cattle

They have a large frame with good muscling with cows at approximately 135-150 cm tall and the bulls at 150-160cm. Their weight can vary of their use but cows can weigh around 700-900 kgs and bulls 1300 kgs



# Hungarian Simmental Cattle

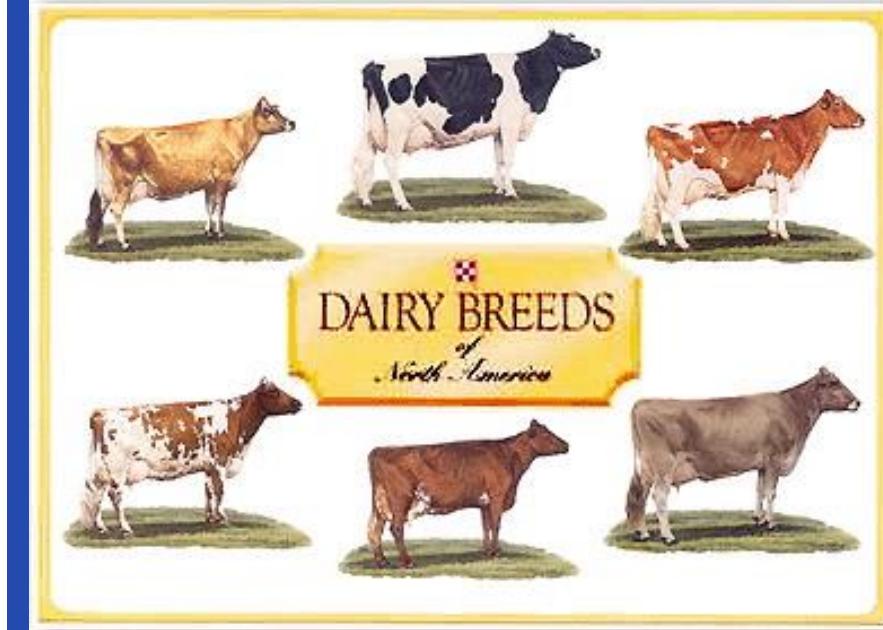
	Milk kg	Fat kg	Fat %	Protein kg	Protein %
Average lactation 2,9	5949	236	3,96	205,3	3,45
The result of the best milk farm	7554	290,8	3,85	255,2	3,38

Table 1: The national lactose results of the milked stocks (2010)

Number of days between two deliveries (day)	410
Age at first delivery (month)	28,9



# Dairy types



Ayrshire



Brown Swiss



Guernsey



Red & White



Holstein



Jersey



Milking Shorthorn

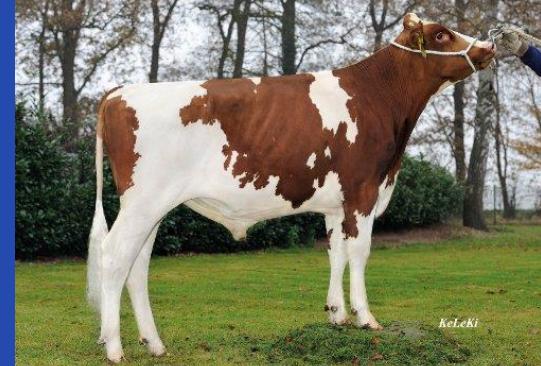
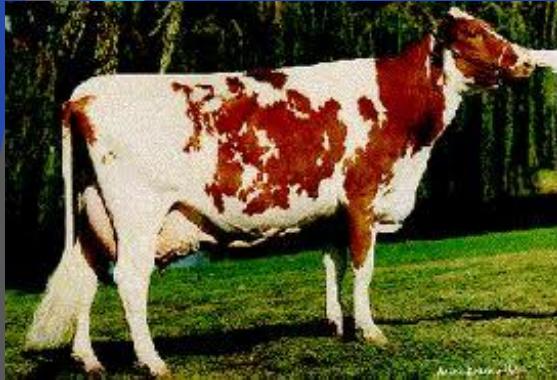
# The Holstein Breed

The Holstein cow originated in Europe, and was imported to America from Holland in the mid 1800's.

Today's Holstein cow is a large black-and-white or red-and-white stylish animal with outstanding milk production.

A mature cow should weigh 650-750 kg. Average production for Holsteins on official testing programs is 10.000 kg milk and 370 kg butterfat.

# The Holstein Breed



# The Jersey Breeds

- The Jersey breed originated on Jersey Island. Jersey Island is one of the Channel Islands located between England and France.
- The Jersey is one of the world's oldest dairy breeds.
- The first Jerseys were brought to the United States in 1850.

# The Jersey Breeds

- Jerseys are found throughout the world because of their ability to adapt to a wide range of management, climates, and geographic conditions.
- The Jersey breed is noted for its efficiency. Averaging 400 kg in body weight.
- The Jersey breed production average is 7000 kg milk, 320 kg fat, and 250 kg protein.
- Jersey milk has the highest concentration of milk solids – including protein – among the other major dairy breeds.

# The Jersey Breeds



# The Ayrshire Breed

The Ayrshire breed originated in the County of Ayr in Scotland prior to 1800, with the first importation to the U.S. around 1822. The breed is medium in size with various red and white markings. Dairymen appreciate Ayrshires because of their efficiency, udder quality, longevity, and ease of care.

# The Ayrshire Breed

Additionally, they produce quality milk, which is highly regarded for manufacturing.

Programs offered by the Ayrshire Breeders' Association in addition to DHIR and Type Traits Appraisal include the Genetic Recovery Program, whereby "grade" Ayrshires can be brought into the herdbook through a three generation series.

The Ayrshire breed has a strong Junior program, presenting awards for production, type, and leadership. Youths with Ayrshires are encouraged to become Junior Members for a one-time fee of \$10.00. Junior Membership allows youth to register their Ayrshires at member rates and to participate in National Youth Contests.

# The Ayrshire Breed

Ayrshires are red and white.

For many years, the Ayrshire horns were a hallmark of the breed. These horns often reached a foot or more in length.

Ayrshires are medium-sized cattle and should weigh over 500-600 kg at maturity.

Ayrshires excel in udder conformation and are not subject to excessive foot and leg problems.

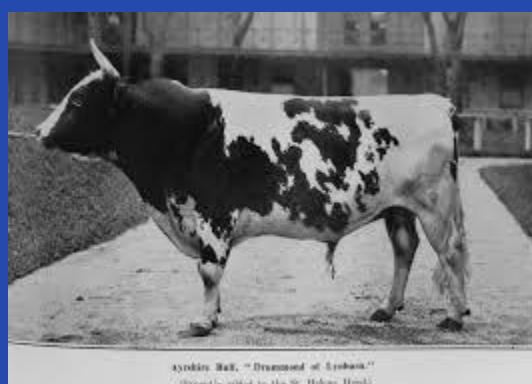
The Ayrshire is a moderate butterfat breed. The actual average of all Ayrshires on Official DHIR test is over 5400 kg of milk.

Top producing Ayrshires regularly exceed 9000 kg of milk in their lactations.

The current world record for Ayrshire is held by Lette Farms Betty's Ida.

In 305 days, on twice-a-day milking, she produced 16860 kg of milk and 722 kg of fat.

# The Ayrshire Breed



Ayrshire Bull, "Dreadnaught of Lynden,"  
(formerly owned by the St. Helens Herd)

# The Brown Swiss Breed

The Brown Swiss has its origins in the mountains of Switzerland, and is one of the oldest dairy breeds in the world.

The first Brown Swiss came to the U.S. in the winter of 1869-70.

Today's Brown Swiss is known for her ability to adapt to any type of dairy setup in any country of the world.

The Swiss cow is gaining popularity worldwide due to the high protein content of her milk, which is 'just right' for the cheese-maker.

## 1) Lactation Production Trends for registered animals (all ages)

Year	No. of Lactations (BSW) *	Milk Yield (kg)	Fat %	Protein %	Fat Yield (kg)	Protein Yield (kg)	Somatic Cell Count ('000 cells/ml)	Calving Interval (days)
2000	160	6864	3.99	3.41	274	234	134	395
2001	221	7117	4.00	3.35	284	238	156	409
2002	329	7505	4.03	3.35	302	252	143	419
2003	453	7811	3.95	3.36	308	263	166	420
2004	635	7859	3.99	3.31	314	260	174	428
2005	758	7907	4.01	3.31	317	262	190	419
2006	844	7833	4.01	3.31	314	259	190	420
2007	1,097	7851	4.01	3.32	315	261	206	419
2008	1,180	7475	4.11	3.43	307	256	171	431
2009	1,378	7387	4.05	3.45	299	255	174	421
2010	1,618	7380	4.10	3.41	303	252	147	422
2011	1,766	7519	4.15	3.40	312	255	158	418

- Derived from animals completing a 305-day Lactation Period. Minimum of 200 days and 5 full tests.

## Lactation / Parity Group Production

Brown Swiss

Parity	lactation count * (BSW)	Milk Yield (kg)	change ** between lactations	Fat %	Protein %	Fat Yield (kg)	Protein Yield (kg)	SCC ('000 cells/ml)	Calving Interval (days)
1	507	6375		4.18	3.41	267	218	96	
2	421	7616	19%	4.15	3.43	316	261	144	421
3	317	8318	9%	4.11	3.38	342	281	155	406
4	221	8088	-3%	4.15	3.39	336	274	173	417
5	115	8282	2%	4.19	3.37	347	279	181	422
6	74	8279	0%	4.05	3.34	335	277	374	429
7	55	7635	-8%	4.08	3.31	311	253	161	436
8	23	8228	8%	4.14	3.34	341	275	334	450
9	19	7650	-7%	4.11	3.31	315	253	640	436
10+	14	6883	-10%	4.20	3.31	289	228	158	412

# The Brown Swiss Breed



# The Milking Shorthorn Breed

Milking Shorthorns are one of the oldest recognized breeds, originating from Northeastern England in the Valley of the Tees River.

In 1783, the first Shorthorns entered the United States. Milking Shorthorns are best known for their versatility.

The American Milking Shorthorn Society was formed in 1948.

Cows producing in excess of 9000 kgs of milk per 305 days on low input management.

Average milk production for the breed is about 7,000 kg in an annual lactation of 305 days, with 3.8% butterfat and 3.3% protein.

They are red, red with white markings, white, or roan.

# The Milking Shorthorn Breed



# Breeds of Beef Cattle

# Aberdeen Angus

The Aberdeen-Angus breed was developed in the early part of the 19th century from the polled and predominantly black cattle of North east Scotland known locally as “doddies” and “hummlies”.

Two colors: red or black

Weight of cows :450-550 kg.

Easy calving

Calf weight at calving: 25-30

Black



Red color



# ABERDEEN-ANGUS



# ABERDEEN-ANGUS



# HEREFORD

The Hereford originated in Herefordshire in south-west England and is one of the earliest British cattle types to have been systematically improved or upgraded



# HEREFORD

Ease of Calving: Herefords have traditionally been used in the dairy sector because of their easy calving; resulting in an increased calf crop, viable cross-breed calves and reduced veterinary costs



# HEREFORD characteristic

The modern Hereford is coloured dark red to red-yellow, with a white face, crest, dewlap, and underline.



# HEREFORD

Mature males may weigh up to 800 kg, while mature females may weigh around 550 kg.

They are muscular, moderate to long in length of side, adequate in length of leg, large in size, trim, and smooth.



# HEREFORD

- Milk production 800-1000 kg;
- Good growth and carcass quality



# HEREFORD

Foto: Dittrich, aid





# CHAROLAIS

Breed or cross	Number (steers)	Carcass weight	Dressing out percentage	Fat depth (mm)	Fat colour	Meat colour	Marbling score	Meat pH
Angus	13,853	314	56.3	7.8	4.9	5.3	1.6	5.8
Charolais	1,069	345	57.4	4.6	5.0	5.2	1.5	5.8
Friesian	2,077	312	54.0	3.6	5.4	4.5	1.7	5.9
Hereford	4,462	315	56.0	8.4	4.9	5.3	1.6	5.8
Simmental	3,045	331	56.6	5.6	5.0	5.3	1.5	5.8
Limousin	648	329.5	57.2	5.4	5.0	5.3	1.7	5.8

# CHAROLAIS

The typical Charolais is white in colour with a pink muzzle and pale hooves, horned, long bodied, and good milkers with a general coarseness to the animal not being uncommon.



Weight of cows:  
600-800 kg,  
Bulls can over than  
1400kg.





# LIMOUSIN

Limousin cattle are a breed of highly muscled beef cattle originating from the Limousin and Marche regions of France.

Most Limousin cattle have a coloration that varies from light wheat to darker golden-red.



# LIMOUSIN

Weight of cows: 600-700 kg

Growing :1100-1200 g/ day ,



# LIMOUSIN



# VIDEOS

- <http://www.youtube.com/watch?v=IhjIEBzjUxY>
- <http://www.youtube.com/watch?v=D797gm5WK9Q>
- <http://ssa.nls.uk/film/0278>  
[http://www.youtube.com/watch?v=EHO\\_msUYT3c](http://www.youtube.com/watch?v=EHO_msUYT3c)  
<http://www.youtube.com/watch?v=QfWWXU1Hehs>  
<http://ssa.nls.uk/film/0277>  
<http://vimeo.com/34384856>
- <http://www.youtube.com/watch?v=TmBIJYUYHWY>

# Questions

- How many cattle breeds are there?
- How are cattle breeds grouped?
- What are the characteristics of Hungarian Grey Cattle breed?
- What are the characteristics of Holstein breed?
- What are the characteristics of Hereford breed?

# Sources:

- [http://en.wikipedia.org/wiki/Limousin\\_\(cattle\)](http://en.wikipedia.org/wiki/Limousin_(cattle))
- <http://kendralindell.files.wordpress.com/2011/10/lbbreeds3.jpg>
- <http://wwf.hu/en/hungarian-grey-cattle>
- <http://www.ansi.okstate.edu/breeds/cattle/holstein/>
- <http://www.brownswiss.org/forms/breed%20stats%202011%20BS.pdf>
- <http://www.dpi.nsw.gov.au/agriculture/livestock/beef/breeding/breeds/hereford>
- [http://www.magyartarka.hu/portal/index.php?option=com\\_content&task=view&id=13&Itemid=33](http://www.magyartarka.hu/portal/index.php?option=com_content&task=view&id=13&Itemid=33)
- <http://www.purebreddairycattle.com/pages/Breeds.php>
- <http://www.thebeefssite.com/breeds/beef/17/simmental/overview#sthash.t4VmZK2R.dpuf>
- <http://www.thecattlesite.com/breeds/beef/11/charolais/overview>
- <http://www.thecattlesite.com/breeds/beef/7/aberdeen-angus/overview>



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# ANIMAL BREEDING

című digitális tananyag

Szegedi Tudományegyetem Mezőgazdasági Kar  
Állattudományi és Vadgazdálkodási Intézet

Mikó Józsefné Dr. Jónás Edit  
Főiskolai docens

2014.

**SZÉCHENYI** 2020



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KORMÁNYA

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Alap



**BEFEKTETÉS A JÖVŐBE**



# CHAPTER 3

## CATTLE BUILDINGS



A JÖVŐBE

The housing of cattle is an economic necessity in many parts of the world, though not to the same extent as the housing of poultry and pigs.

Dairy cows are most likely to be kept indoors for a large part of the year, because of greater control of diet, the need to limit damage to a farm's pastureland, and the opportunity to mechanize milking and other aspects of the routine animal care.



<http://www.oldcon.com/latest-news/slatted-unit/>

The cow is a tolerant creature and can accustom herself to a wide range of types of housing with little apparent effect on her performance.

This does not imply that buildings and their design are not important, but emphasizes that milk can be produced efficiently in cheap and simple buildings if the basic principles of housing are followed.

In fact, most cow buildings are planned with the comfort and convenience of the man in view rather than the cow.

This is acceptable, provided that a few simple points concerning the cow's requirements are observed.

Firstly, cows do not mind being cold, and they do not particularly mind being wet, but if they are both cold and wet, and are subjected to wind or draught as well, they will suffer.

Secondly, cows dislike being cramped for space.

The specific objectives of cattle housing are:

- to provide a comfortable environment and adequate food and water supplies for the animals, thus meeting their behavioural and physiological needs;
- to provide a comfortable and safe working environment for the stockperson;
- to minimize injury to stock and the transfer of diseases;
- to provide ready access for the cows to handling facilities and in the case of lactating cows, the milking parlour;
- to protect the land area of the farm from damage by cattle treading or overgrazing.

The most important elements of any cattle house are the floor, the lying area and the feeding system.

A freestall-housed dairy cow has five key activities.

She needs time each day for milking, feeding, standing in the alley, which includes drinking water, standing in a stall and lying in a stall.

Dairy researchers call these activities a cow's behavioural time budget.

Time out of the pen milking, stall base type and lameness can alter her time budgets with negative consequences for her health, well-being and milk production.

## Floors in cattle buildings

The floor is the physical point of contact of the animal with its environment, and is important from the point of view of wear and tear on the animal, primarily the hooves, the ability to sustain normal locomotory behaviour and the conduction of heat from the animal to the floor.

Floors must be designed to withstand the heavy animal traffic caused by a high stocking density in the house.



<http://www.moore-concrete.com/agricultural/>

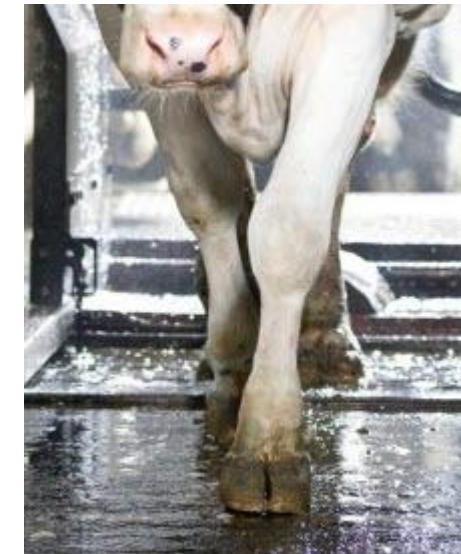


<http://www.fwi.co.uk/articles/15/04/2014/144134/slats-aid-cow-foot-health-and-slurry-storage.htm>

## Floors in cattle buildings

Concrete is the material of choice, since it is relatively durable, inexpensive and not too slippery, at least in the initial period after laying.

It can be laid with a variety of types of corrugated surfaces that help to prevent the animals slipping, from a tamped surface, which is created at the time of laying by stippling the surface with a plank of wood, to a grooved surface, which is usually created with a cutting device in floors that have been worn smooth over time.



[http://www.delaval.hu/ImageVaultFiles/id\\_1773/cf\\_5/st\\_edited/hHGyxdNaFTg24Pdsmzic.jpg](http://www.delaval.hu/ImageVaultFiles/id_1773/cf_5/st_edited/hHGyxdNaFTg24Pdsmzic.jpg)



<http://www.pointernet.pds.hu/ujsagok/agraragazat/2011/04/20110616080832153000000392.html>

## Floors in cattle buildings

Slipping is a particular problem for lactating cows on smooth floors, and the cows may not be able to get up if their legs splay.

Falls, slips and splays on smooth floors cause bone, muscle and joint problems, but a concrete floor that is too rough can lead to damage to the sole of the hoof.

Slipping is particularly a problem on concrete because the hard surface prevents the hoof from sinking into the floor surface as it does on earth.

## Floors in cattle buildings

Slipping can be minimized by increasing the coefficient of friction of the floor, determined as the force required to move an object over a floor divided by the weight of that object.

The risk of slipping is greatest at the beginning of the stride (just before the thrusting phase), when the forward horizontal force of the cow is large relative to the vertical force of the cow's mass, and the friction provided by contact between the hoof and the floor is reduced.

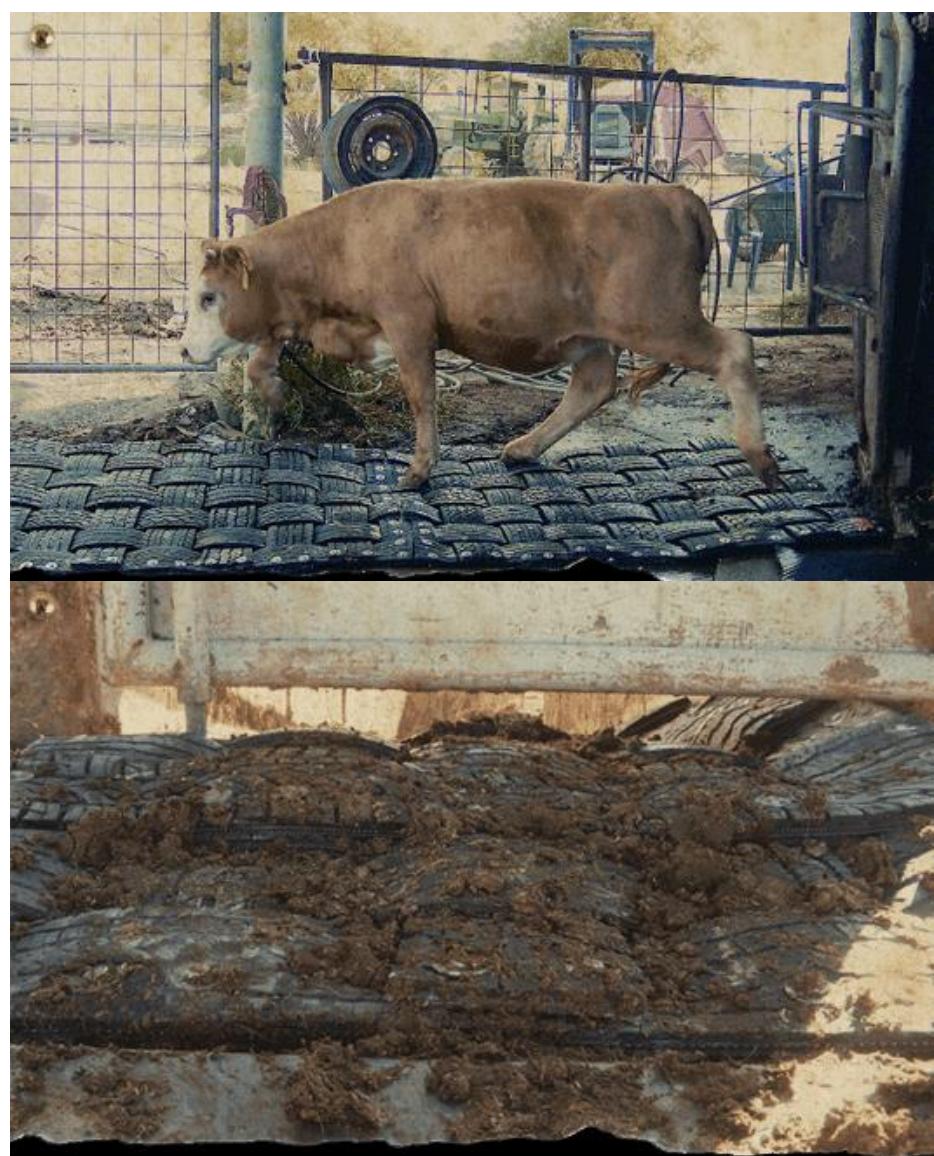


<http://www.speedcrete.co.uk/hexagon-cattle-concrete-roller-i3182.html>

## Floors in cattle buildings

Particular attention should be paid to floor quality in areas of heavy cattle traffic, such as around water troughs and in the feeding area. In dairy cows, heavy traffic occurs in the milking parlour, and in places where cows are required to turn sharp corners suddenly, such as in leaving a building to go to be milked or entering or leaving the parlour.

As cows turn a corner, the outer and inner limbs rotate, putting more pressure on the outer and inner claws of those respective limbs. In high-risk areas, the floor can be treated with an aggregate embedded into a resin, which reduces slipping considerably.



<http://www.ddfamilymats.net/>

# Floors in cattle buildings

Other environmental and cattle factors will influence the likelihood of cattle slipping:

- wet surfaces are more slippery than dry surfaces, so regular removal of surface water is preferable;
- freshly tamped surfaces are rather better than grooved surfaces at providing a slip-resistant surface;
- cows with small upright feet are more likely to slip than cows with large, overgrown toes, which means that care must be taken in breeding cattle with ‘improved’ hoof conformation.

# Lying areas and feeding

Cattle spend about one-third of their life lying down and resting.

Lying is important to cows; it allows them time to recuperate and digest their food

Cattle do not spend more than about 5 min at a time sleeping, which can be recognized by their neck being recumbent, with the head usually tucked back so that it rests against their thorax.

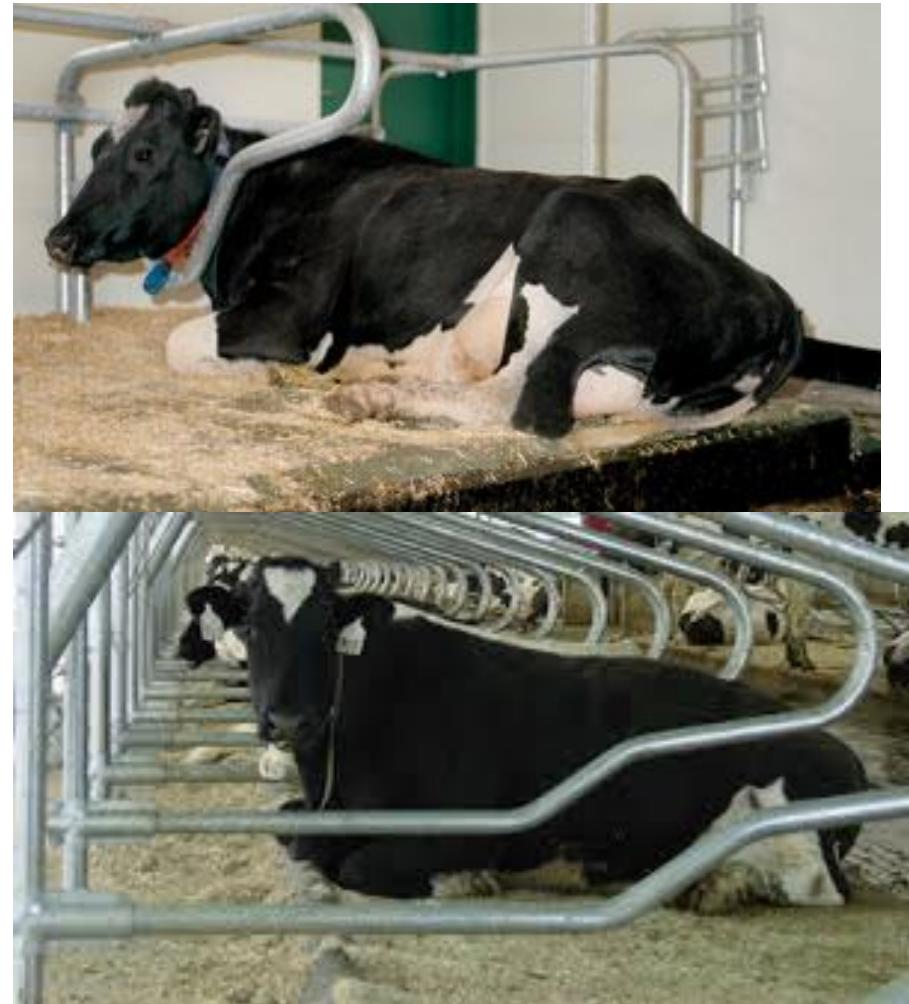
Up to about 8 h a day are spent ruminating, in a semi-trance-like state, which may substitute for sleep.

## Lying areas and feeding

In most countries cows are kept inside and fed conserved feeds for at least part of the year, because grass and other crops for grazing will only grow in warm wet conditions at certain times of year.

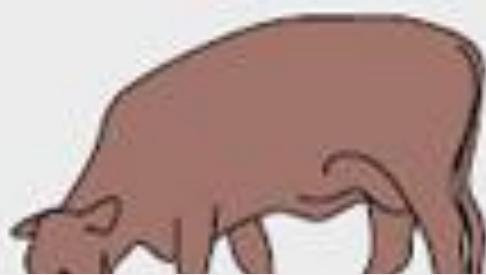
Inside, cows can be accommodated in areas where they are free to move around and lie down (loose housing), or they can be tethered by a chain or with their head between two bars in individual stalls (tie stalls).

If loose-housed, cows usually have access either to food delivered along a passage (easy feeding) or they help themselves from a clamp of silage or from racks of feed outside (self-feeding).



How a cow lies down

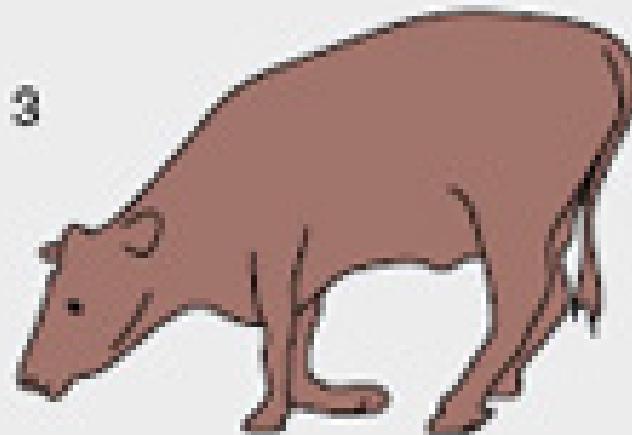
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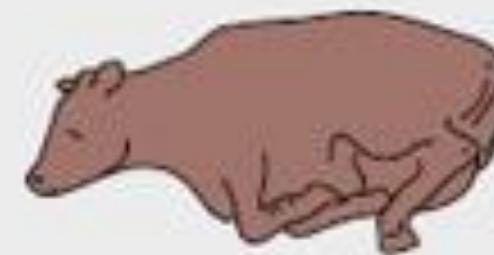
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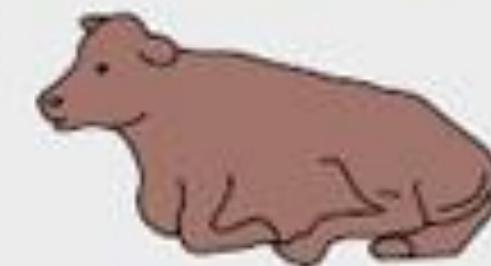
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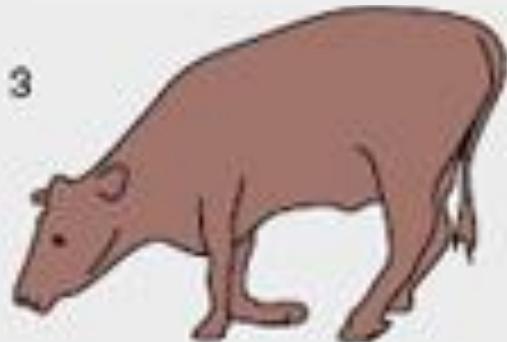
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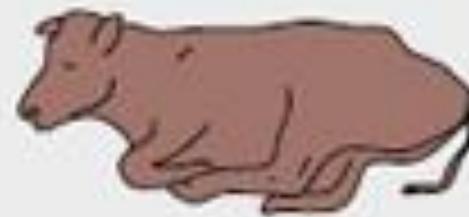
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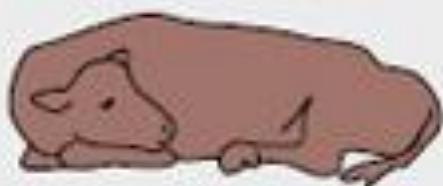


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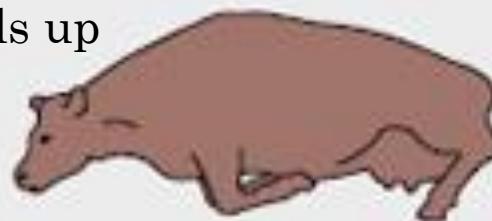


How a cow stands up

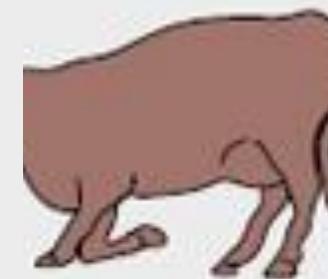
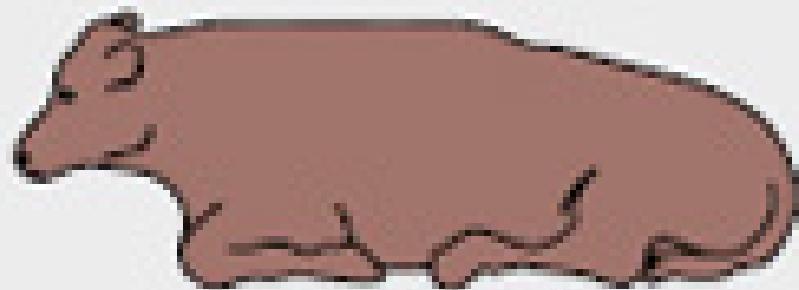
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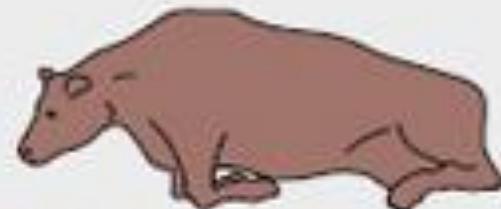
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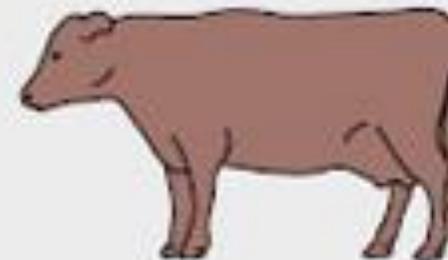
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4



8



# Feeding along a passage

Feeding along a passage If cattle get their food offered to them on a concrete passage, they must be prevented from walking on it by a barrier.

The design of this barrier is important, as the cows will strain to get feed that is furthest from them and which has not been sampled by other cows.

As a result, they exert a lot of forward pressure on the barrier.

It is also important that the design of the barrier prevents the cows taking food and retreating with it to their lying area, since there will be some waste of the food as it falls from their mouth to the floor.



- The food for the cattle should be provided either on the passage floor or in a trough.
- Cattle prefer fresh forage and not that which has been recently contaminated by other cattle, a defence against disease transmission.
- Cattle often take a mouthful of feed and throw it forwards into the middle of the passage (food tossing), particularly if the food is not presented at floor level but is in a raised trough.
- It is a time-consuming job to fork it all back to the cows, but an angled scraper can be mounted onto a tractor to return the feed to the cows.
- Food tossing also makes the cows' backs dirty, and wastes food.
- If the food is in a trough at floor level, cattle find it harder to toss their food forwards, but it will rarely hold enough food for more than one-half to 1 day.



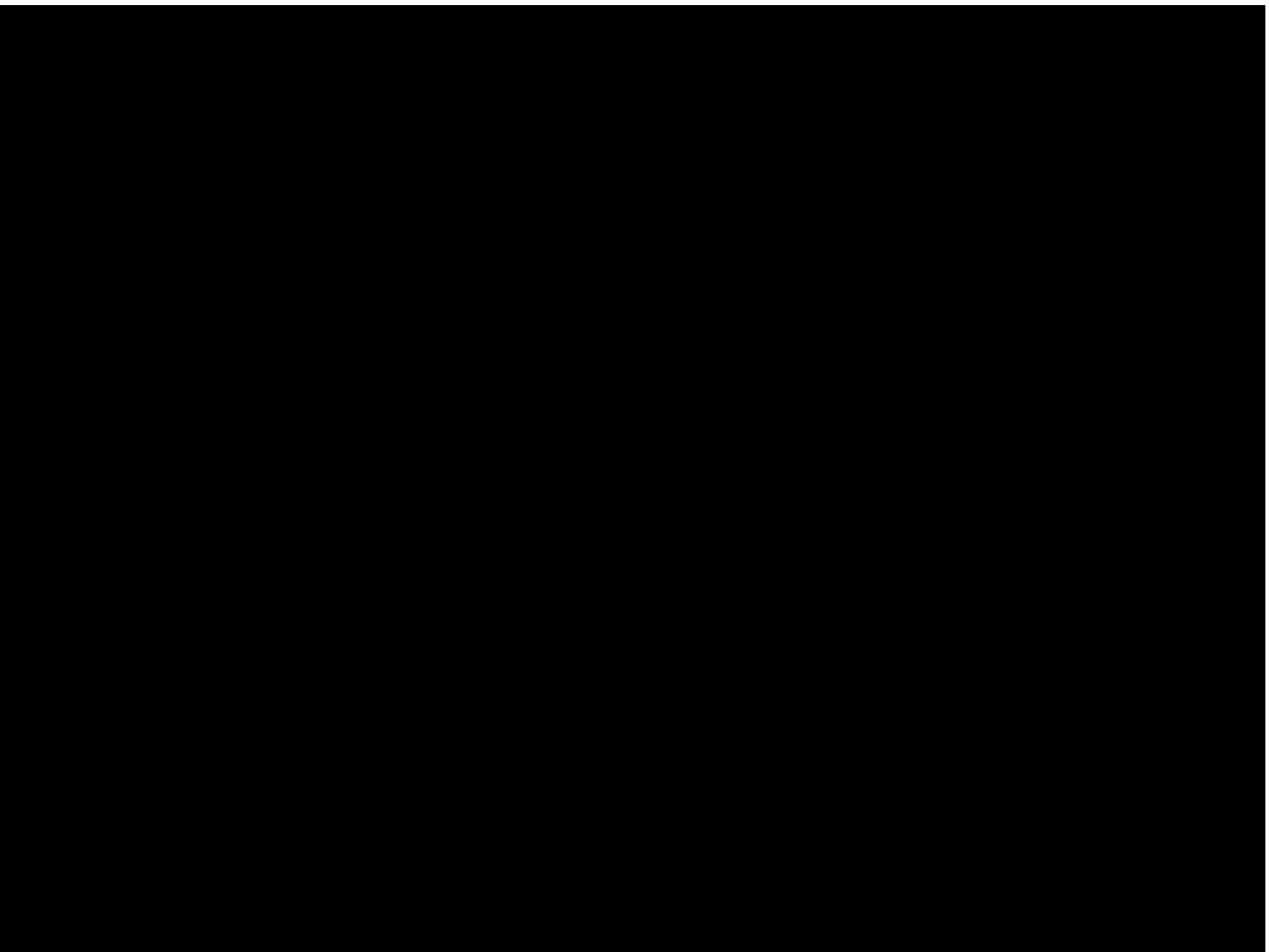
**GEA Farm Technologies**

## **Self-feeding**

Cattle take their food, usually silage, directly from a store, which is usually clamped between two walls.

A barrier is needed in front of the clamped silage to prevent wastage, so that the cattle cannot trample on feed that has fallen to the floor after being taken from the clamp.

The barrier for self-feeding silage clamps is either free-standing, in which case it is likely to comprise a metal pole attached to a wooden frame, or it may be an electrified metal pole that is suspended from a bar inserted into the silage.



<http://www.youtube.com/watch?v=yJ0kLbWr6oI>

# The cubicle

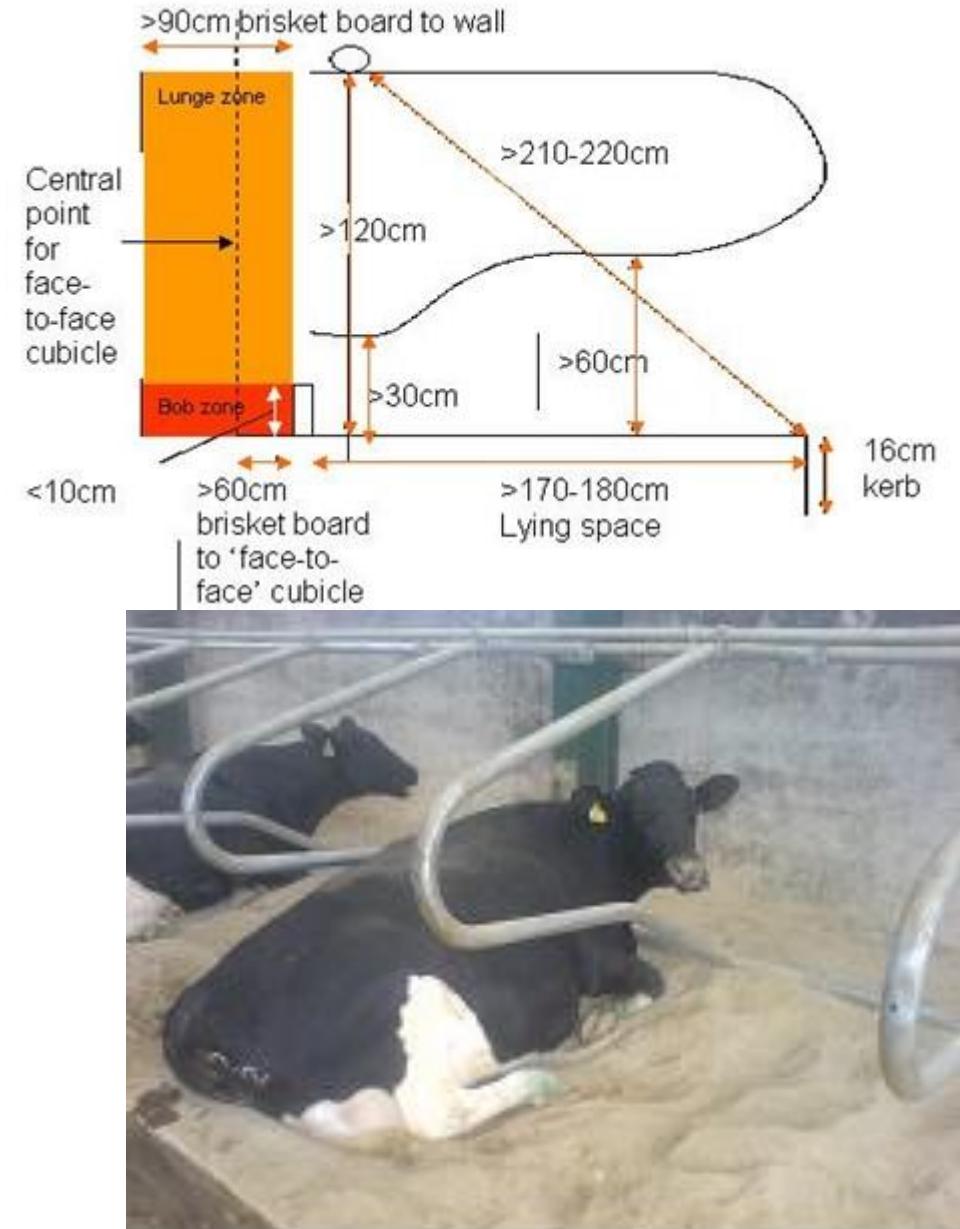
In cubicle housing, cows are given access to raised lying beds of c.2×1m, usually with an absorbent material (bedding) on the surface.

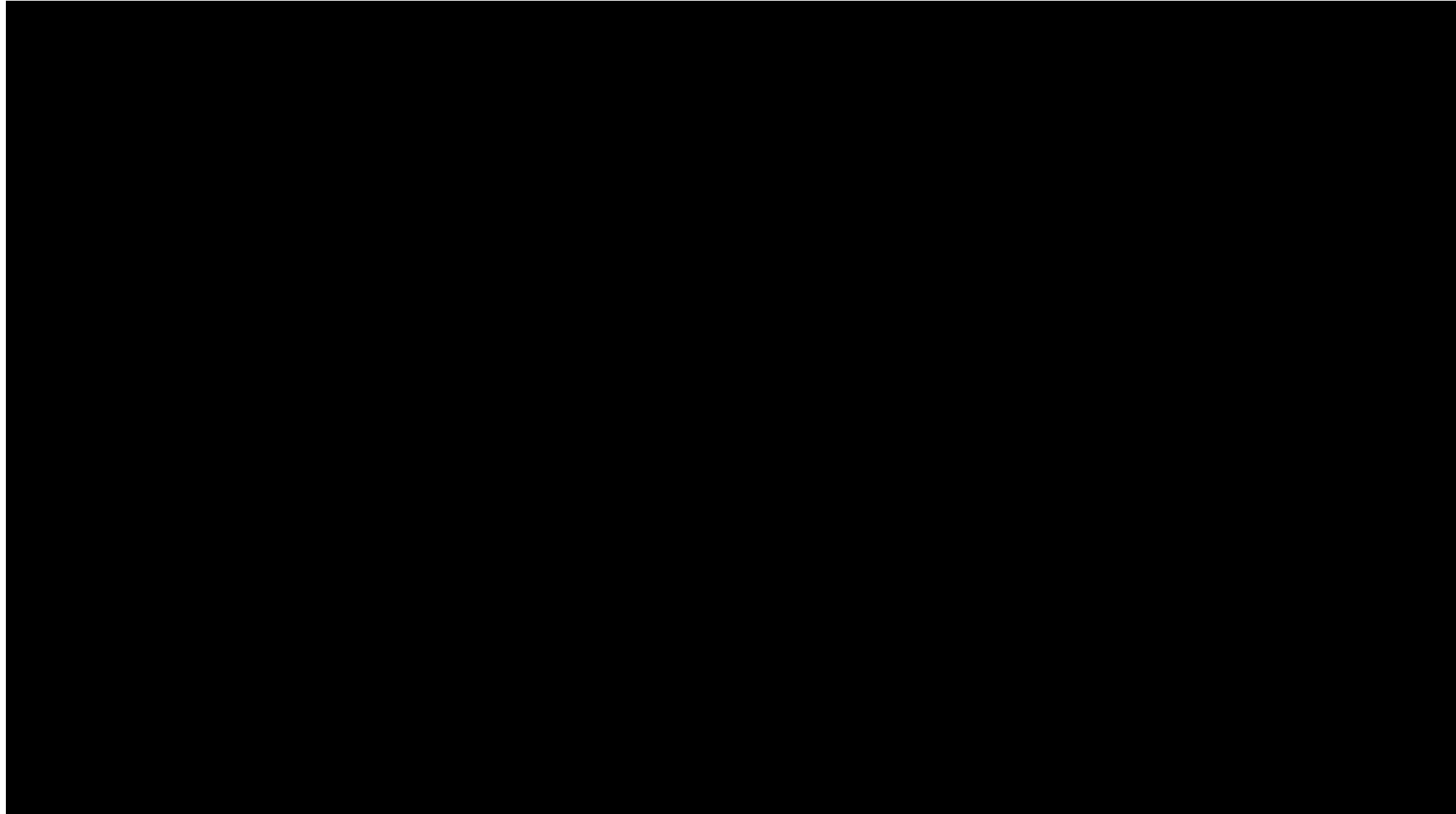
They can walk into and back out of these beds, but they should not be able to turn around on them.

The beds are separated from each other by a division, usually constructed with metal bars.

At best, a cubicle division creates a barrier between neighbouring cows and increases the feeling of personal space.

At worst, it acts as a restriction to movement of the cow, especially when it lies down and gets up, and may lead to damage to the cows' legs.





<http://www.youtube.com/watch?v=61sZqSTM4GU>

# Passageways

Cubicle passageways should be at least 2.2 m wide to allow cows to pass comfortably behind others that are standing half out of the cubicles.

The feed passage should be wider, at least 2.8 m, to ensure that cows can pass freely behind other cows that are feeding.

Slurry should be removed by a tractor-mounted rubber scraper at least once a day and preferably twice, if possible during milking when cows are out of the building.

The less disturbance to the cows the better.



<http://www.delaval.com/en/-7Product-Information1/Manure/Products/Cleaning/Sprayers/DeLaval-hydraulic-scraper-DML/>

Automatic scrapers that are attached to a heavy-duty chain keep the passageways very clean, but they wear the concrete more rapidly to leave a slippery surface.

# Strawed yards

One of the first considerations with a straw yard is to determine the shape of the yard this will affect the space available for the cows.

Since cows prefer to lie down along the peripheral walls of straw yards, a rectangular yard is considered a better shape than a square yard.



# Strawed yards

Friesian cows in straw yards require an area of about 5.5 to 6 m<sup>2</sup> if they are to keep reasonably clean.

This assumes that the cows will stand on concrete to feed, and that this concrete will be scraped daily.

Since each cow needs 600 mm of manger space, the width of the building each side of the manger needs to be about 9 to 10 m, of which 3 m will be concreted and the remainder strawed.

To allow for the build-up of dung over the winter it is desirable, if soil conditions allow, to lower the floor of the bedded area about 600 mm below the feeding passage, with steps up for the cows.

## Tie stalls

In stalls, cows are either tied by the neck with a chain or kept with their head in a yoke, the former giving the cow more freedom of movement.

They can get up and lie down but not turn around.

Usually there is a simple partition between the cows, often of solid wood to reduce draughts.

The cows are fed in troughs at the front of the stall, either made of concrete or tiles so that they can be easily cleaned, or more traditionally wood, which is difficult to keep clean.

Water is usually provided from a small bowl in the stall, which is triggered by a noseplate.

The cows are milked in their stalls, usually nowadays with the milk passing directly to a pipeline, and the milking unit transferred between cows.

# Tie stalls



# Questions

- What are the specific objectives of cattle housing?
- What are the characteristics of good floor?
- How does a cow lie down?
- How does a cow stand up?

# Sources:

- Clive JC Phillips (2010):Principles of Cattle Production, Landlinks Press
- <http://asicoverbuildings.com/cattle-buildings-cattle-barn>
- <http://www.milkproduction.com/Library/Scientific-articles/Housing/Cow-comfort-9/>
- <http://www.omafra.gov.on.ca/english/livestock/dairy/herd/house/index.html>

# Home work



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# ANIMAL BREEDING

című digitális tananyag

**Szegedi Tudományegyetem Mezőgazdasági Kar  
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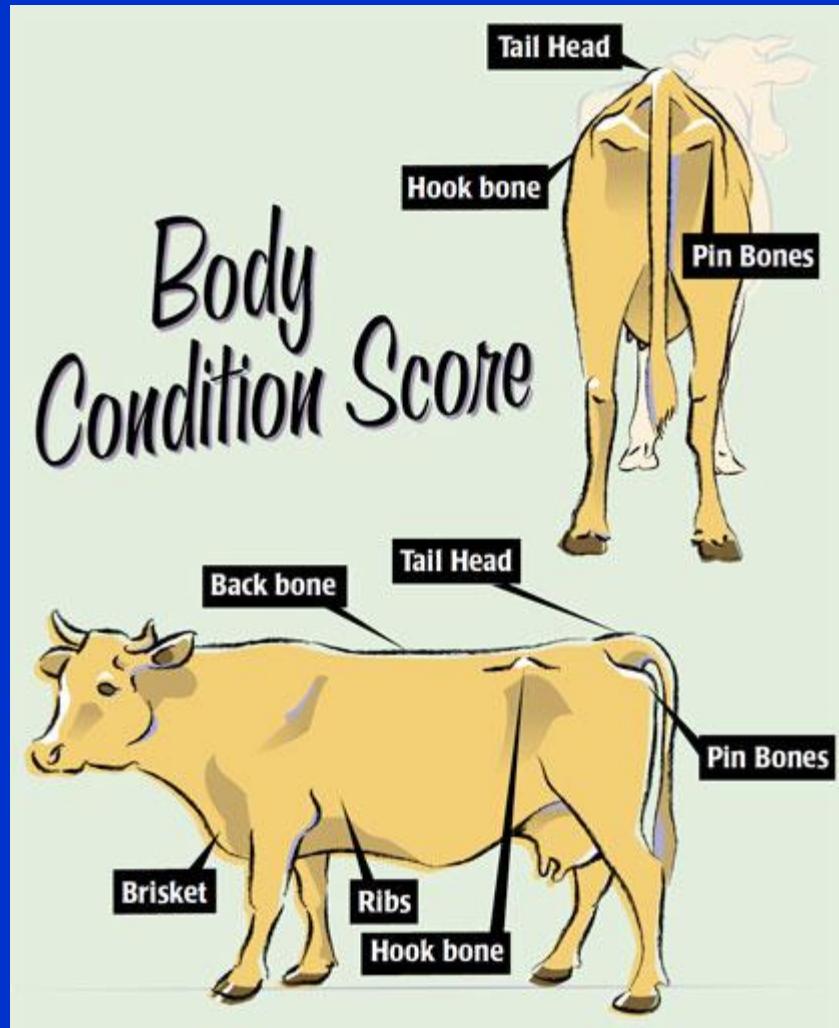
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**BEFEKTETÉS A JÖVŐBE**

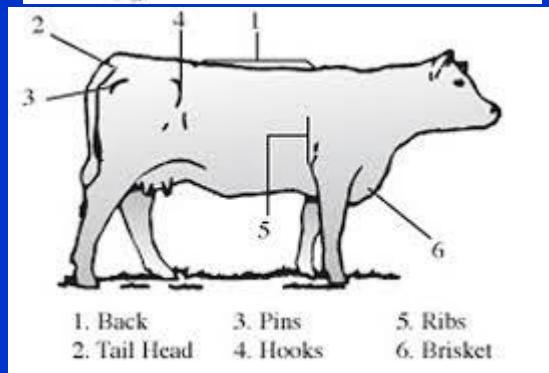
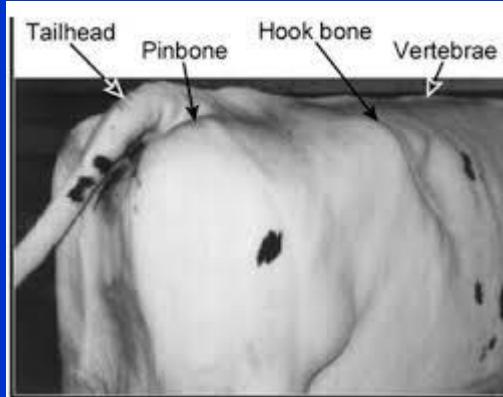
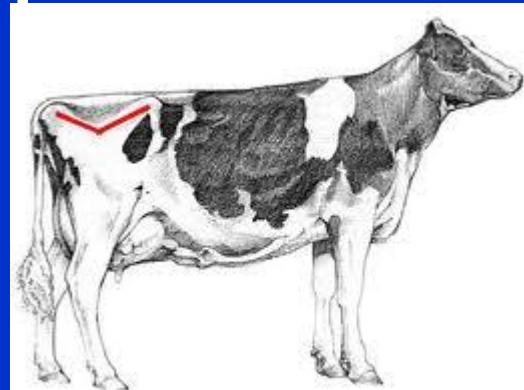
# Condition scoring of dairy cows

## CHAPTER 4

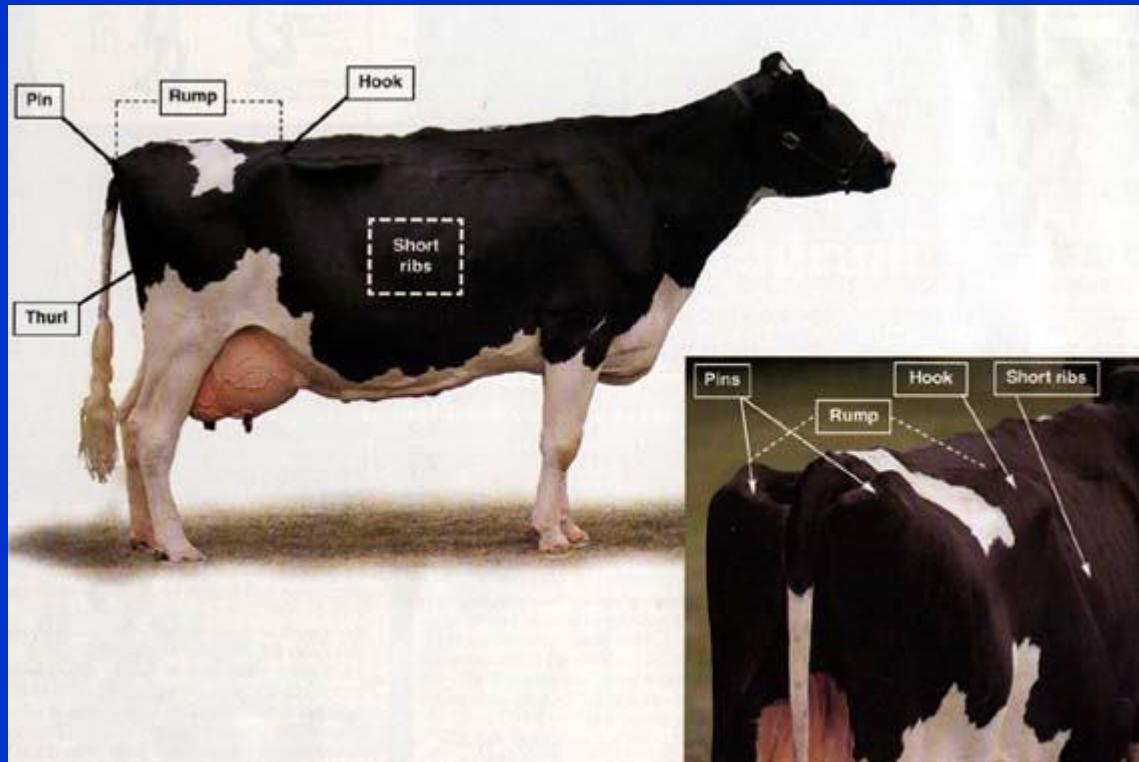


Condition scoring is a technique for assessing the condition of livestock at regular intervals.

The purpose of condition scoring is to achieve a balance between **economic feeding, good production and good welfare.**



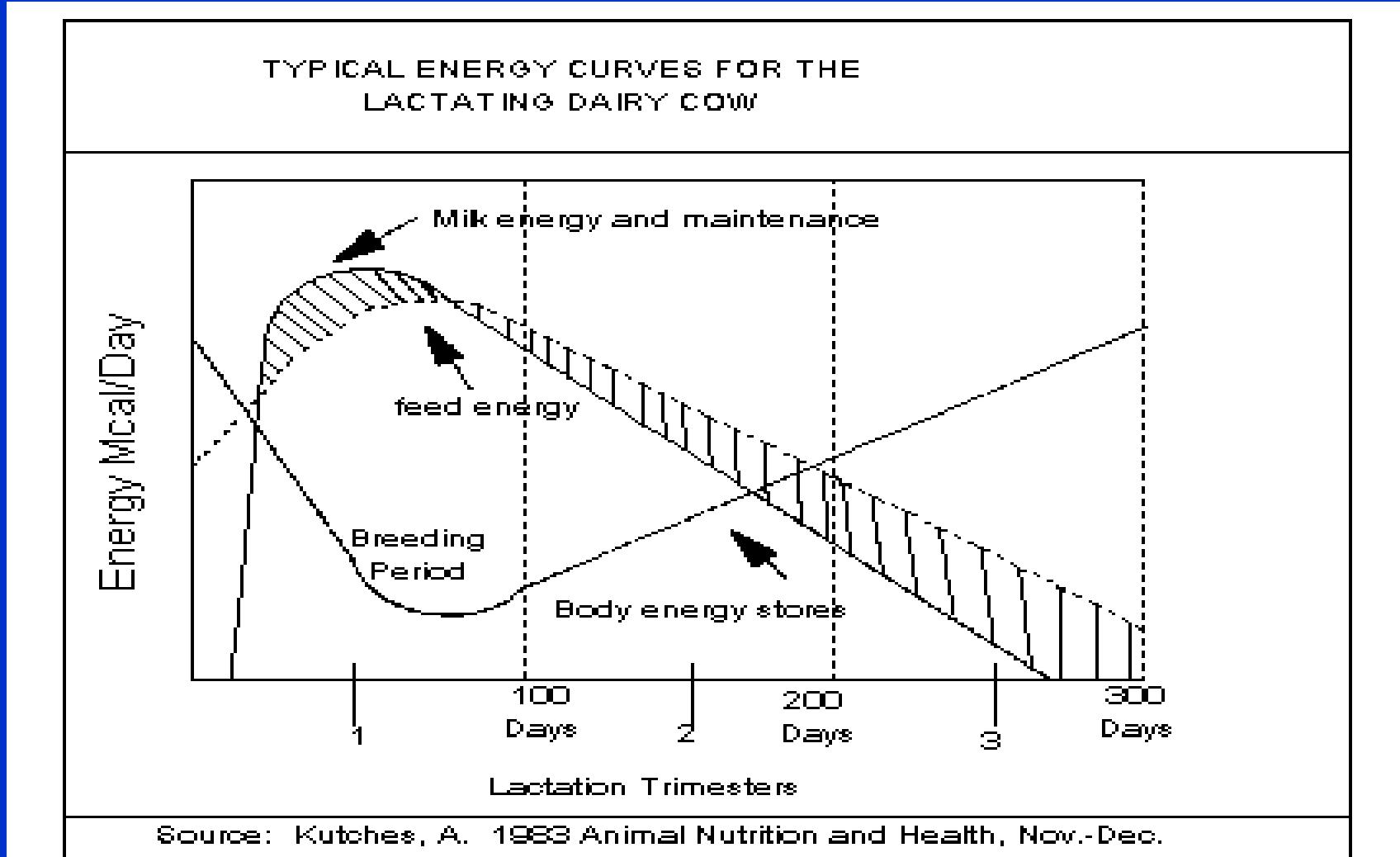
Condition scoring is particularly useful as an aid to **dry cow and pre-calving** management.

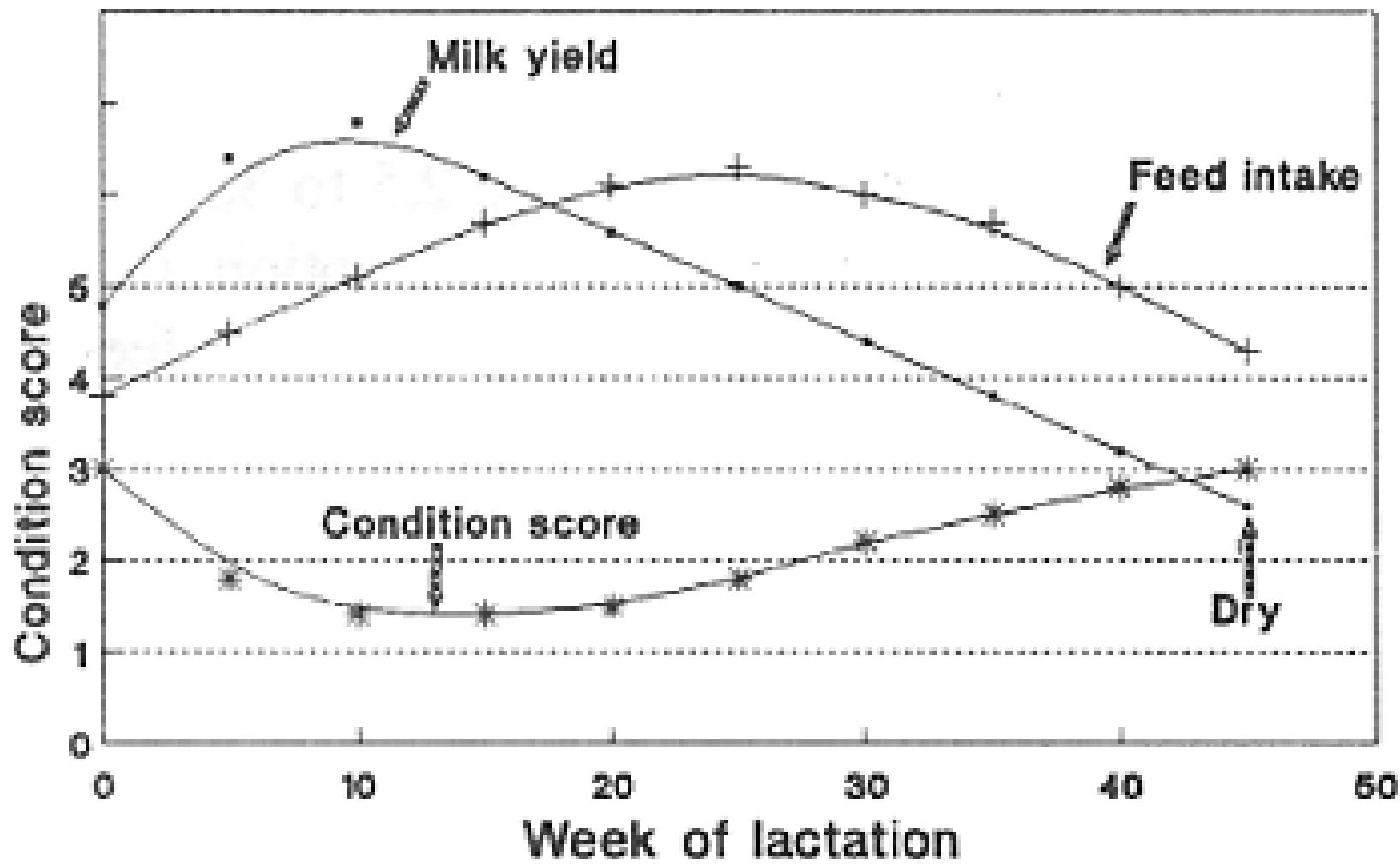


- The objective is to ensure that cows **calve down** safely whether they are on a controlled diet indoors or outdoors at grass.

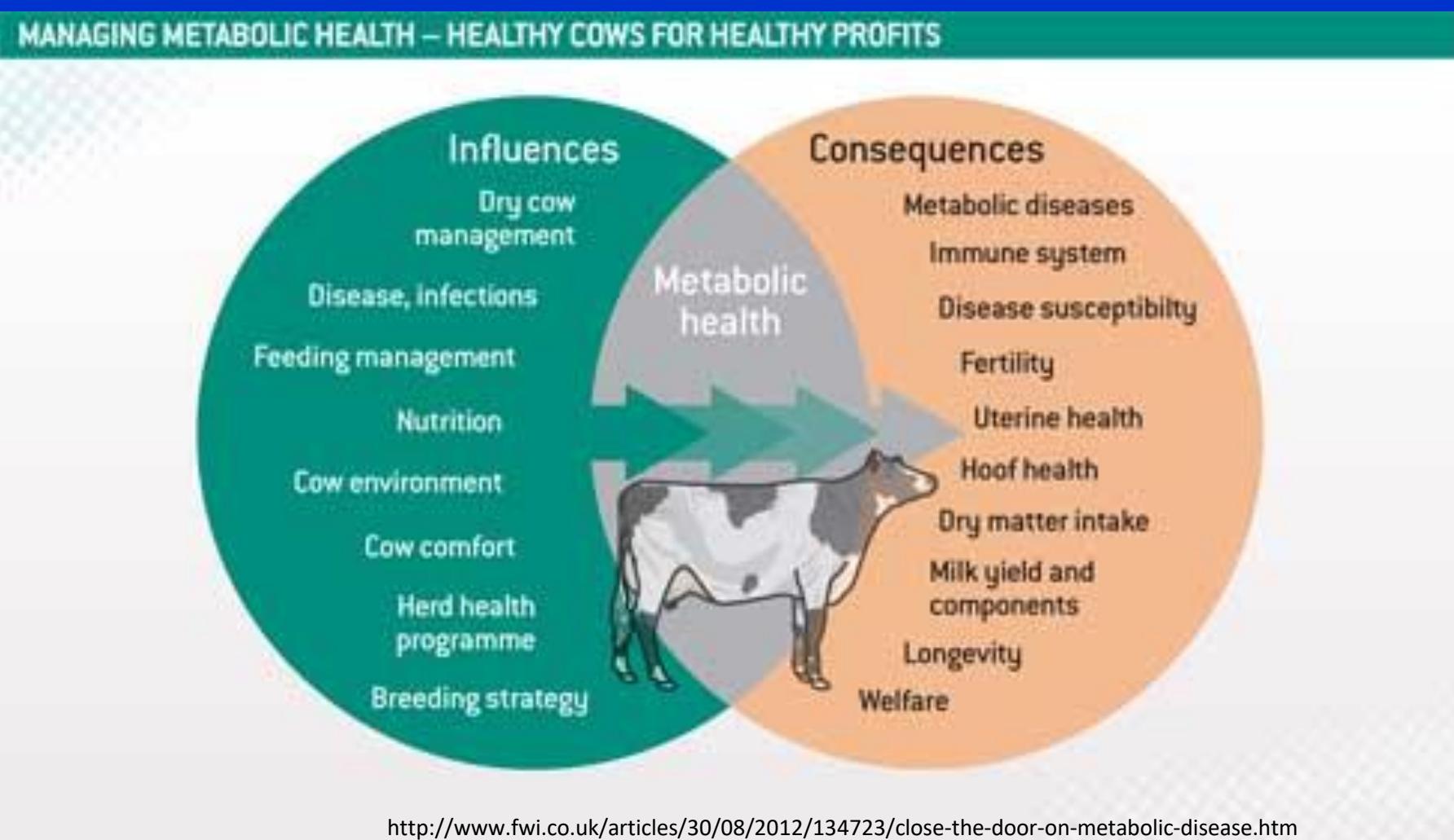


Subsequently in early lactation the cow is under considerable nutritional pressure and body condition is a vital indicator of excessive weight loss.

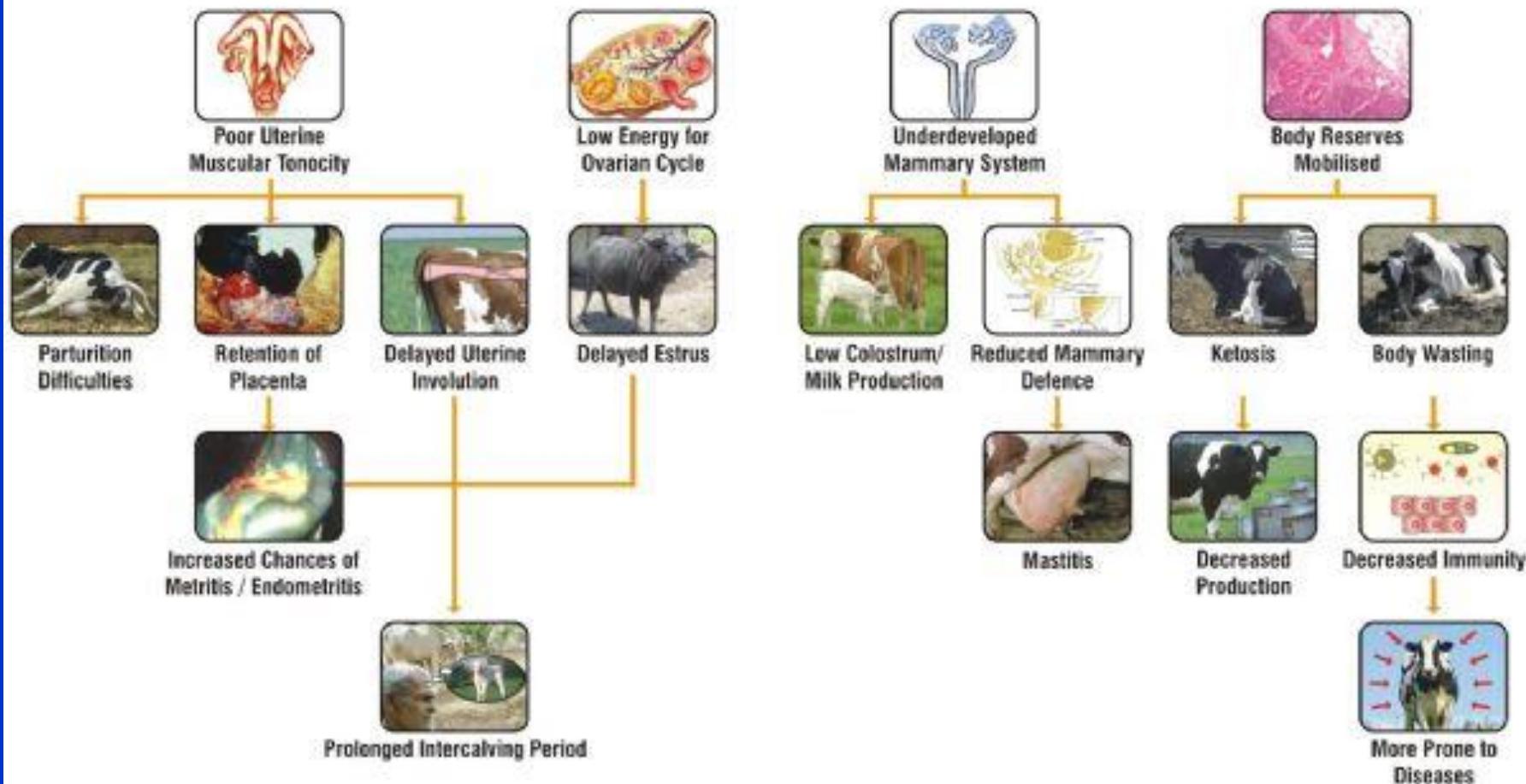




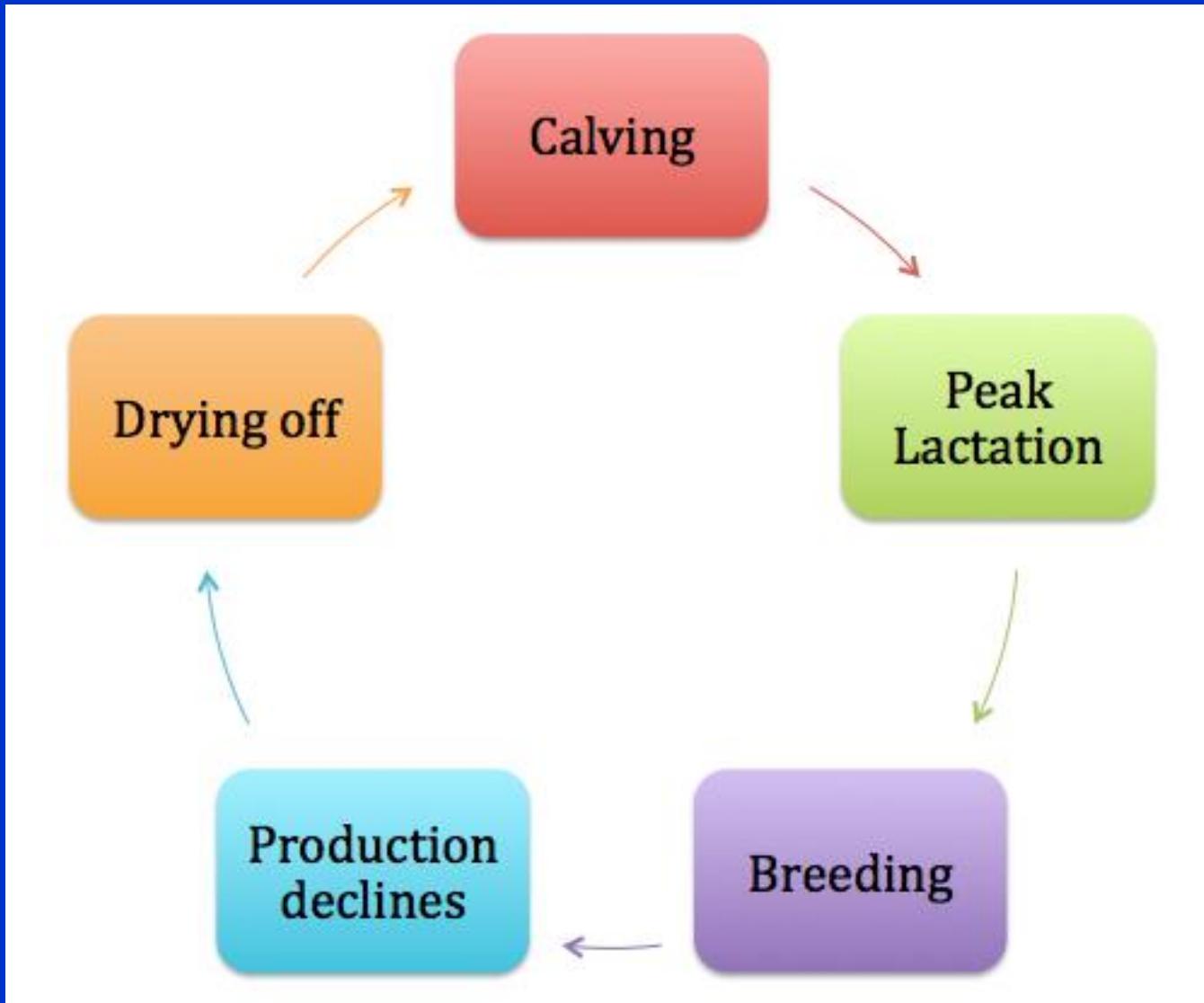
- We can lead to **metabolic disorders** and other welfare problems and should be avoided.



## NEB - Consequences



# Dairy cow annual production cycle



# The important stages of production are

## Pre-calving

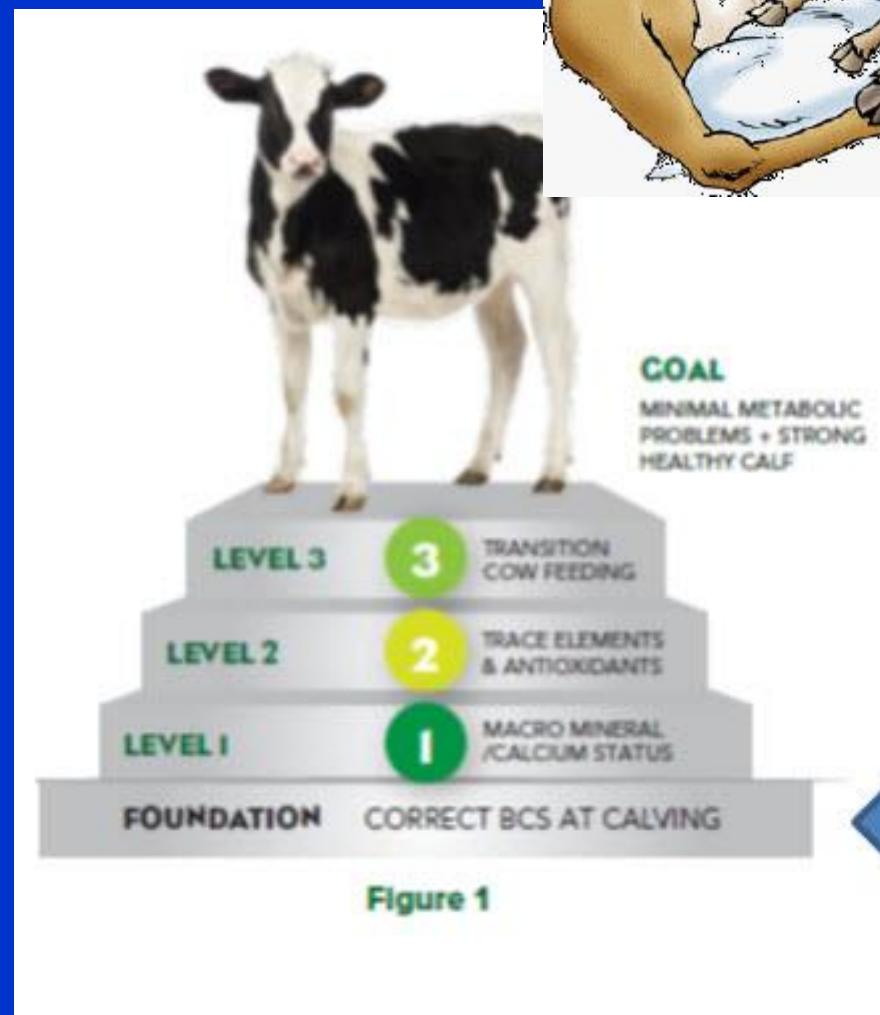
**Condition** should be “fit not fat”, and (drying off) should be such to allow a moderate level of supplementation to prepare cows for early lactation.



# The important stages of production are

**At calving** cows should not calve in an excessively fat condition.

Fat cows may develop fatty liver disease or ketosis and are more prone to milk fever, mastitis, lameness and infertility.



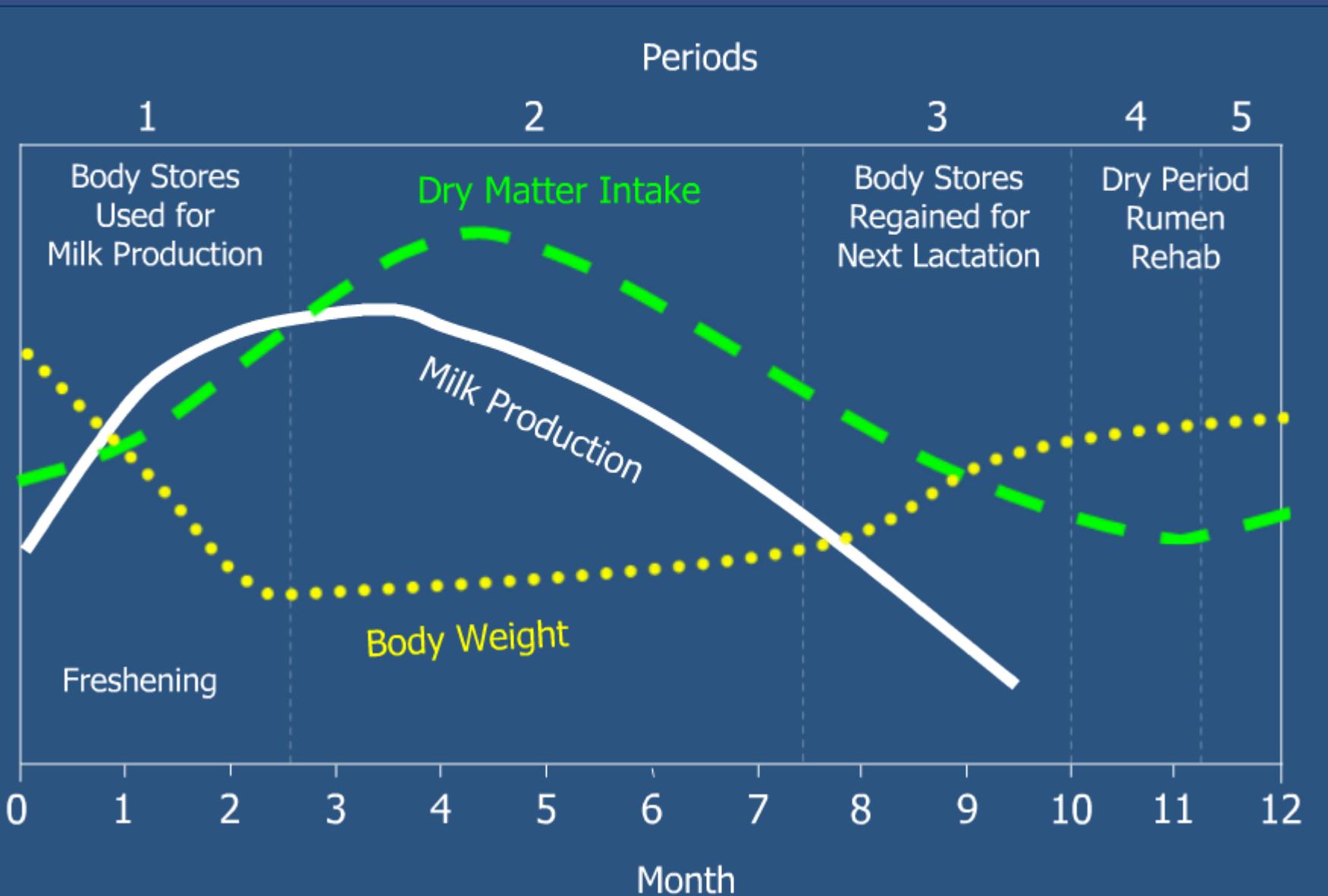
# The important stages of production are

## **Early Lactation**

Dairy cows are under considerable nutritional stress and adequate feeding is essential to avoid excessive weight loss.

Excessively thin cows can suffer discomfort in a housing environment such as cubicles.

# Nutrient and Milk Yield Relationships in the Lactation and Gestation Cycle



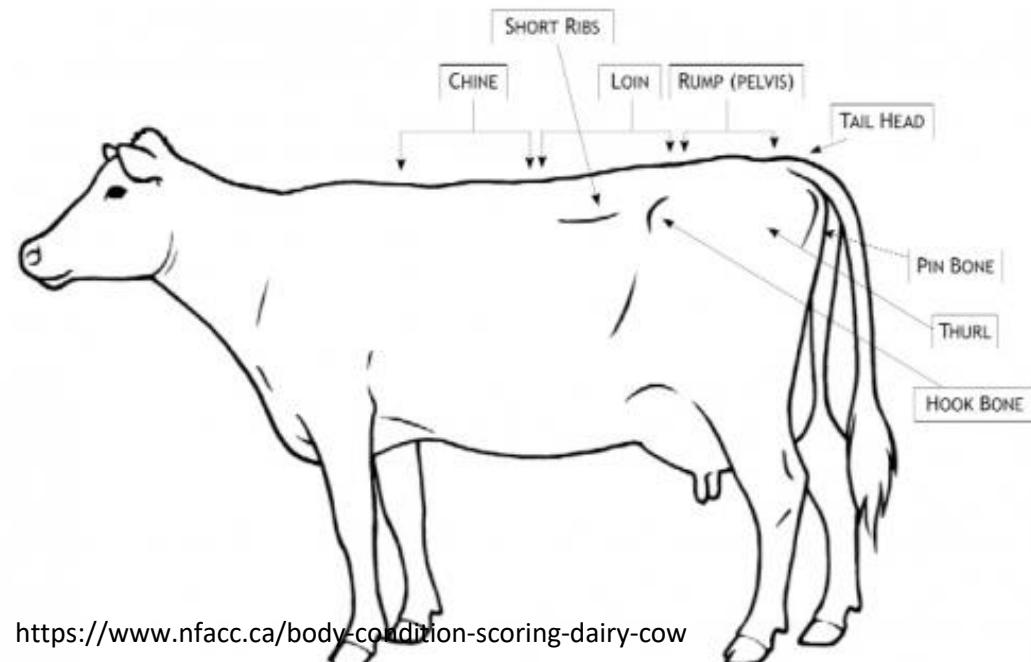
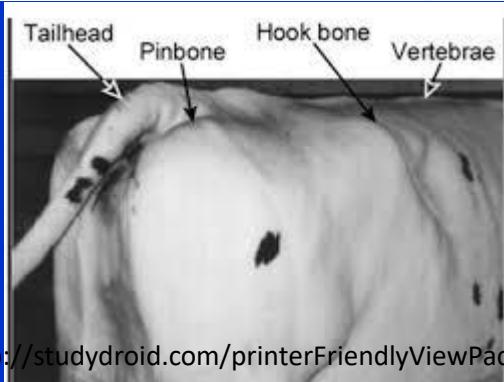
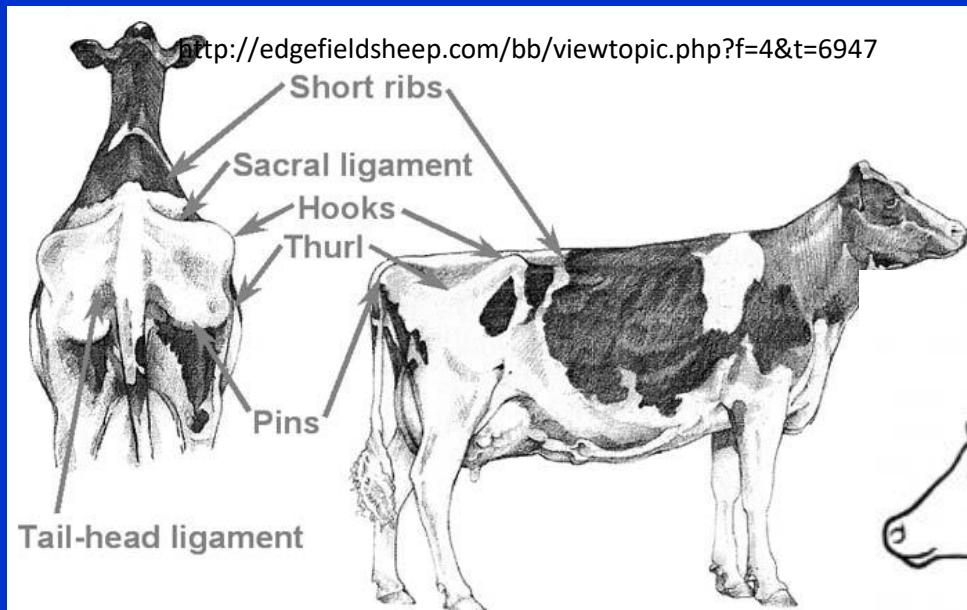
The important stages of production are

## **At service**

Dairy cows should not be in energy deficit by this stage as this may result in low fertility.

# How to Body Condition Score

The scoring method involves a manual assessment of the thickness of fat cover and prominence of **bone** at the **tail head** and **loin** area.



# How to Body Condition Score

You should stand directly behind the cow to score both areas and always handle the animal quietly and carefully using the same hand



*Critical Points for Body Condition Scoring*

- Assessment relies mainly on the tailhead but is refined by the loin score if both are very different.
- On a scale of 1-5, a score of 1 is extremely thin and a score of 5 is extremely fat. If possible assess the scores to the nearest half point.

# Description of Scores

Score	Condition	Detailed Description	Visual Guide
1	Poor	<p><i>Tail head</i> – deep cavity with no fatty tissue under skin.</p> <p>Skin fairly supple but coat condition often rough.</p>	
		<p><i>Loin</i> – spine prominent and horizontal processes sharp.</p>	

2

Moderate

*Tail head* – shallow cavity but pin bones prominent; some fat under skin. Skin supple.



*Loin* – horizontal processes can be identified individually with ends rounded.



2.5



**3**

Good

*Tail head* – fat cover over whole area and skin smooth but pelvis can be felt.



*Loin* – end of horizontal process can only be felt with pressure; only slight depression in loin.



4

Fat

*Tail head –*  
completely filled  
and folds and  
patches of fat  
evident.



*Loin –* cannot  
feel processes  
and will have  
completely  
rounded  
appearance.



**5**

Grossly      *Tail head* – buried  
Fat              in fatty tissue,  
                    pelvis impalpable  
                    even with firm  
                    pressure.

## Scoring cattle condition

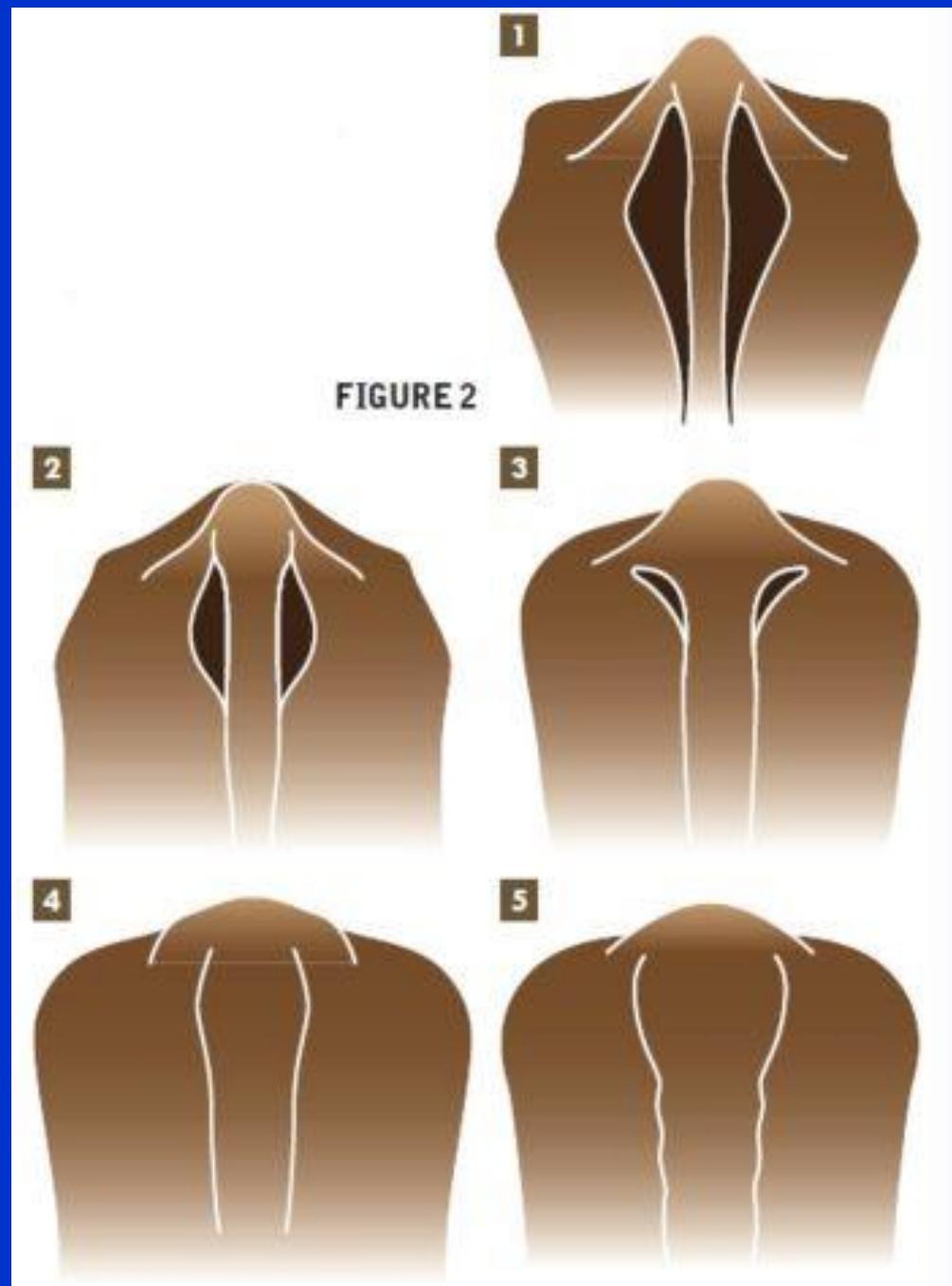
1 = too thin

2 = thin, but healthy

3 = ideal condition

4 = fat

5 = too fat



## Scoring should be done at:

1. Drying off ( 7–8 weeks pre-calving)
2. Pre-calving ( 3 weeks pre-calving)
3. Pre-service

## Target Scores

Dairy Cows	Cows	Heifers
pre-calving	2.5–3	2.5–3
pre-service	2–3	2–2.5
drying off	2.5–3	

For dairy cows, ideal condition at drying off should be close to that for calving and ideally not more than half a score above.

This “fit not fat” condition avoids having to slim cows off as this leads to metabolic disorders. Maiden dairy heifers require special attention as they are ‘nutritionally’ on a knife edge. An example of this is that the loss of one condition score equates to 15 kg liveweight in a heifer, versus 30 kg in an adult cow, and similarly when gaining condition in mid-lactation, heifers need to gain 90 kg for one condition score versus 60 kg in an adult cow.

Figure 1

# BCS at Calving



Optimal

Low Milk Yield  
Fertility Issues

Milk Fever  
Difficult Calving

# Different scales

**Table 2. International body condition**

<b>Country</b>	<b>Scale</b>	<b>Interval (points)</b>	<b>Visual or palpation</b>
United Kingdom, Ireland	0 to 5	0.5 (11)	Palpation
United States	1 to 5	0.25 (17)	Visual
New Zealand	1 to 10	0.5 (19)	Palpation
Australia	1 to 8	0.5 (15)	Visual
Denmark	1 to 9	1 (9)	Visual

How sunken is the area between the tail and pins?



deeply sunken

Are the insides of the pins hollow?

YES

NO

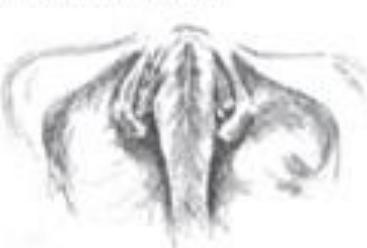


sunken

Is the backbone a bumpy ridge?

YES

NO



slightly sunken

Is the depression between the hip and pin...

U-SHAPED

SHALLOW

FLAT



filled in



Condition  
Score 3



Condition  
Score 3.5



Condition  
Score 4



Condition  
Score 4.5



Condition  
Score 5

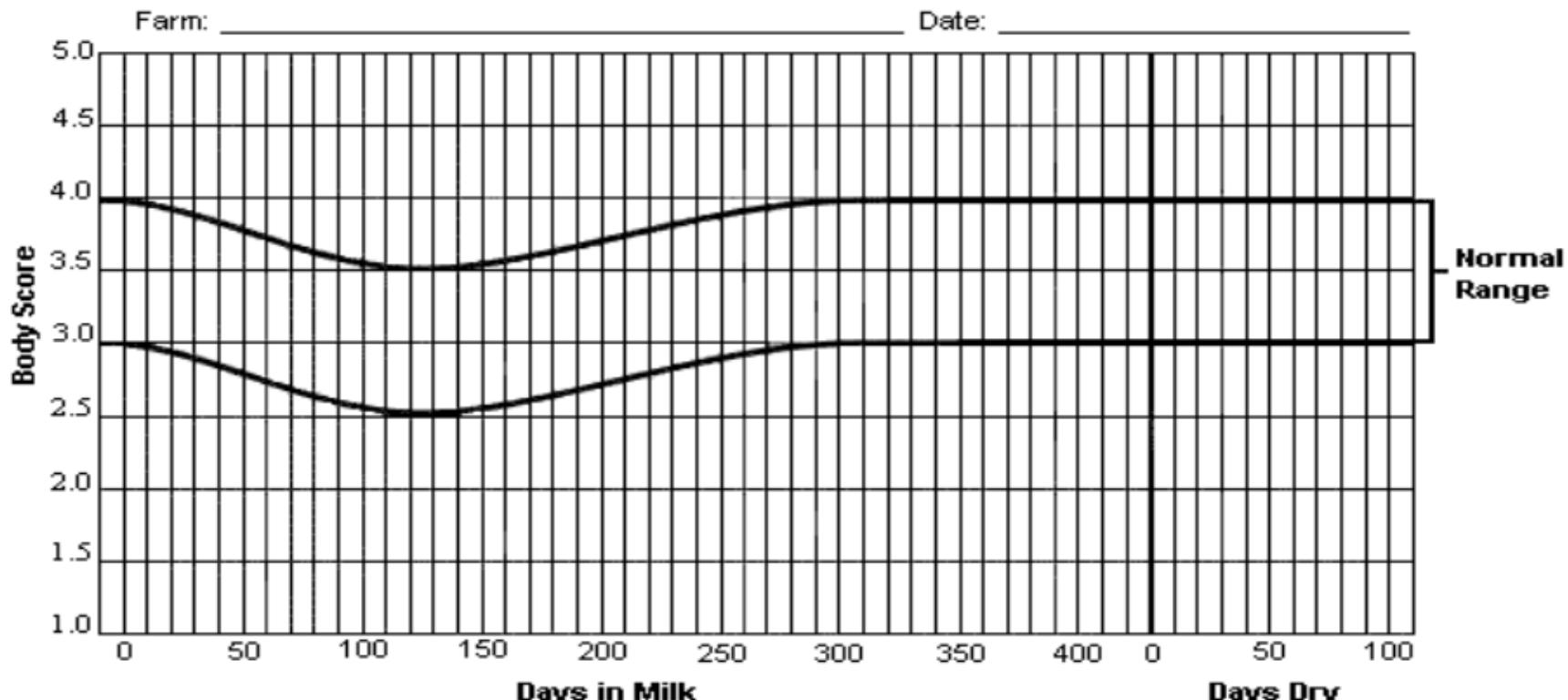


Condition  
Score 5.5



Condition  
Score 6

# Dairy Herd Body Condition Score Chart



Plot individual cows on the chart according to stage of lactation. The chart can be used to profile a herd at one point in time or to monitor changes over a lactation for an individual cow.

## **Ranges of Ideal Body Condition Scores**

<b>Stage of Lactation</b>	<b>Score</b>
Drying-off	3.5 - 4.0
Calving (older cows)	3.5 - 4.0
One-month postpartum	2.5 - 3.0
Mid-lactation	3.0
Late lactation	3.25 - 3.75
Calving (first lactation)	3.5

# Questions

- Where we can check the condition on the cow?
- What is the ideal condition of a cow at the beginning of lactation?
- What is the ideal condition of a cow at the peak of lactation?
- What is the ideal condition of a cow at the end of lactation?

# Sources:

- [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/69371/pb6492-cattle-scoring-diary020130.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69371/pb6492-cattle-scoring-diary020130.pdf)
- [http://www.youtube.com/watch?v=FZJat\\_LIB6c](http://www.youtube.com/watch?v=FZJat_LIB6c)
- [http://www.publish.csiro.au/?act=view\\_file&file\\_id=SA0501209.pdf](http://www.publish.csiro.au/?act=view_file&file_id=SA0501209.pdf)



TÁMOP-4.1.1.C-12/1/KONV-2012-0004

# ANIMAL BREEDING

című digitális tananyag

**Szegedi Tudományegyetem Mezőgazdasági Kar  
Állattudományi és Vadgazdálkodási Intézet**

**Mikó Józsefné Dr. Jónás Edit  
Főiskolai docens**

**2014.**

**SZÉCHENYI** 2020



MAGYARORSZÁG  
KORMÁNYA

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Alap



**BEFEKTETÉS A JÖVŐBE**

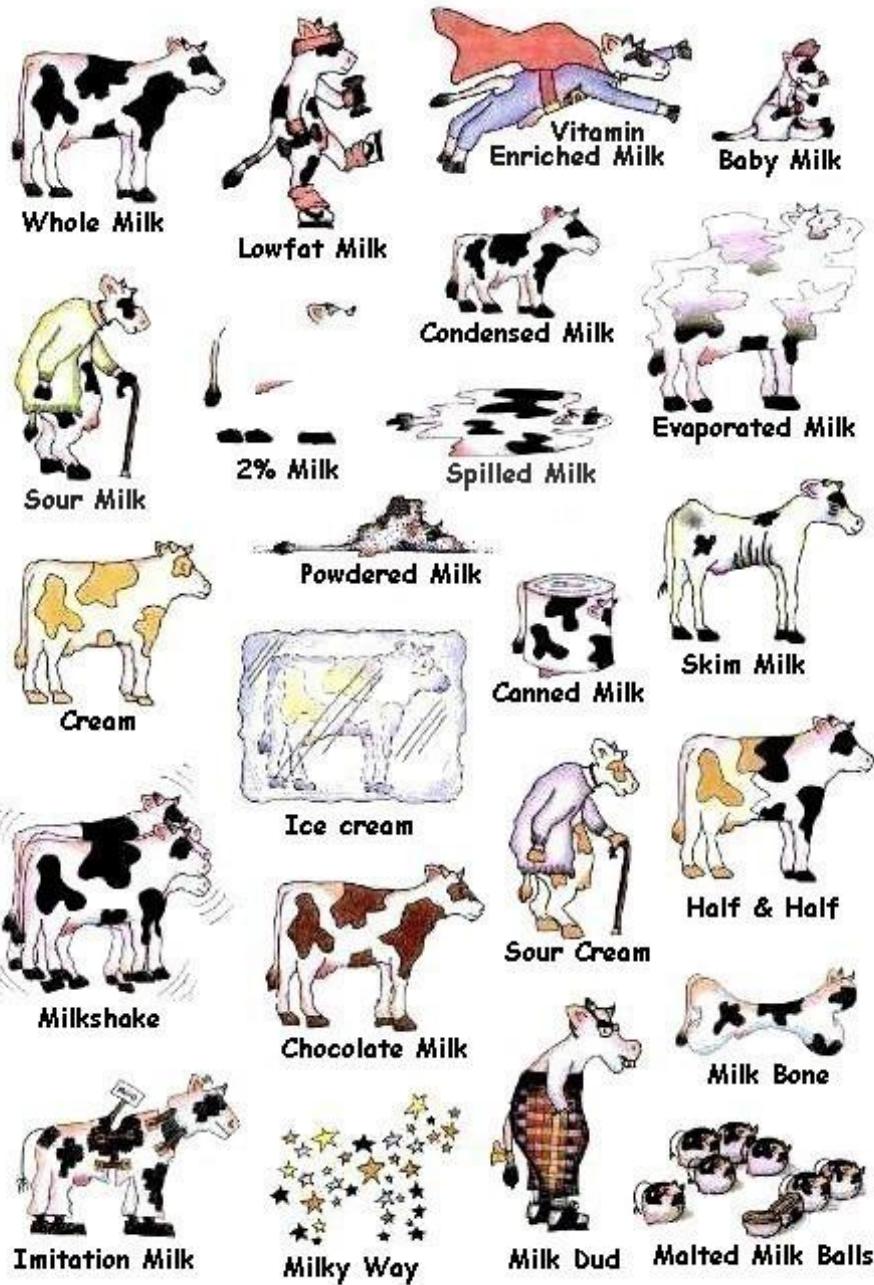
# Conformation Recording Of Dairy Cattle

---

CHAPTER 5

# MILK COWS

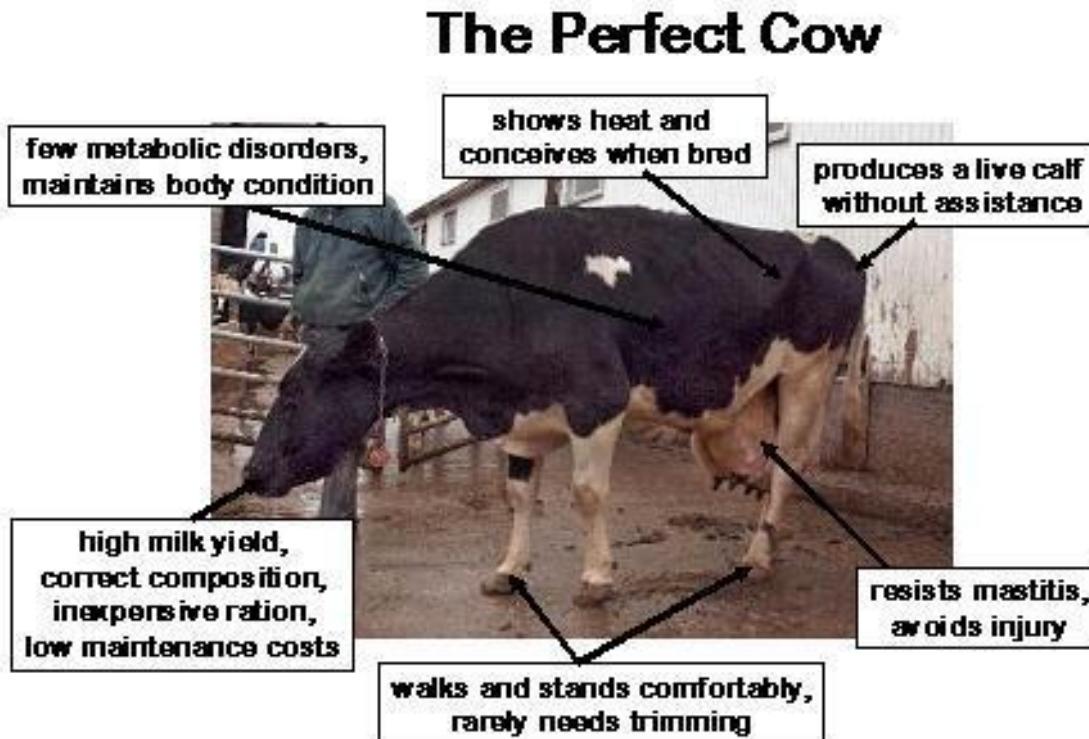
## The perfect cow



Linear type traits are the basis of all modern type classification systems, and are the foundation of all systems for describing the dairy cow.

Linear classification is based on measurements of individual type traits instead of opinions. It describes the degree of trait not the desirability.

---





# Advantages of linear scoring are:

---

- Traits are scored individually.
- Scores cover a biological range.
- Variation within traits is identifiable.
- Degree rather than desirability is recorded.

<https://www.youtube.com/watch?v=31z7JGh6uec>

<https://www.youtube.com/watch?v=9Xtla31L2Ig>

# International standard traits

---

The International standard traits satisfy the following definitions:

- Linear in a biological sense.
- Single Trait.
- Heritable.
- Economic value; Direct or indirect with reference to the breeding goal.
- Possible to measure instead of score.
- Variation within the population.
- Each linear trait should describe a unique part of the cow which is not covered by a combination of
- the other linear traits.

# Approved Standard Traits

---

The precise description of each trait is well defined and it is essential that the full range of linear scores to identify the intermediate and extremes of each trait be used.

The assessment parameters for the calculations should be based on the expected biological extremes of a cow in the first lactation.

---

The scale must cover the biological extremes of the current population.

Recommended Scale 1 - 9

**The linear scale used, must cover the expected biological extremes of the population in the country of assessment.**

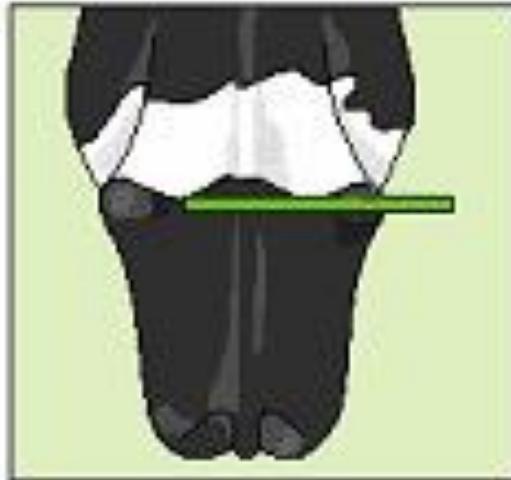
# Stature

---

Ref. point: Measured from the top of the spine in between hips to ground. Precise measurement in centimetres or inches, or linear scale.



- 1 Short
- 5 Intermediate
- 9 Tall



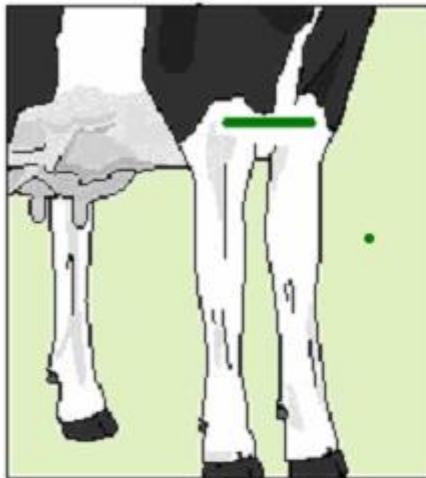
# Chest width

Ref. Point: Measured from the inside surface between the top of the front legs.

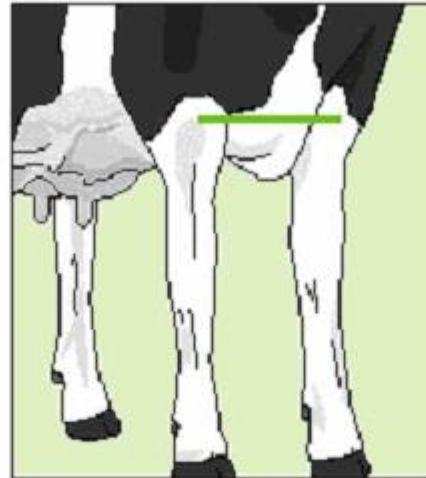
1 - 3 Narrow

4 - 6 Intermediate

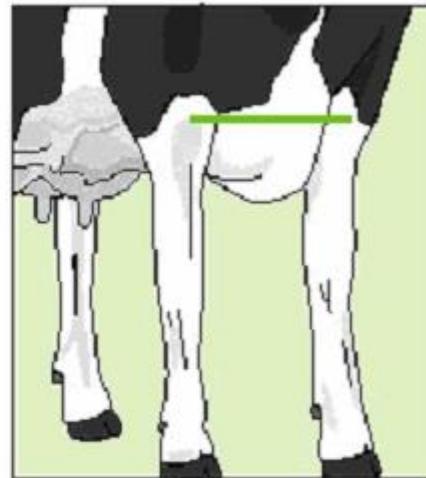
7 - 9 Wide



**1**  
**Narrow**



**5**



**9**  
**Wide**

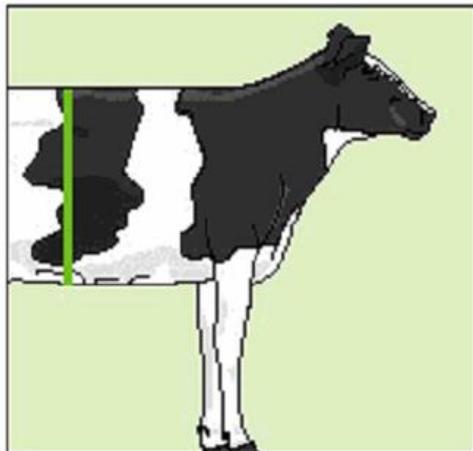
# Body depth

Ref. Point: Distance between top of spine and bottom of barrel at last rib - the deepest point.

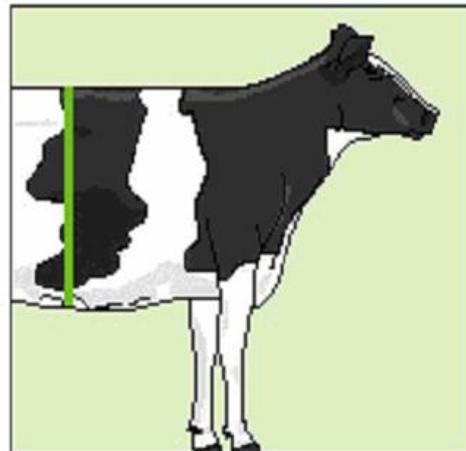
1 - 3 Shallow

4 - 6 Intermediate

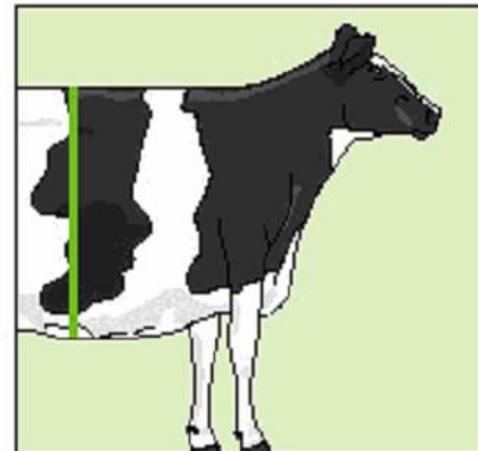
7 - 9 Deep



**1**  
**Shallow**



**5**



**9**  
**Deep**

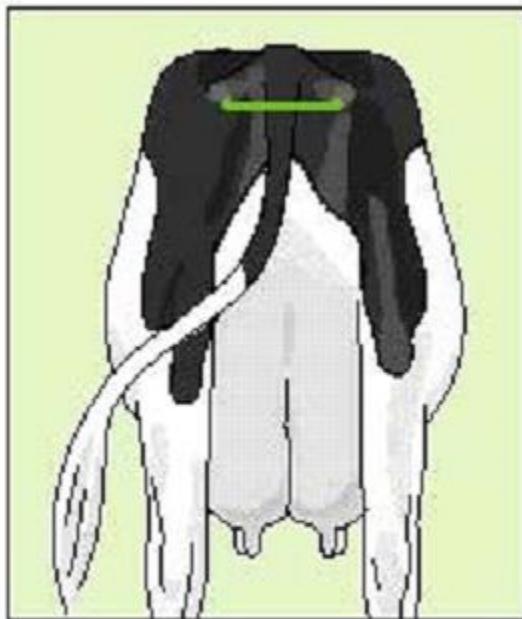
# Rump width

Ref. point: The distance between the most posterior point of pin bones.

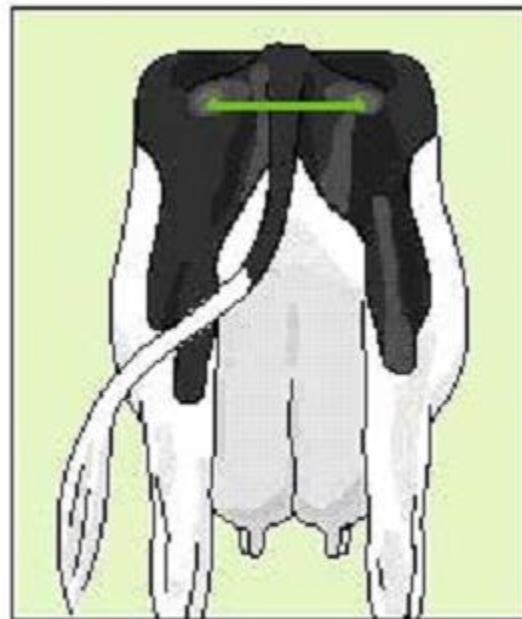
1 Narrow

5 Intermediate

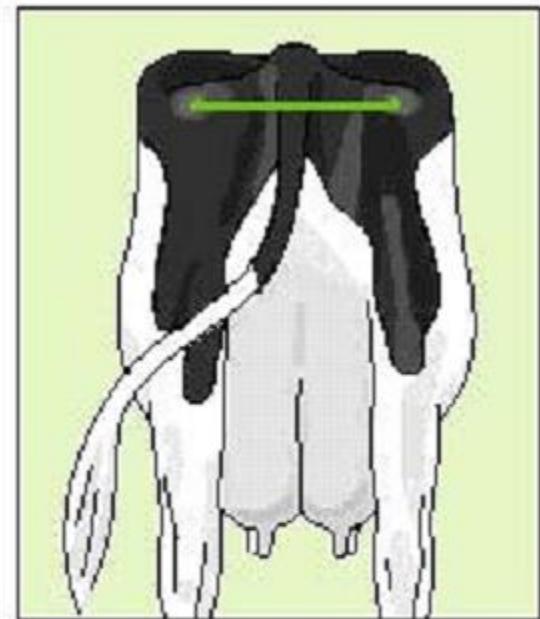
9 Wide



**1**  
**Narrow**



**5**



**9**  
**Wide**

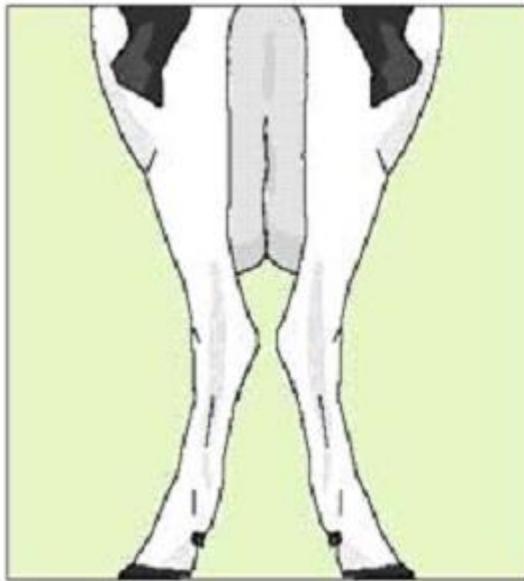
# Rear legs rear view

Ref. point: Direction of feet when viewed from the rear.

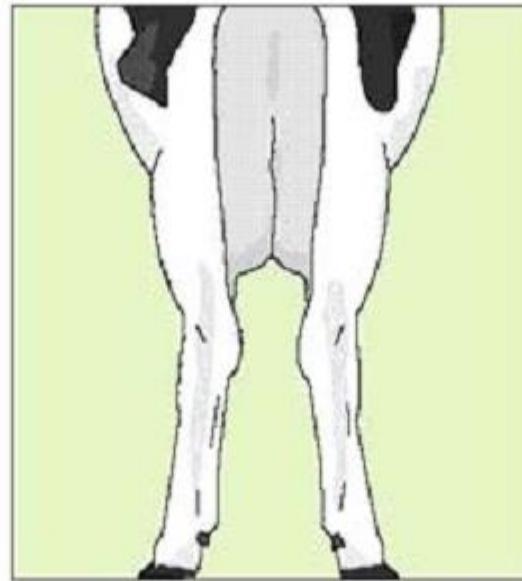
1 Extreme toe-out

5 Intermediate; slight toe-out

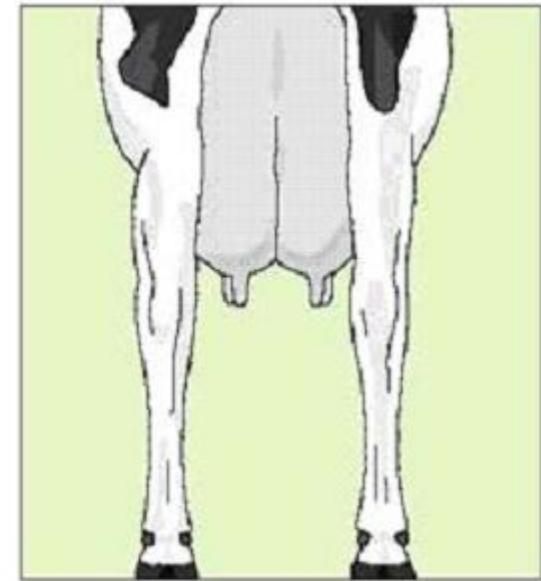
9 Parallel feet



**1**  
**Hock In**



**5**



**9**  
**Parallel**

# Fore udder attachment

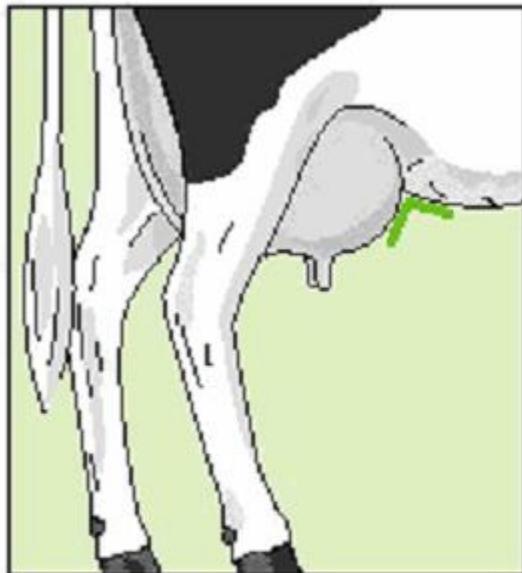
Ref. point: The strength of attachment of the fore udder to the abdominal wall.

1 Weak and loose

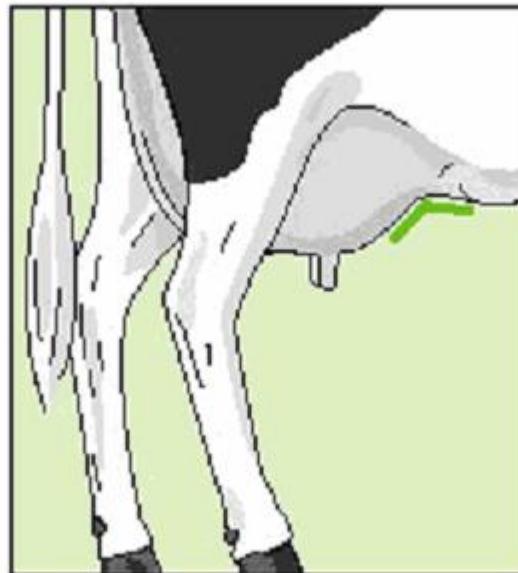
5 Intermediate acceptable

9 Extremely strong and tight

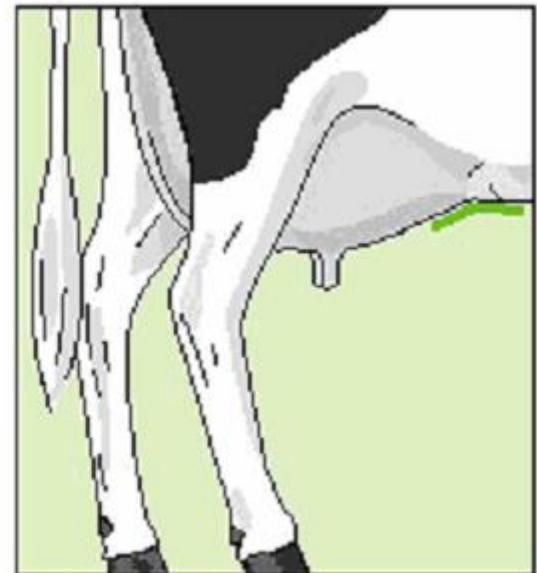
Not a true linear trait - optical.



**1**  
**Loose**



**5**

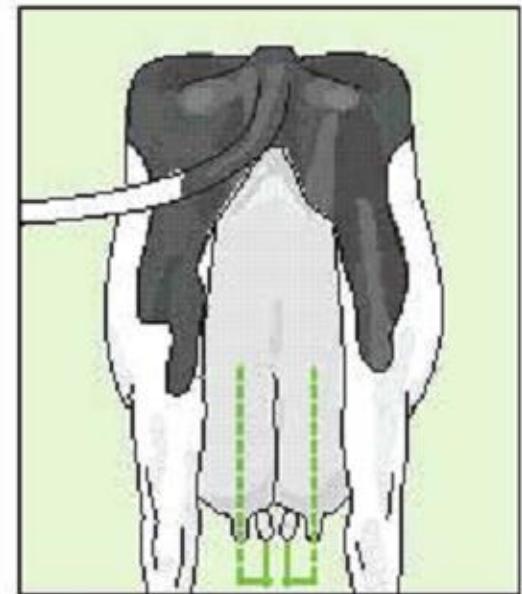
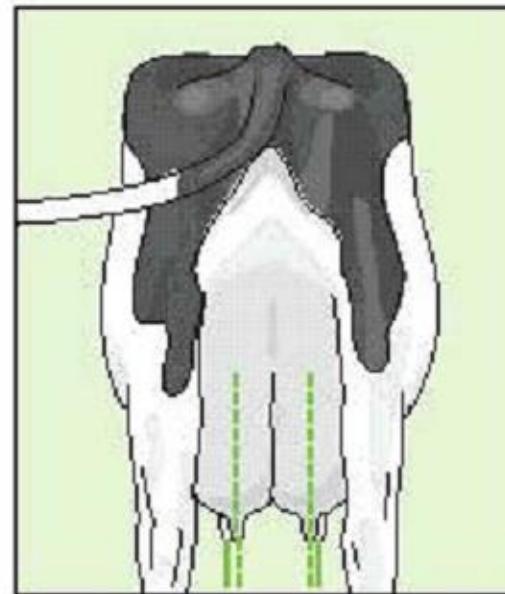
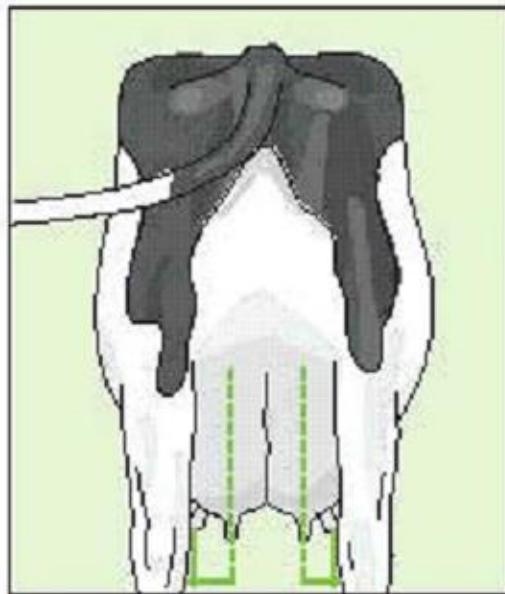


**9**  
**Strong**

# Front teat position

Ref. point: The position of the centre of the front teat placement at the point of the udder as viewed from the rear.

- 1 Outside of quarter
- 5 Middle of quarter
- 9 Inside of quarter



**1**  
**Outside**

**5**

**9**  
**Inside**

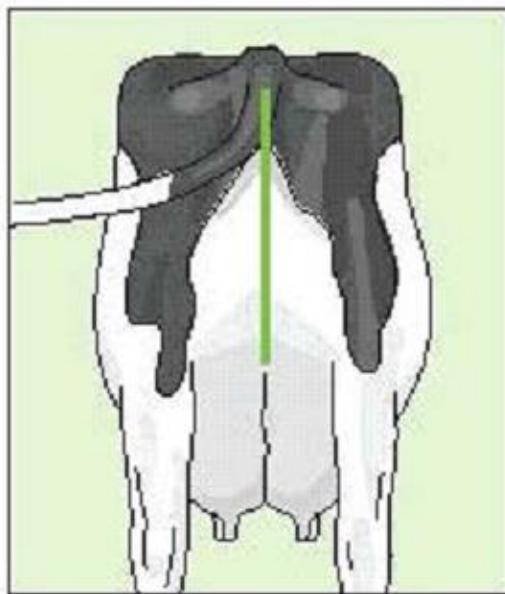
# Rear udder height

Ref. point: The distance between the bottom of the vulva and the milk secreting tissue: in relation to the height of the animal.

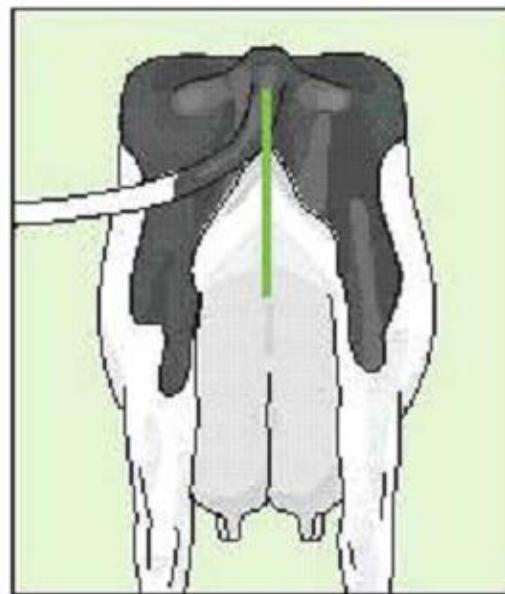
1 Very low

5 Intermediate

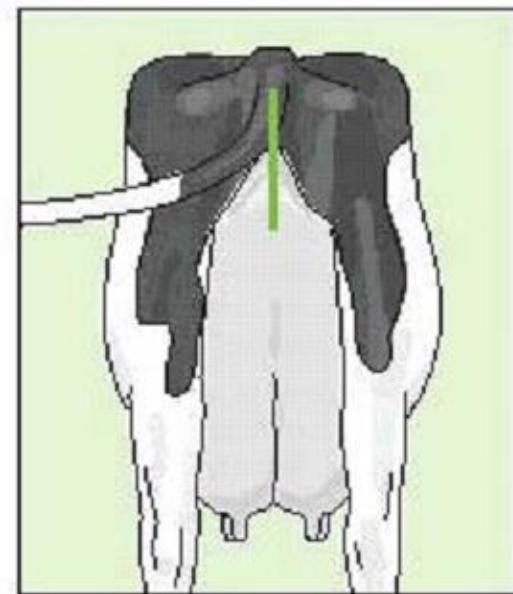
9 High



**1**  
**Low**



**5**



**9**  
**High**

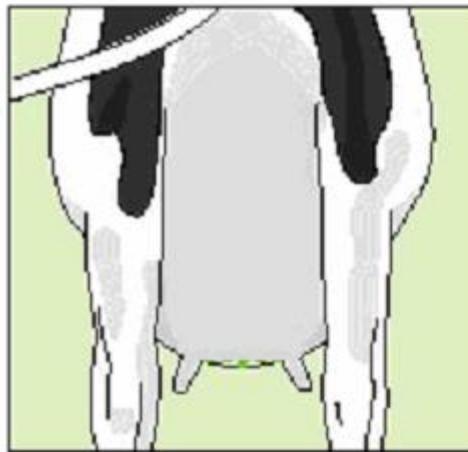
# Central ligament

Ref. point: The depth of the central ligament, at the base of the rear udder.

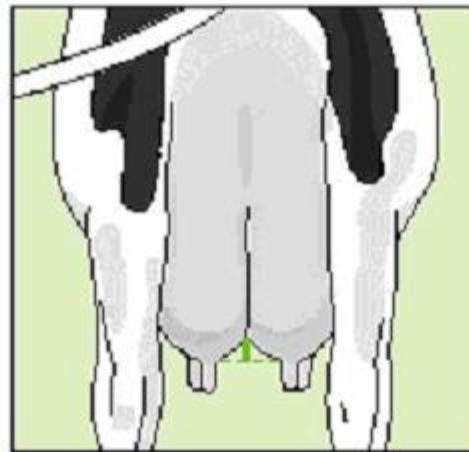
1 - 3 Convex to flat floor (flat)

4 - 6 Slight definition

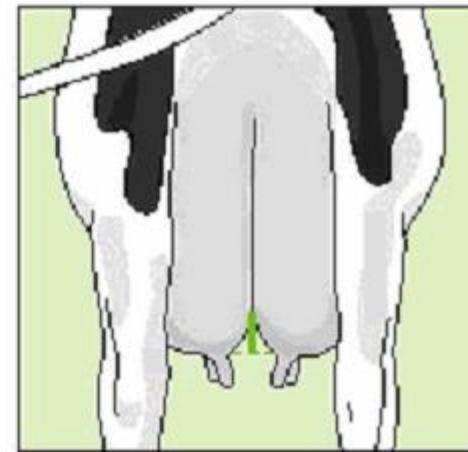
7 - 9 Deep/strong definition



**1**  
**Broken**



**5**

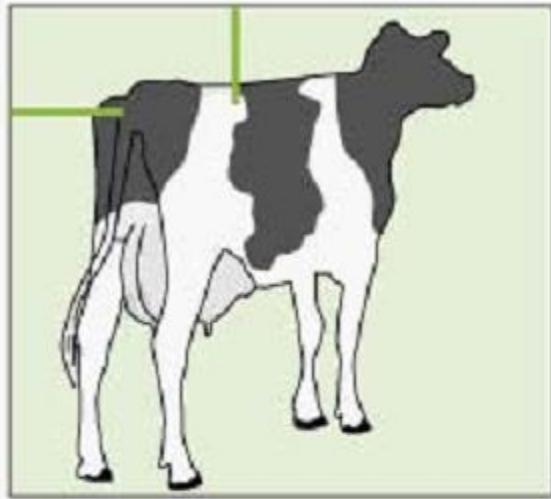


**9**  
**Strong**

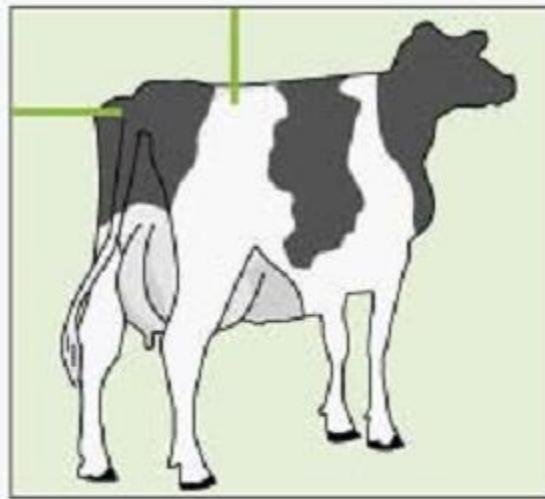
# Body condition score

Ref. Point: The covering of fat over the tail head & rump

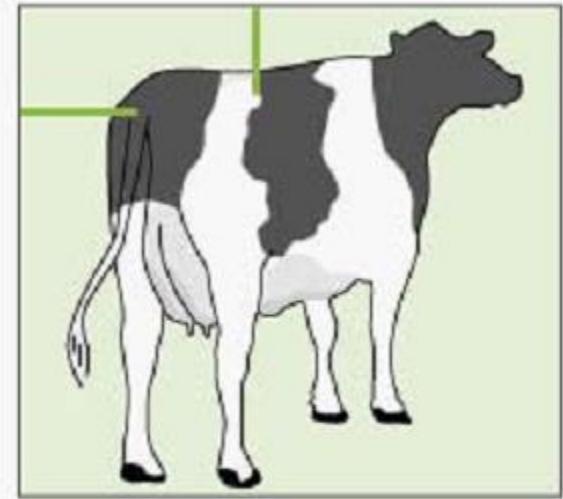
1	Very thin
5	Average
9	Very fat



**1**  
**Poor**



**5**



**9**  
**Grossly Fat**

# Type inspection system - General

---

1. One organisation should be in charge of classifications within each evaluating system.
2. There should be a head-classifier in charge of training and supervising other classifiers within the evaluating system to achieve and maintain a uniform level of classification. Additionally the exchange of information between head-classifiers from different systems/countries is recommended.
3. Individual full time professionals should complete classification. Classifiers should be independent of commercial interest in AI-bulls/studs.
4. Classifiers must record the trait as observed without adjustment e.g. age, stage of lactation, sire or management system.
5. The working information provided for the classifier should make no reference to the pedigree or performance of the cow.

# Type inspection system - Genetic Evaluation

---

1. Breeding values for bulls and cows to be based on the classification of cows in the first lactation scored in a herd evaluation system.
2. In a herd evaluation system all first lactating cows, which have not be previously evaluated, must be scored during the visit of the classifier

# Type inspection system - Genetic Evaluation

The most common scale for mature cows (second or more lactations) are:

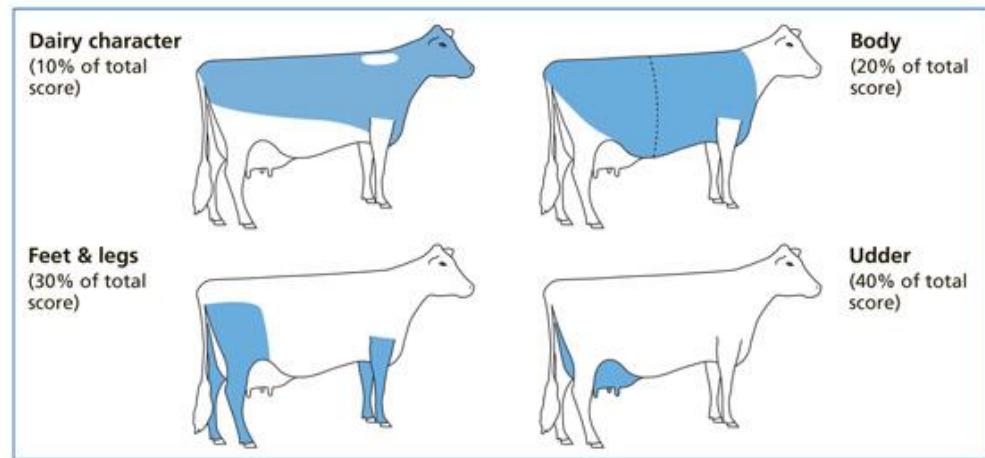
Excellent 97 - 90 points

Very Good 85 - 89 points

Good Plus 80 - 84 points

Good 79 - 75 points

Fair/Poor/Insufficient 74 - 50 points



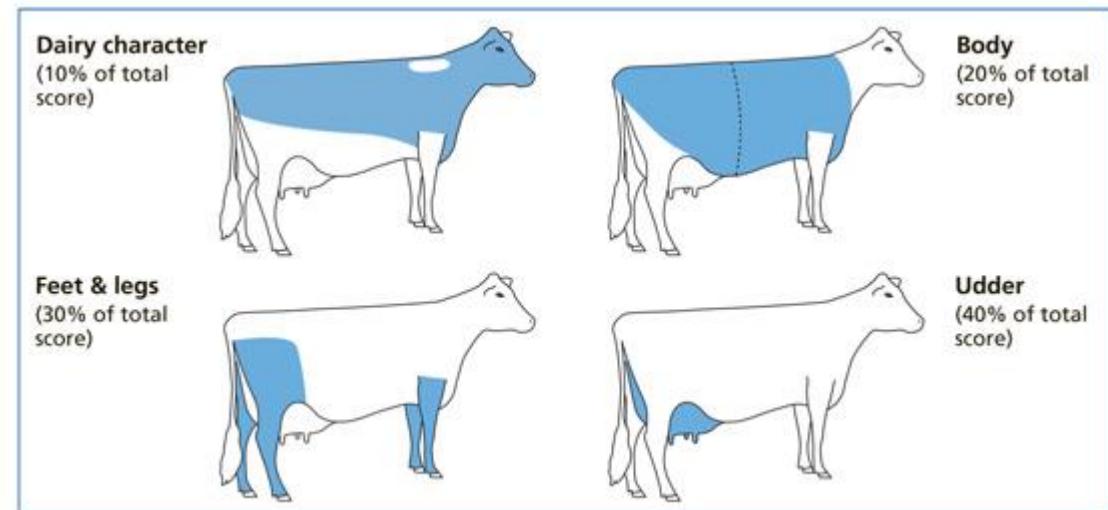
It is recommended that for first lactating cows the range of scores used is 70 - 90 points.

The average score is always in the middle of the maximum and minimum a first lactating cow can be awarded.

The awarding of classification grades varies in each country depending upon the breeding goals, and therefore classification scores must be considered in the context of the country of inspection.

5. The final class and score are derived from a breakdown of the main functional areas of the female;

- o Frame including Rump.
- o Dairy Strength.
- o Mammary System.
- o Legs/Feet.



6. The weighting of the component breakdown scores should meet the breeding goals in the Country of inspection.

# Questions

---

- What are the leg points?
- What are the body points?
- What are the udder points?
- What are the most common scales?

# source

---

[http://www.icar.org/documents/Rules%20and%20regulations/Guidelines/Guidelines\\_2012.pdf](http://www.icar.org/documents/Rules%20and%20regulations/Guidelines/Guidelines_2012.pdf)



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# ANIMAL BREEDING

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2014.

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Alap



**BEFEKTETÉS A JÖVŐBE**

# CHAPTER 6

## FEEDING DAIRY COWS



**SZÉCHENYI** 2020



MAGYARORSZÁG  
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**Európai Unió**  
Európai Strukturális  
és Beruházási Alapok



**BEFEKTETÉS A JÖVŐBE**

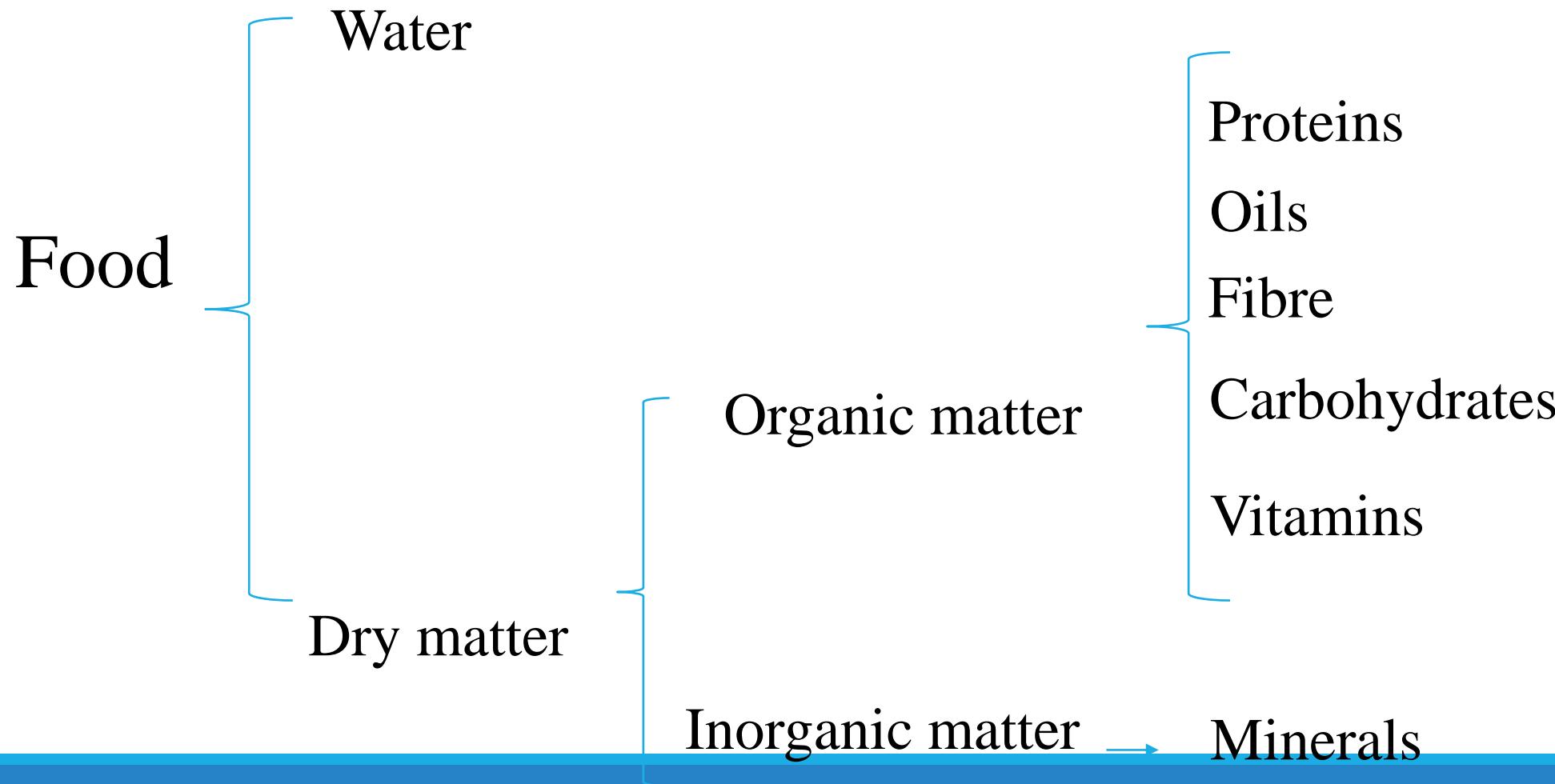
The feeding of dairy cows is without doubt an art, but for success in this skilful operation it is important to know and to practice some well-established scientific principles in animal nutrition.

A vital feature in the correct feeding of dairy cows is to know the requirements of the cow for specific nutrients, the properties and feeding value of the common foods, and finally how to bring these two aspect of feeding together in a profitable system of milk production.

Food, either purchased or home-grown, accounts for 60 percent of the total costs of producing milk, and it is thus extremely important to be efficient in feeding the dairy cow.

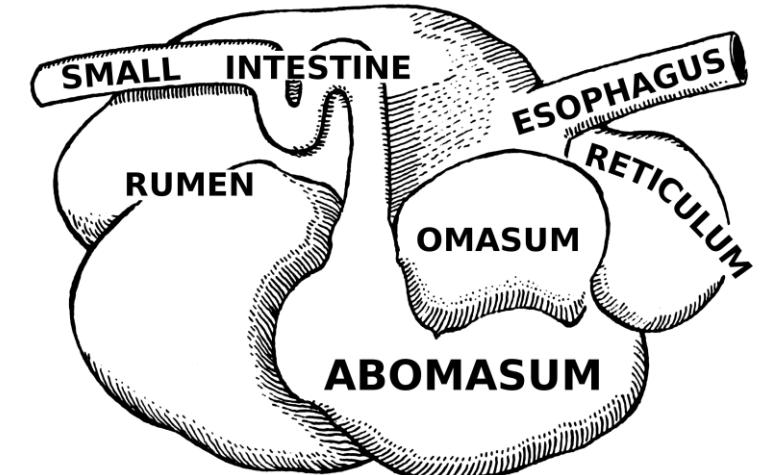
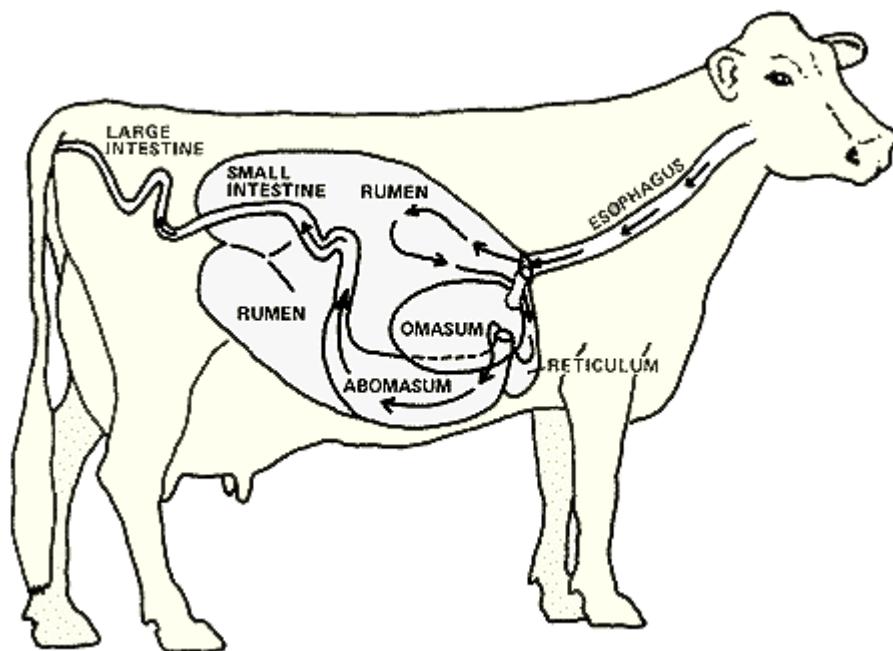
# Food constituent

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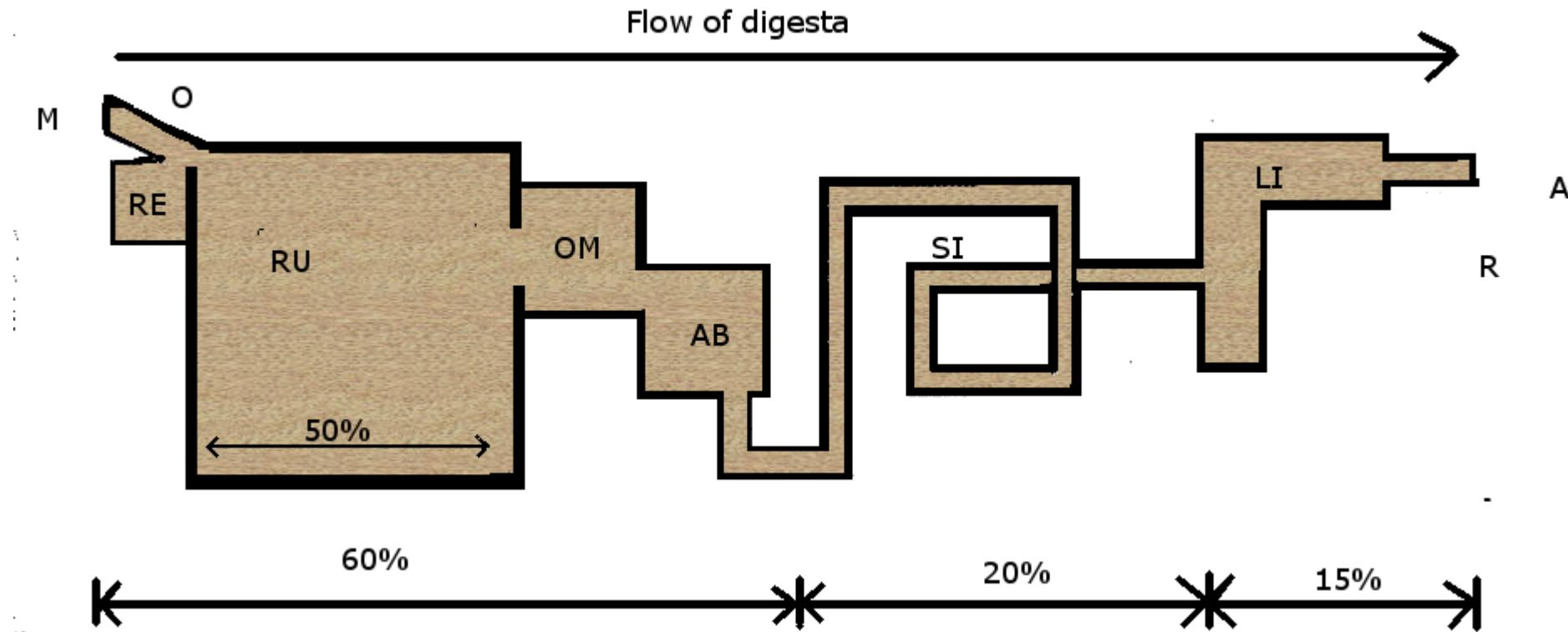


# Digestion

Food is digested in the alimentary tract, which is a tube extending from mouth to anus along which the food passes.



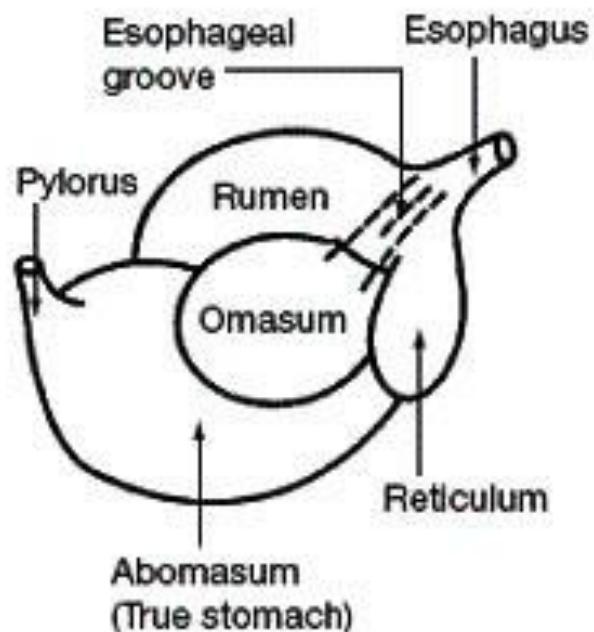
# Diagrammatic representation of the digestive tract of the cow



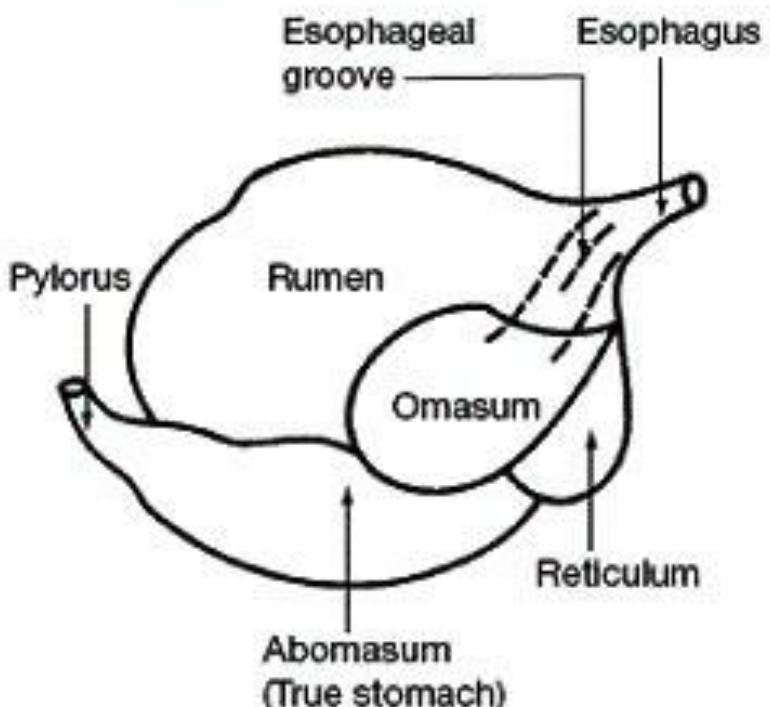
M = mouth; O = esophagus; RE = reticulum; RU = rumen; CM = omasum; AB = abomasum; SI = small intestine; LI = large intestine; R = rectum; A = anus

Figure 1. Development of bovine stomach compartments from birth to maturity.

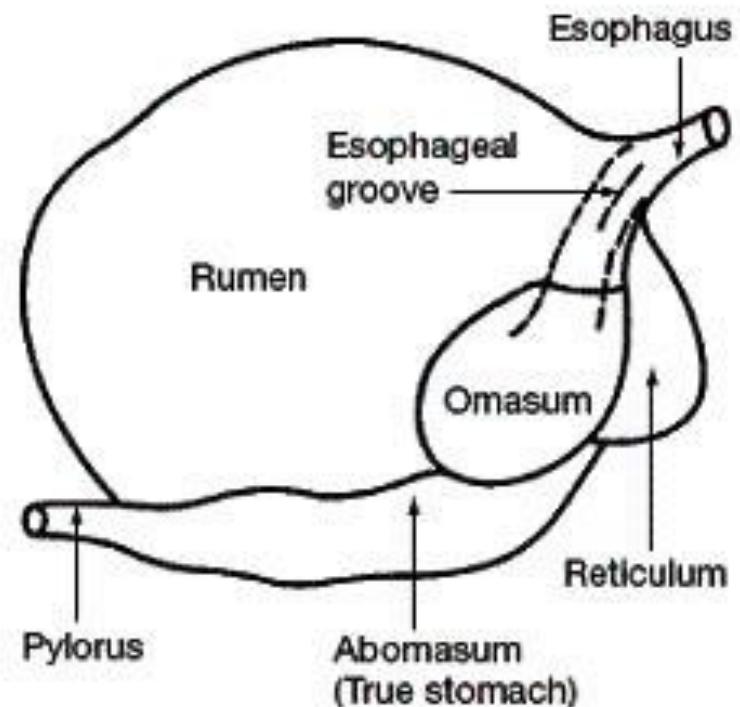
First Week

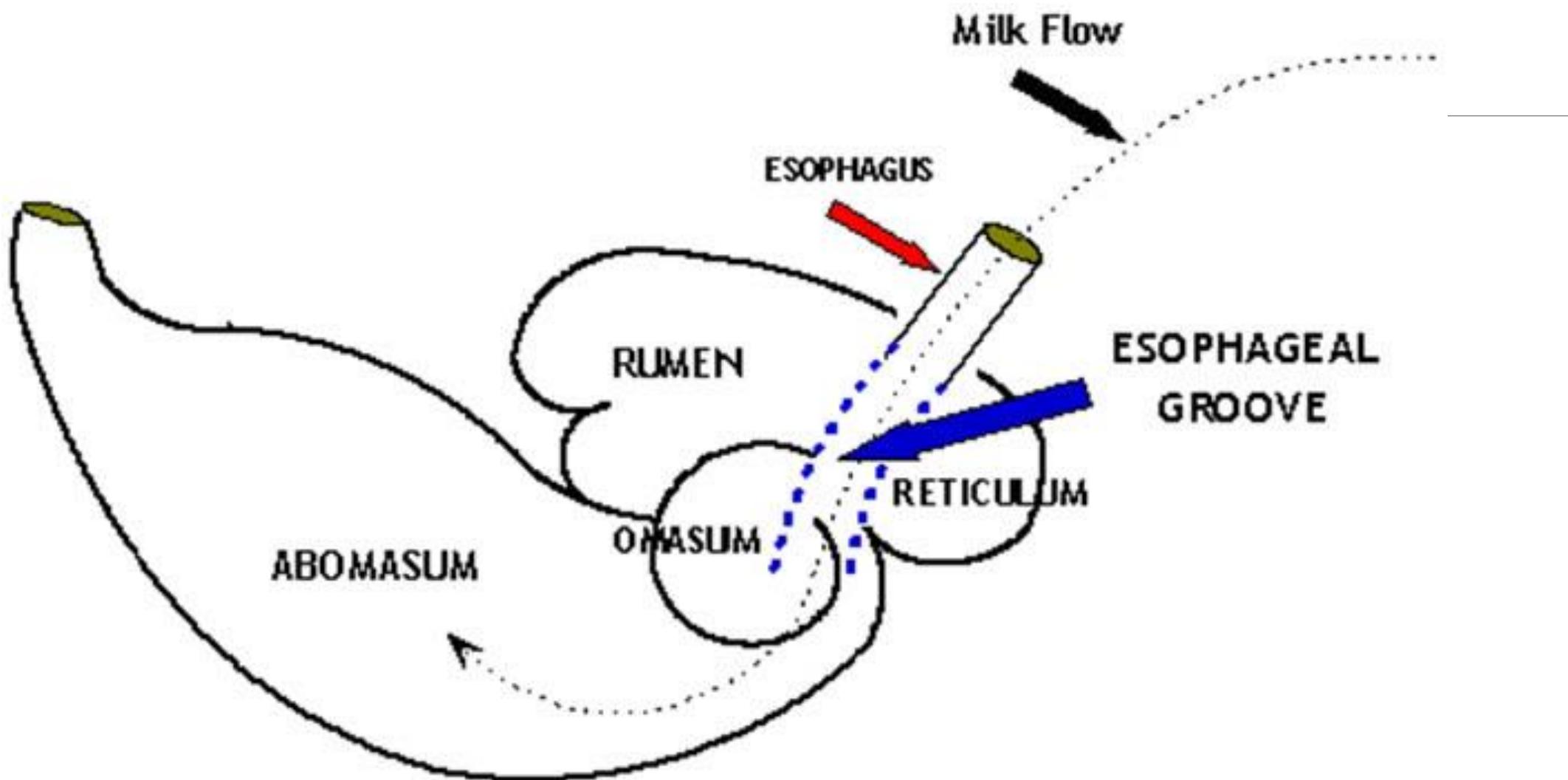


Three to Four Months



Maturity





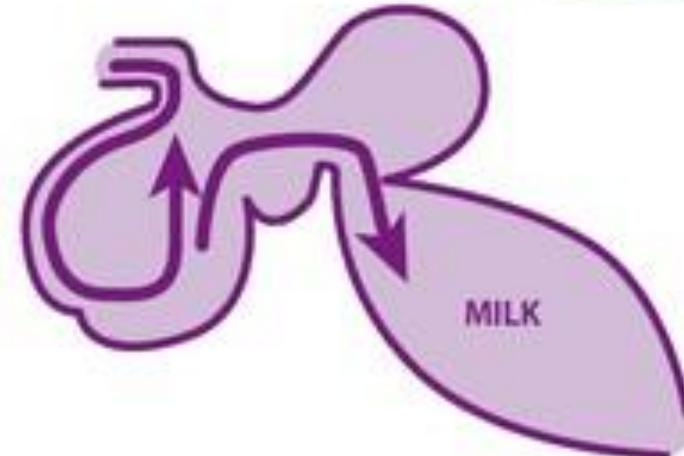
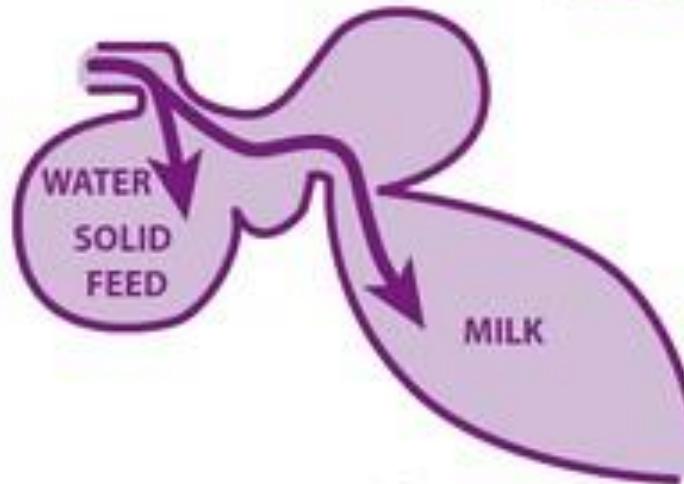
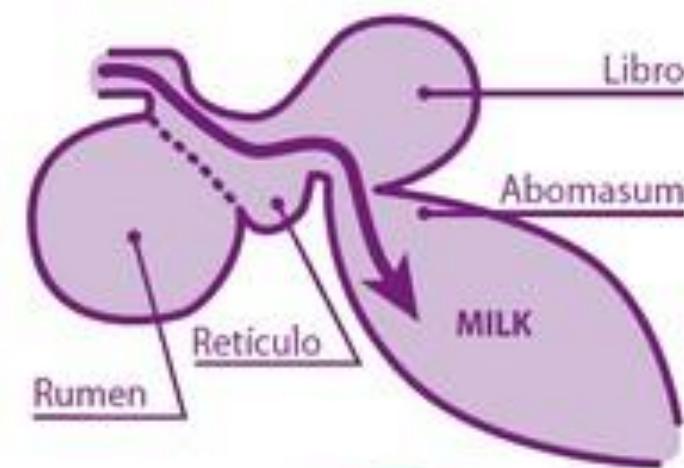
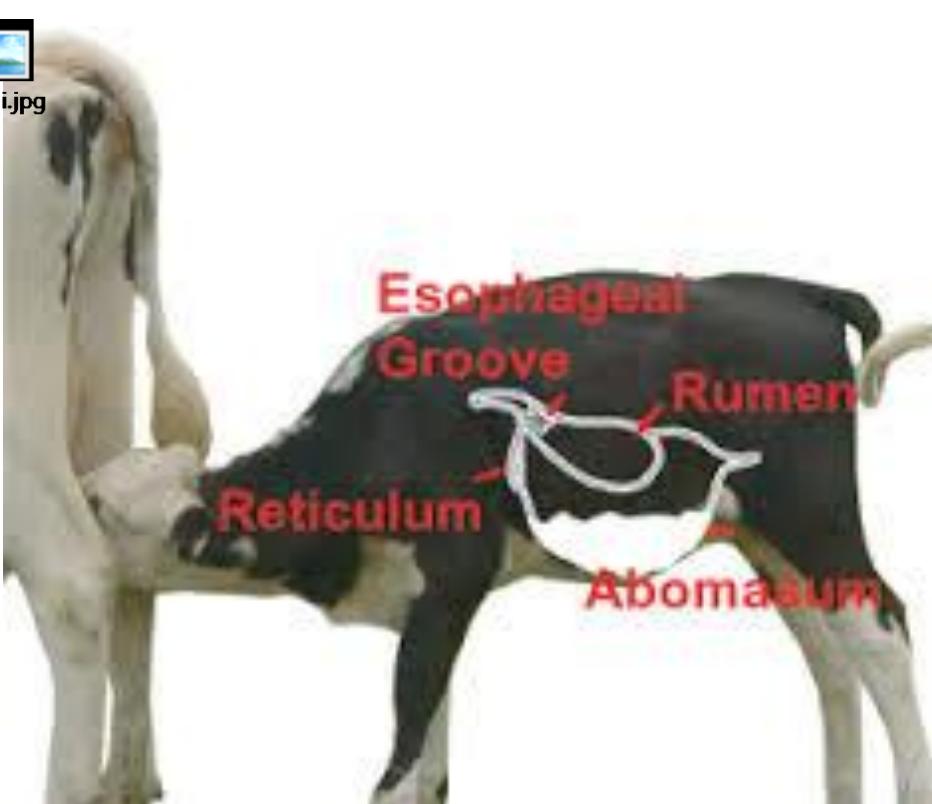
# Milk digestion

---

When a calf drinks milk or a milk replacer based from skim milk, it goes into the abomasum. Within ten minutes, the milk forms a clot in the abomasum from the coagulation of milk protein or casein, the enzymes rennin and pepsin, and the hydrochloric acid in the abomasum. Other milk components, primarily whey proteins, lactose and most minerals separate from the curd and rapidly pass into the small intestine (as much as 200 ml per hour). The lactose is digested quickly and, in contrast to casein and fat, provides immediate energy to the calf. The clot is then slowly absorbed by the blood stream over the next 12–18 hours.



rumi.jpg



The chemical breakdown of the food in the rumen and reticulum is effected by enzymes secreted by the hosts of bacteria and protozoa which are present in these parts of the digestive tract.

There are about 10,000 million bacteria and 1 million protozoa per ml of rumen contents; the surface area of all the organisms in the rumen of a cow is about 0.5 ha.

The activity of these organisms within the rumen is immense, and 60 to 70 per cent of all digestible dry matter entering the rumen is converted into compounds which are directly absorbed from the rumen into the bloodstream.

The other 30 to 40 per cent continues onwards through the alimentary tract via the small intestine and large intestine where the food is further digested and absorbed, until the solid waste material i.e. the faeces, is finally excreted.

The protein in the food is also broken down by the bacteria and protozoa in the rumen to simpler substances such as amino acids and ammonia.

These organisms build up protein within their own bodies and thus, after they have entered the small intestine, are themselves digested and absorbed.

This microbial protein may account for 50 to 90 per cent of all the protein entering the small intestine and there is often little relationship between the quantity of protein eaten in the food and the amount of protein entering the small intestine for absorption.

The rumen microorganisms dominate digestion in the ruminant, and it is imperative that the rumen functions correctly if the cow is to be healthy and capable of high production.

# Digestibility

---

Although the analysis of a food may be a useful guide to its feeding value, the real value of that food to the cow depends on the amount which is digested by the animal.

Digestibility is defined simply as the proportion of the food which is absorbed by the animal and which is not excreted and wasted in the faeces.

# Calculations of Digestibility

---

$$\text{Digestibility (g/kg)} = \frac{\text{Nutrient in feed} - \text{Nutrient in feces}}{\text{Nutrient in feed}} \times 1000$$

$$\text{Dry matter digestibility (DMD, g/kg)} = \frac{\text{DM in feed} - \text{DM in feces}}{\text{DM in feed}} \times 1000$$

$$\text{Organic matter digestibility (OMD, g/kg)} = \frac{\text{OM in feed} - \text{OM in feces}}{\text{OM in feed}} \times 1000$$

# Digestibility indices that estimated energy value

---

Digestible organic matter content (DOMD) (g/kg DM) =  $\frac{\text{OM in feed} - \text{OM in feces}}{\text{DM in feed}} \times 1000$

TDN = DCP + DCF + DNFE + DEE(2.25)

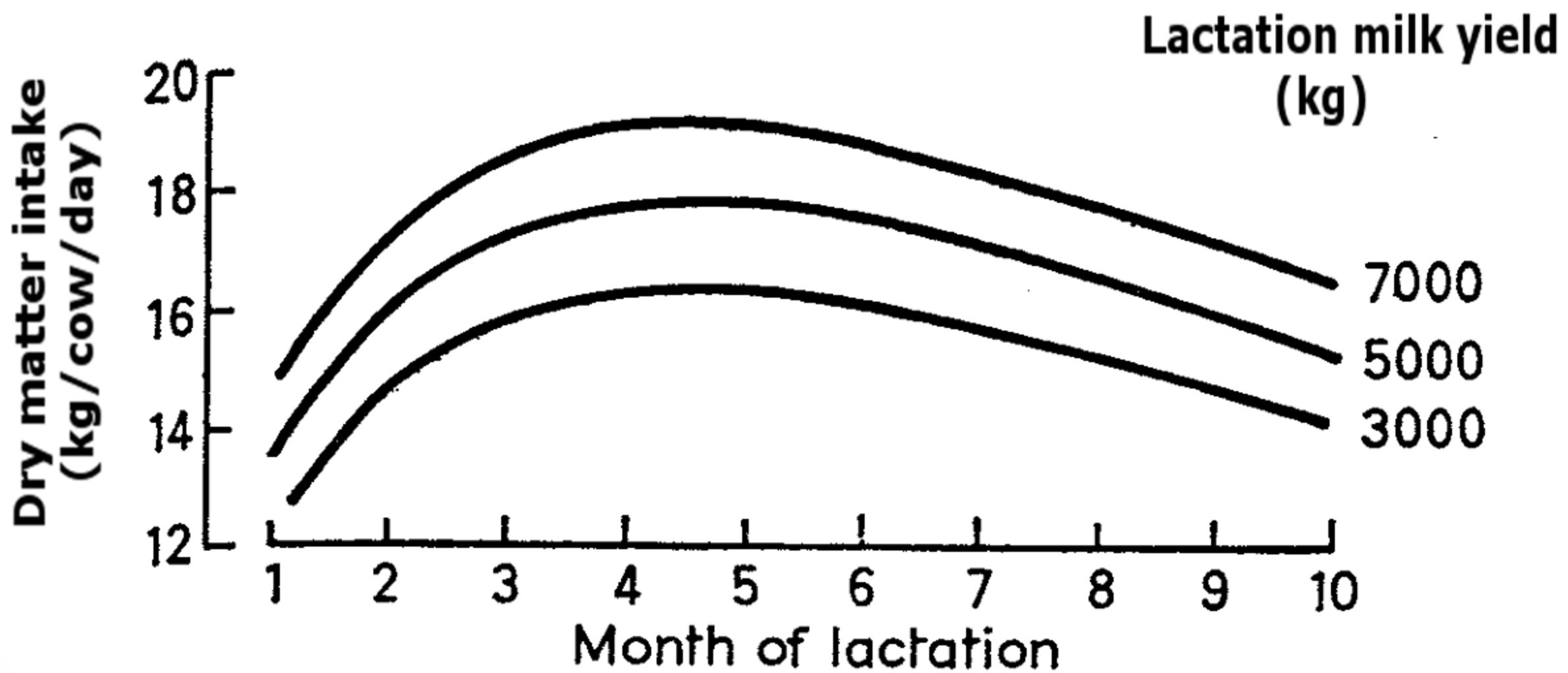
- DCP= Digestible Crude Protein
- DCF= Digestible Crude Fiber
- DNFE= Digestible Nitrogen-Free Extract
- DEE= Digestible Ether Extract (2.25)

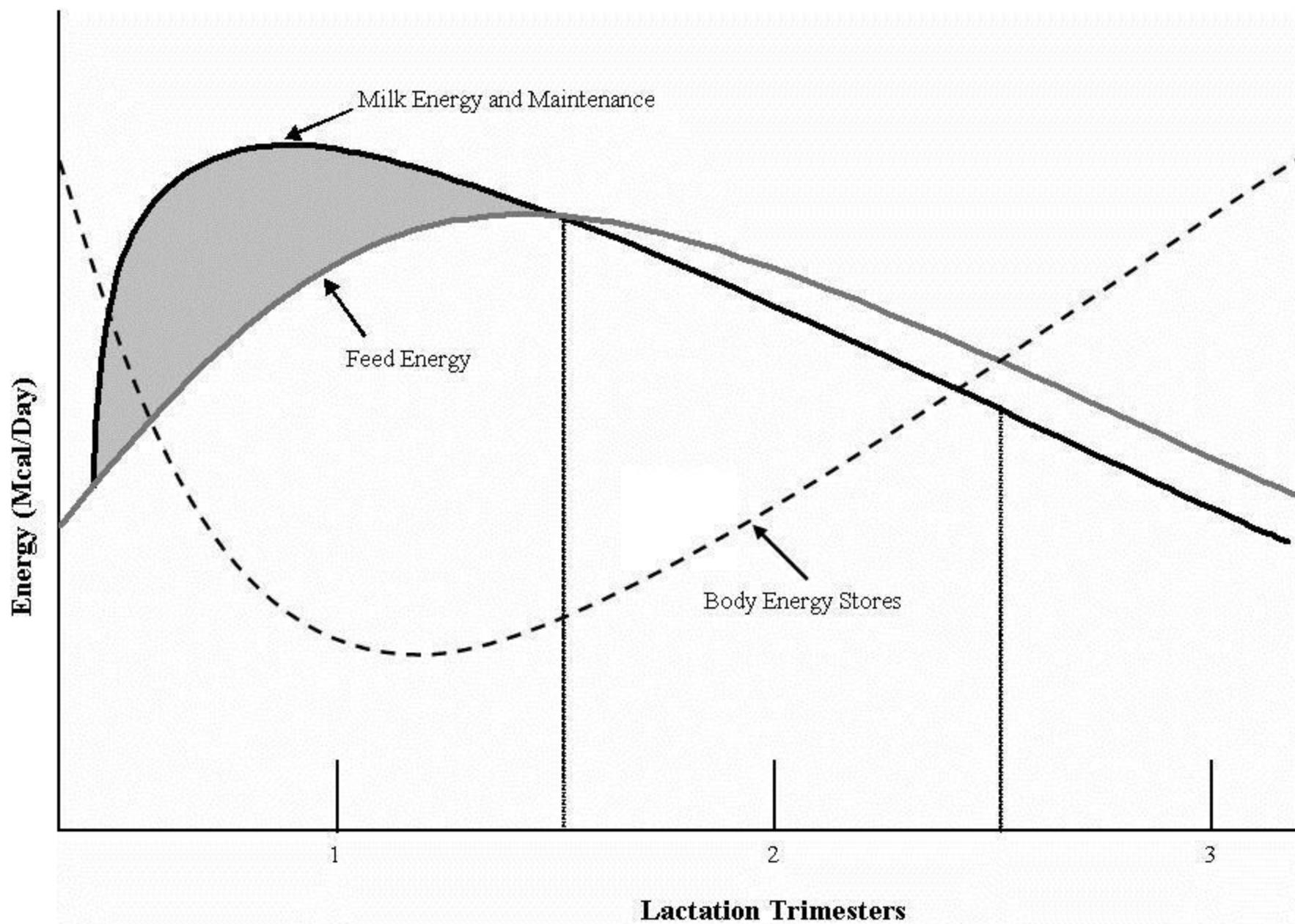
# Dry-matter Intake

---

Before calculating a ration for a cow an estimate of the dry-matter intake of the animal must be made.

A general guide is to allow 2.5 to 3.0 kg dry matter per day per 100 kg live weight, but factors such as milk yield, stage of lactation, type of ration and method of feeding also affect intake, and allowance must be made for them in determining the ration.





# Feeding during lactation

---

The lactation can be divided into three periods.

The first is characterized by a rapid increase in milk production to a peak.

The increase is more pronounced than in other mammals, or even beef cows, and it is this early lactation period when most metabolic and some infectious diseases occur.

Taking this into consideration, a future priority for dairy cow breeding will be to develop cows that have a flatter lactation curve, i.e. they do not ascend to such a high peak milk yield and a high output is maintained for a longer period of time.

The deficit between the nutrients required for milk production and the nutrients available from feed consumption is met by the mobilization of body fat reserves and to some extent body protein and mineral stores.

The nutrient deficits are caused by the failure of feed intake to increase as rapidly as milk production in early lactation, so that it is not until mid-lactation that the energy balance is normally restored.

This is in the second period, following gut involution, which is when peak DM intake is attained.

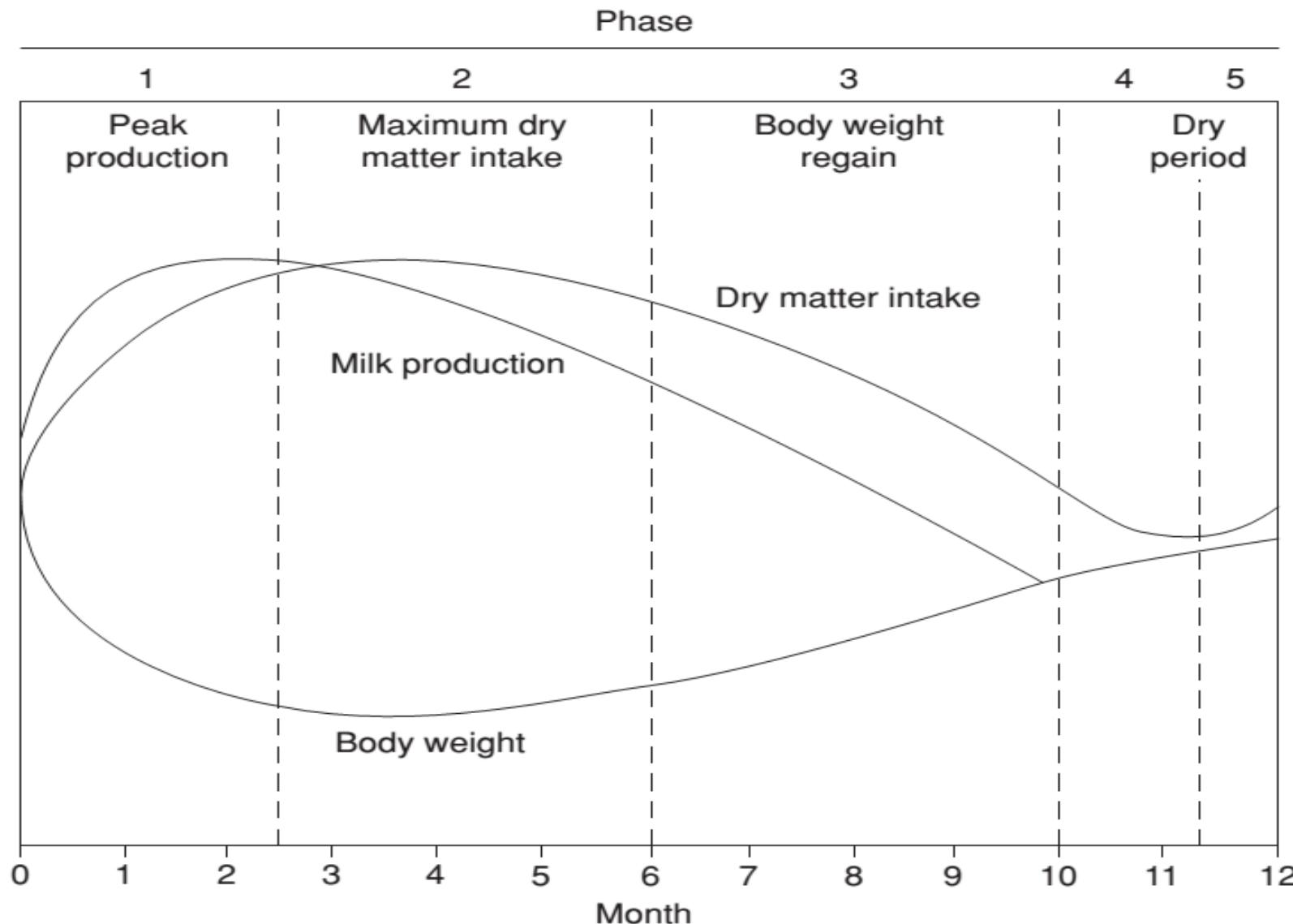
A high-energy diet will accelerate the return to maximum intake, which is one advantage of allocating more concentrates to the early lactation period.

An early return to maximum DM intake will advance the nadir of live weight, that should be reached during this second period.

An excessive weight loss during this period will reduce milk yield, reduce the chances of conceiving and maintaining a viable embryo, and increase the risk of acidosis.

If cows have a low level of body reserves, it is less likely that they will be able to endure a period of underfeeding without milk yield being reduced.

# The changes in milk production, dry matter intake and body weight over the year of a typical dairy cow



In the third period the loss of body tissue, which can be up to 80 kg in a high-yielding cow, should be regained, probably at about 0.5–0.75 kg day.

The decline in milk yield, which has been at a rate of about 2.5% per week since peak milk yield, continues and will accelerate if the cow is pregnant.

First lactation cows have a flatter lactation curve, because they do not initially have the same milk production potential as cows, and in addition they have to divert nutrients to weight gain.

Hence the increase up to peak lactation is particularly pronounced for high-yielding, older cows, compared with cows in their first or second lactation, whose lactation is preserved for a longer period.

Total milk yield increases at least until the fourth or fifth parity and probably reductions in yield after this time are caused by an increased disease incidence rather than senescence.

# Questions

---

- What does food consist of?
- How many parts does the digestive system consist of?
- How many parts does the lactation consist of?
- How do the feed requirements change during lactation?



TÁMOP-4.1.1.C-12/1/KONV-2012-0004

# ANIMAL BREEDING

című digitális tananyag

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Állattudományi és Vadgazdálkodási Intézet

Mikó Józsefné Dr. Jónás Edit  
Főiskolai docens

2014.

SZÉCHENYI 2020



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KORMÁNYA

Európai Unió  
Európai Szociális  
Alap



BEFEKTETÉS A JÖVŐBE



# CHAPTER 7

## CATTLE MILKING



# The role of the milk in our life



Milk is an **important** part of our diet.

Milk is one of the **most nutritionally** complete foods available on the food market to date.

It is **naturally** a good provider of a whole range of nutrients essential to growth, development and maintenance of the human body and contains no artificial preservatives or colourings.

# Nutritional Components in Milk

- Water,
- Carbohydrate,
- Fat,
- Protein,
- Vitamins,
- Minerals, and Minor Biological Proteins & Enzymes.

**Water:** Milk is approximately 87% water, so it is a good source of water in the diet.

Milk is approximately 4.9% **carbohydrate** in the form of **lactose**.

**Carbohydrates** are the primary source of energy for activity. **Glucose** is the only form of energy that can be used by the brain. **Carbohydrates** are important in hormonal regulation in the body.

**Lactose** is a disaccharide made up of glucose and galactose bonded together. Before it can be used by the body, the bond must be broken by the enzyme lactase in the small intestine.

Milk is approximately 3.4% **fat**.

**Fats** are a structural component of **cell membranes** and **hormones**. Fats are a concentrated energy source and are the main energy source used by the body during low intensity activities.

Milk is approximately 3.3% **protein** and contains all of the essential amino acids. **Proteins** are the fundamental building blocks of muscles, skin, hair, and cellular components.

## Nutrient content of milk varieties by 100 g reference amount.

Cow					
Component	Unit	Whole (3.25% fat)	Reduced Fat (2% fat)	Lowfat (1% fat)	Skim
Water	g	88.32	89.33	89.92	90.84
Energy	kcal	60	50	42	34
Carbohydrate	g	4.52	4.68	4.99	4.96
Fat	g	3.25	1.97	0.97	0.08
Protein	g	3.22	3.30	3.37	3.37
Minerals (Ash)	g	0.69	0.71	0.75	0.75

Vitamins have **many roles** in the body including metabolism co-factors, oxygen transport and antioxidants. They help the body use carbohydrates, protein, and fat.

Vitamins	unit	Whole (3.25% fat)	Reduced Fat (2% fat)	Lowfat (1% fat)	Skim	Goat	Sheep	Water Buffalo
<b>Vitamin A</b>	µg	28	55	58	61	57	44	53
<b>Thiamin (Vitamin B1)</b>	mg	0.044	0.039	0.02	0.045	0.048	0.065	0.052
<b>Riboflavin (Vitamin B2)</b>	mg	0.183	0.185	0.185	0.182	0.138	0.355	0.135
<b>Niacin (Vitamin B3)</b>	mg	0.107	0.092	0.093	0.094	0.277	0.417	0.091
<b>Pantothenic Acid (Vitamin B5)</b>	mg	0.362	0.356	0.361	0.357	0.310	0.407	0.192
<b>Vitamin B6 (Pyridoxine)</b>	mg	0.036	0.038	0.037	0.037	0.046	0.060	0.023
<b>Vitamin B12 (Cobalamin)</b>	µg	0.44	0.46	0.44	0.53	0.07	0.71	0.36
<b>Vitamin C</b>	mg	0.0	0.2	0.0	0.0	1.3	4.2	2.3
<b>Vitamin D</b>	IU	40	43	52	41	12	ND3	ND
<b>Vitamin E</b>	mg	0.06	0.03	0.01	0.01	0.07	ND	ND
<b>Folate</b>	µg	5	5	5	5	1	7	6
<b>Vitamin K</b>	µg	0.2	0.2	0.1	0.0	0.3	ND	ND

Minerals have many roles in the body including enzyme functions, bone formation, water balance maintenance, and oxygen transport.

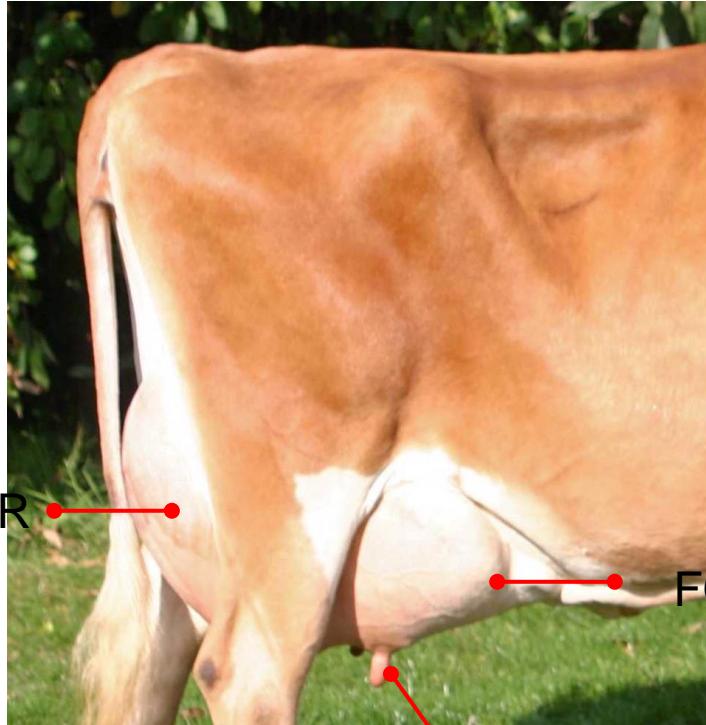
Minerals (Ash)	unit	Whole (3.25% fat)	Reduced Fat (2% fat)	Lowfat (1% fat)	Skim	Goat	Sheep	Water Buffalo
Calcium	mg	113	117	119	125	134	193	169
Copper	mg	0.011	0.012	0.010	0.013	0.046	0.046	0.046
Iron	mg	0.03	0.03	0.03	0.03	0.05	0.10	0.12
Magnesium	mg	10	11	11	11	14	18	31
Manganese	mg	0.003	0.003	0.003	0.003	0.018	0.018	0.018
Phosphorus	mg	91	94	95	101	111	158	117
Potassium	mg	143	150	150	156	204	137	178
Selenium	µg	3.7	2.5	3.3	3.1	1.4	1.7	ND
Sodium	mg	40	41	44	42	50	44	52
Zinc	mg	0.40	0.43	0.42	0.42	0.30	0.54	0.22

# Minor Biological Proteins and Enzymes

Other minor proteins and enzymes in milk that are of nutritional interest include lactoferrin and lactoperoxidase. There are many other enzymes in milk but these do not have a role in human nutrition.

## Nutrient content of milk varieties by 100 g reference amount.

		breeds		
Component	Unit	Goat	Sheep	Water Buffalo
Water	g	87.03	80.70	83.39
Energy	kcal	69	108	97
Carbohydrate	g	4.45	5.36	5.18
Fat	g	4.14	7.00	6.89
Protein	g	3.56	5.98	3.75
Minerals (Ash)	g	0.82	0.96	0.79

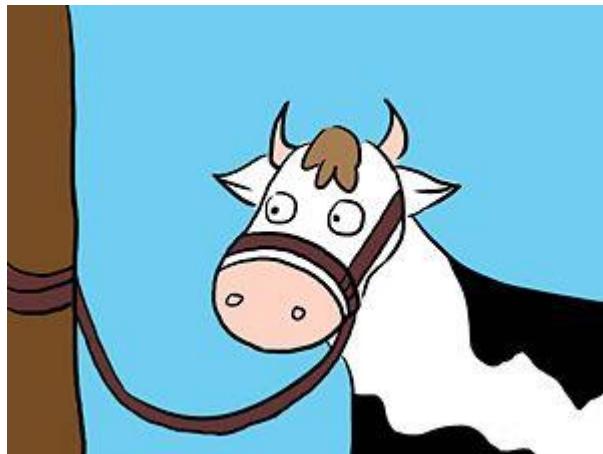


# Milking technologie

Cows are normally milked 2 times per day, however some high producing herds are milked 3 times per day.

Milking time takes about 5 minutes per cow but depends on the type of machine and the amount of milk the cow is producing

# Milking by hand



Make sure the cow **is tied** with a halter to a sturdy post or held in a stanchion.



**Clean the teats** with soapy water or iodine. Warm, soapy water can help "bring down" the milk. **Dry them**, but don't rub or irritate the teats.



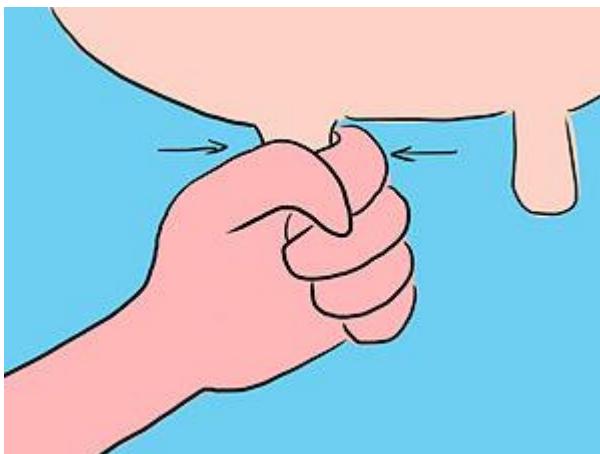
Place a **bucket** underneath the udder. Better yet, hold it between your legs. This takes practice, but it can be done, easily and comfortably. This position lowers the chances of the cow kicking over an almost-filled pail of milk



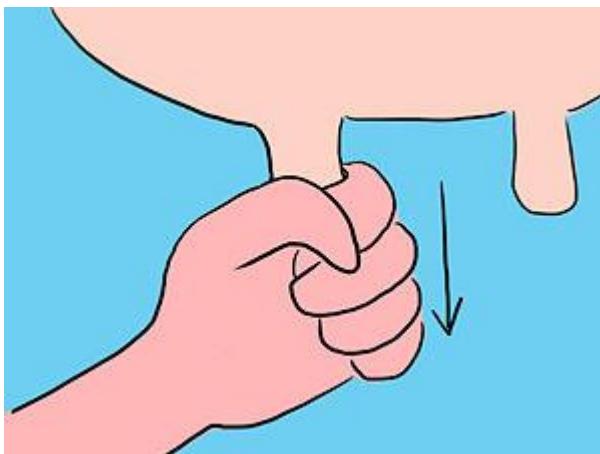
Sit or squat in a position that will allow you to move away quickly if the cow becomes uncooperative.



Wrap your hands around two of the four teats. Choose diagonal teats (front left and rear right, for example). Or, try the front teats first, then the back pair.



Squeeze the base of the teat, after gently clamping each teat between your extended thumb and first finger, so that the teat fills your palm as you squeeze down.



Squeeze down to push out the milk, maintaining your grip on the base of the teat so that the milk doesn't flow back up into the udder.

# **Milking by machine**



## **Step 1.**

### Observation

Make sure to identify cows that must be milked last or that are receiving treatment (e.g. those identified with a leg band).

# Preparation



# Cleaning the teats



Disinfectant solution

The cleaning time depending on how dirty teats are.

# disinfectant solution



GEA Farm Technologies

# Forestripping



This step is essential for detecting the early signs of mastitis.

It flushes out bacteria from the teat canal and stimulates the milk flow.



# Attaching and adjusting the milking unit



# Milking



# End of milking

Complete milking should take from 4-6 minutes per cow for most cows.



**Avoid overmilking.**



**Milking unit removal**

# Disinfection



Once milking is completed, dip the teats fully in a disinfectant solution.

# After milking



# Golden rules for milking

## **BEFORE MILKING**

# Monitor udder health regularly



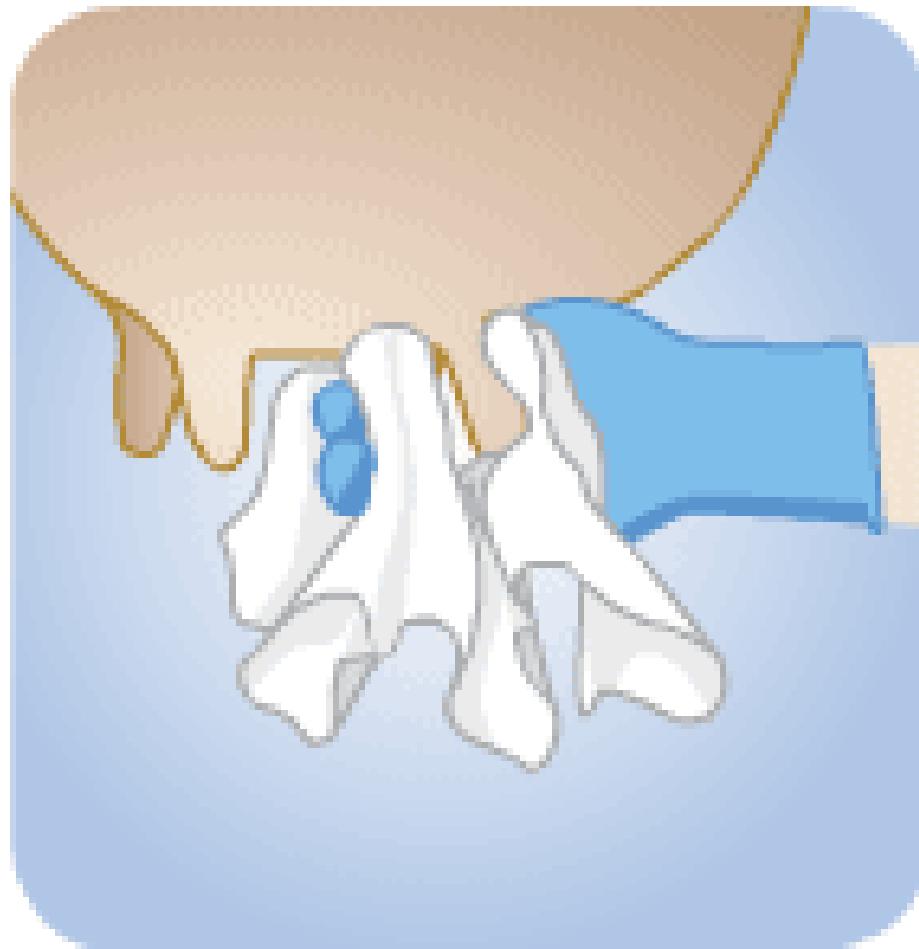
# Follow the right milking order



# Always foremilk



# Clean and/or disinfect teats before milking

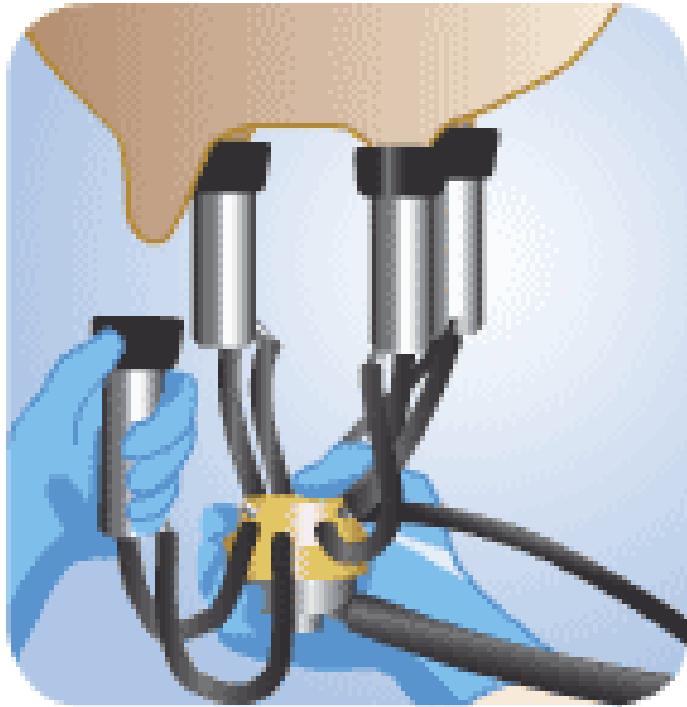


# Golden rules for milking **DURING MILKING**

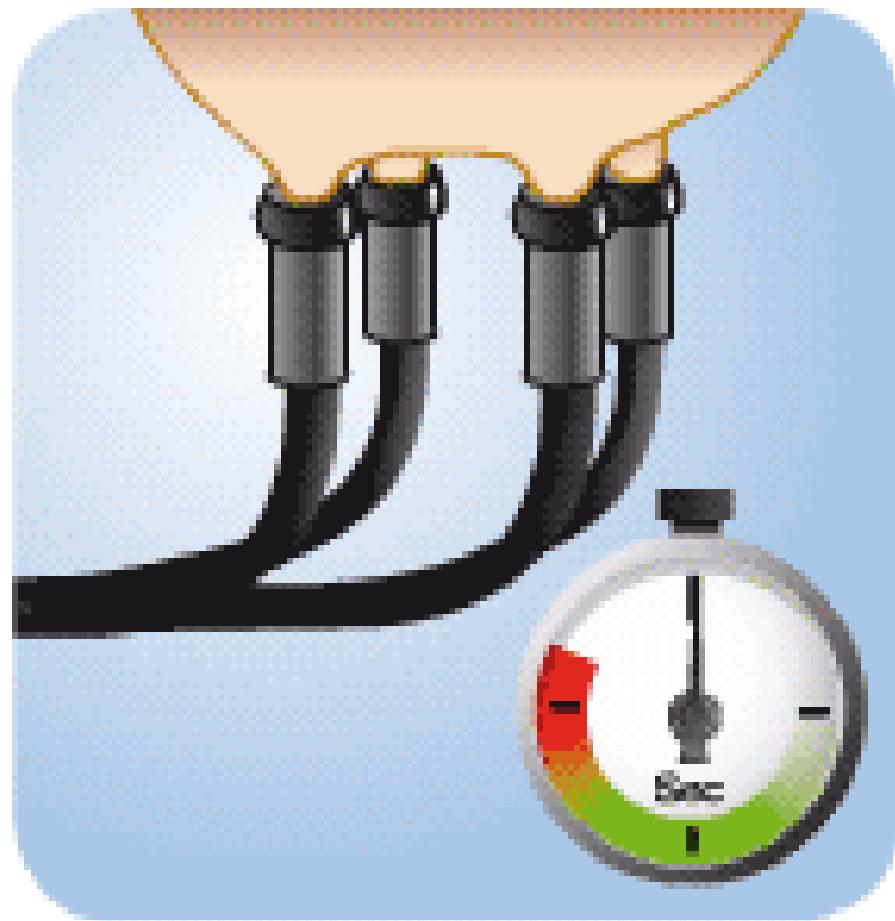
# Check milking vacuum



# Attach milking cluster in time



# Avoid overmilking



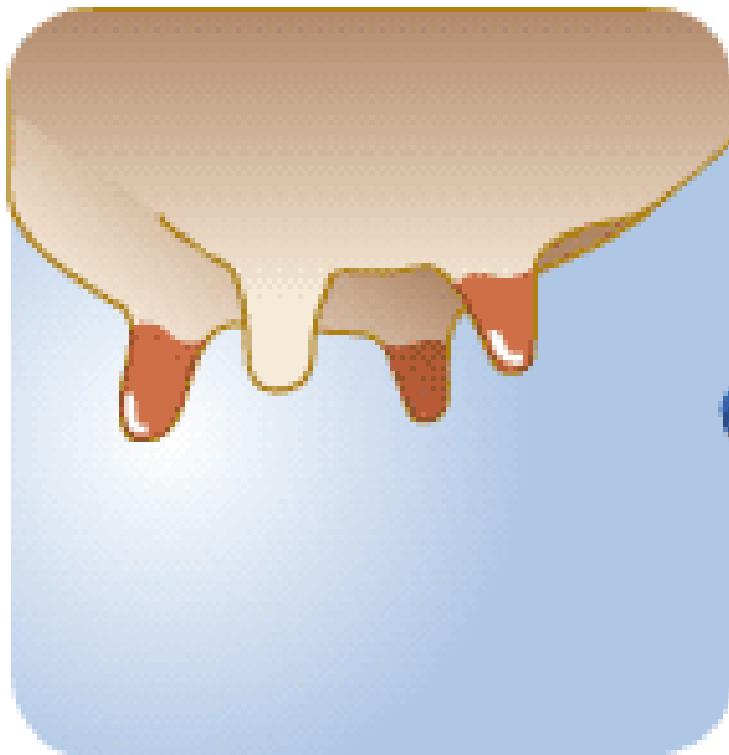
# Detach milking cluster correctly



# Golden rules for milking

## **AFTER MILKING**

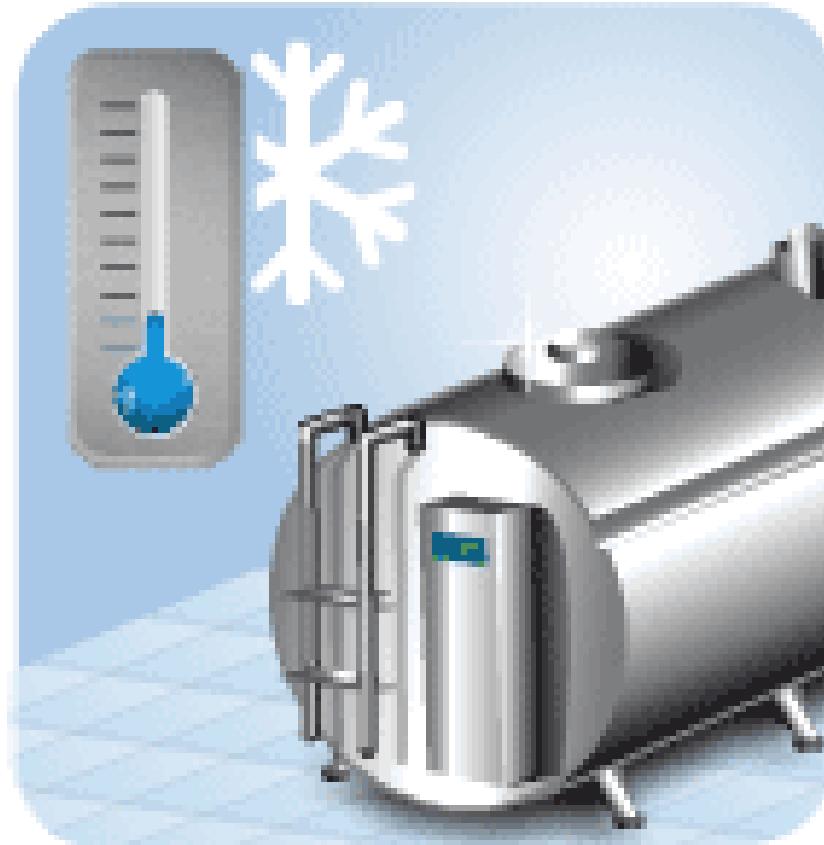
# Disinfect teats immediately



# Clean/disinfect milking equipment

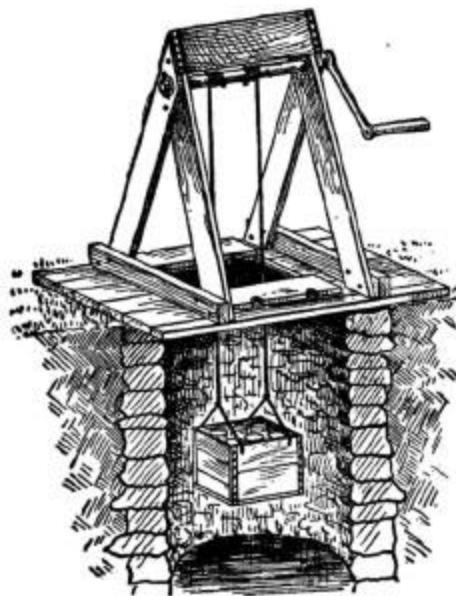


# Ensure proper milk cooling



# Regularly monitor milking results





COLD STORAGE FOR MILK

Cool of milk

# Questions

- What are the nutritional components of milk?
- What percentage of milk is water?
- How many times are cows milked a day?
- What are the golden rules for milking?

# Sources:

- <http://www.vacas.info/categoria/informacion/>
- [http://www.medvet.umontreal.ca/rcrmb/dynamiques/PDF\\_AN/Toolbox/Factsheets/Milking\\_procedure\\_pro.pdf](http://www.medvet.umontreal.ca/rcrmb/dynamiques/PDF_AN/Toolbox/Factsheets/Milking_procedure_pro.pdf)
- <http://www.delaval.com/en/-/Dairy-knowledge-and-advice/Milking/12-golden-rules-for-conventional-milking/>
- <http://www.milk.co.uk/page.aspx?intPageID=131>



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# ANIMAL BREEDING

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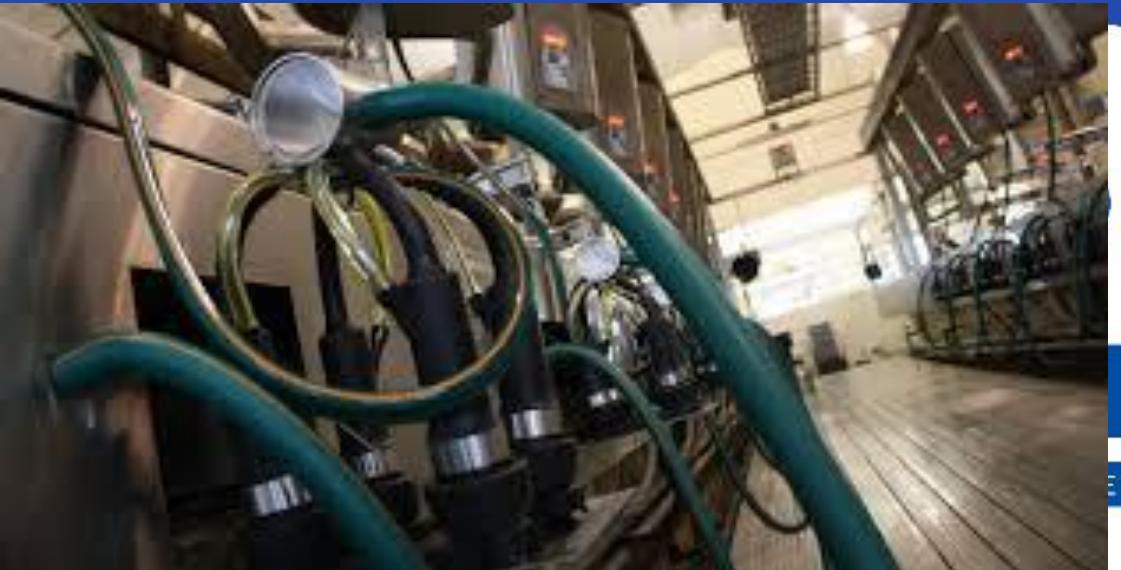


BEFEKTETÉS A JÖVŐBE



# CHAPTER 8

## MILKING FACILITIES



For the dairy farmer, milking is a time-consuming task.

Most cows are now milked mechanically, although hand milking prevails in some developing countries.

Cows are usually walked to a specialized building for milk collection, the parlour, which must be situated close to a room for cooling the milk and storing it in a tank.

Since the tank must be accessible from a road, this constrains the layout of dairy farm buildings.

# Milking parlours

- Milking is Tie stalls:
  - Bucket machine milking
  - Pipeline Milking System
- Conventional milking parlours:
  - Side Opening (Tandem) parlour
  - Herringbone (Fishbone) parlour
  - Parallel (Side by Side) parlour
  - Swing (Swing-over) parlour
  - Rotary (Carousel, Turnstile) parlour
- mobile milking parlour
- Robotic Milking parlour





<http://www.youtube.com/watch?v=drkEzxzbzdgM>

# Bucket milking machines

- Bucket milking machines were the first major development in the mechanisation of milking systems and were designed particularly for herds kept in cowsheds. Each portable unit, consisting of a 15 litre capacity lidded bucket, pulsator and teat-cup assembly or cluster, requires manual attachment to a vacuum supply when it is moved from cow to cow during milking.
- Milk is tipped from the buckets into milk cans positioned in the dairy (milk room) or in the cowshed.



<http://www.delaval.co.nz/-/Product-Information1/Milking/Systems/Stanchion-barn-milking-system/>

# Bucket milking machines

- The system is mechanically simple with relatively low investment, running and maintenance costs compared with milking machines in parlours.
- Milking performance is restricted in terms of cows milked per hour by the amount of work that must be carried out on each cow (the work routine).
- A high proportion of time and effort is spent walking from cow to cow and manually carrying equipment and transporting, lifting and tipping milk.
- As a result, each operator is unlikely to be able to use effectively more than 2 or 3 bucket machine units and, consequently, will not milk more than about 30 cows per hour.



<http://www.delaval.co.nz/-/Product-Information1/Milking/Systems/Stanchion-barn-milking-system>

# Pipeline Milking System

For herds where milking directly in the tie stall is required, the pipeline milking system is the ideal solution.

Pipeline milking is a high investment, low labour cost system, originally installed in cowsheds and milking barns but particularly suited to large and medium sized herds milked in parlours with bulk milk collection. Milk is transported direct from udder to refrigerated bulk milk tank for cooling and storage, and plant cleaning is done in-situ.



<http://sajware.com/equip/milking/pipelinemilking.html>

## Side Opening (Tandem) parlour

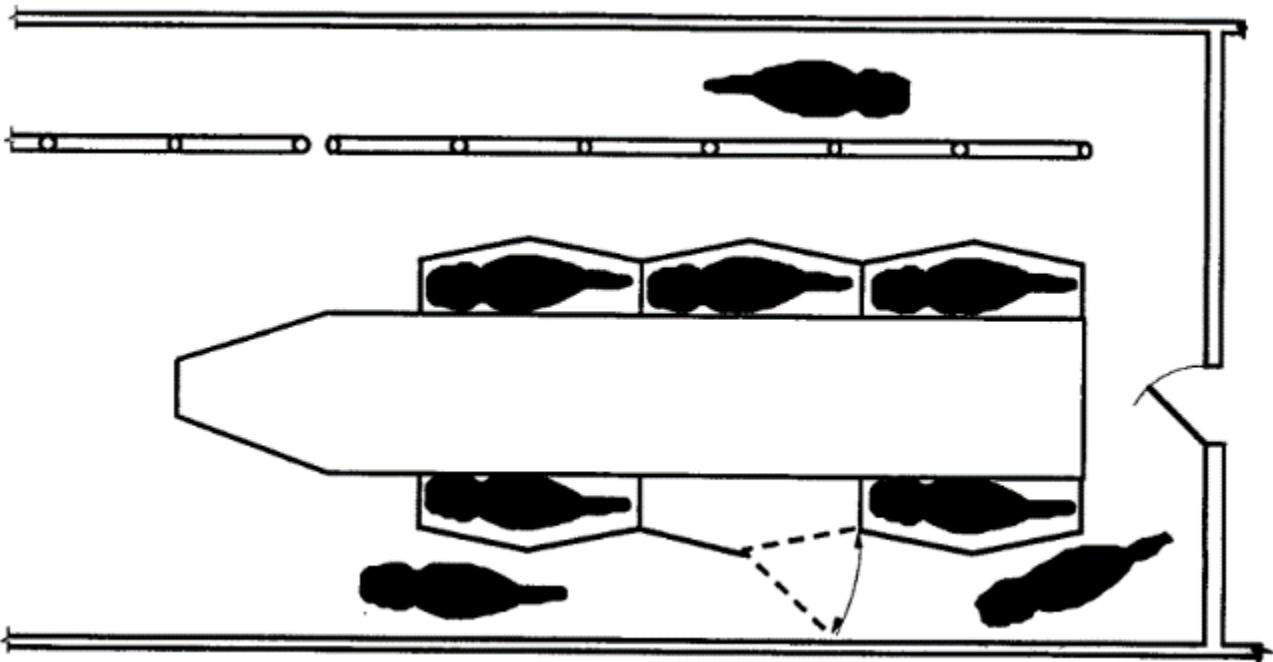
Construction costs are high per cow place. Operators can milk standing upright. Cows in the entry/exit passages are remote from the operator's control.

Size of parlour and throughput are limited by the distance (2.5m) between udders. Individual stalls allow individual attention during milking.

Food troughs can be easily reached and inspected by the operator.



<http://www.delaval.hu/-/Product-Information1/Milking/Systems/>



## Herringbone parlours

Cows stand in echelon formation at  $30^\circ$ – $35^\circ$  to the operator's pit with no division between cows. Distance between udders is reduced to 0.9 m.

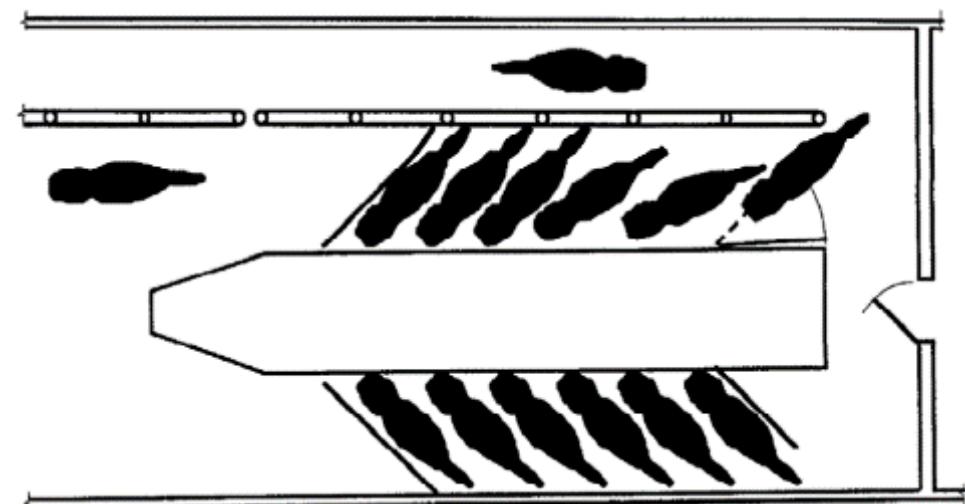
Operator has control over cow entry/exit .

Cows enter and leave in batches.

Suitable for herds of 50–400 cows.



[http://www.dunglinson.co.uk/milking\\_machines\\_herringbone.html](http://www.dunglinson.co.uk/milking_machines_herringbone.html)



Cows stand on an elevated platform at a 90-degree angle facing away from the operator area.

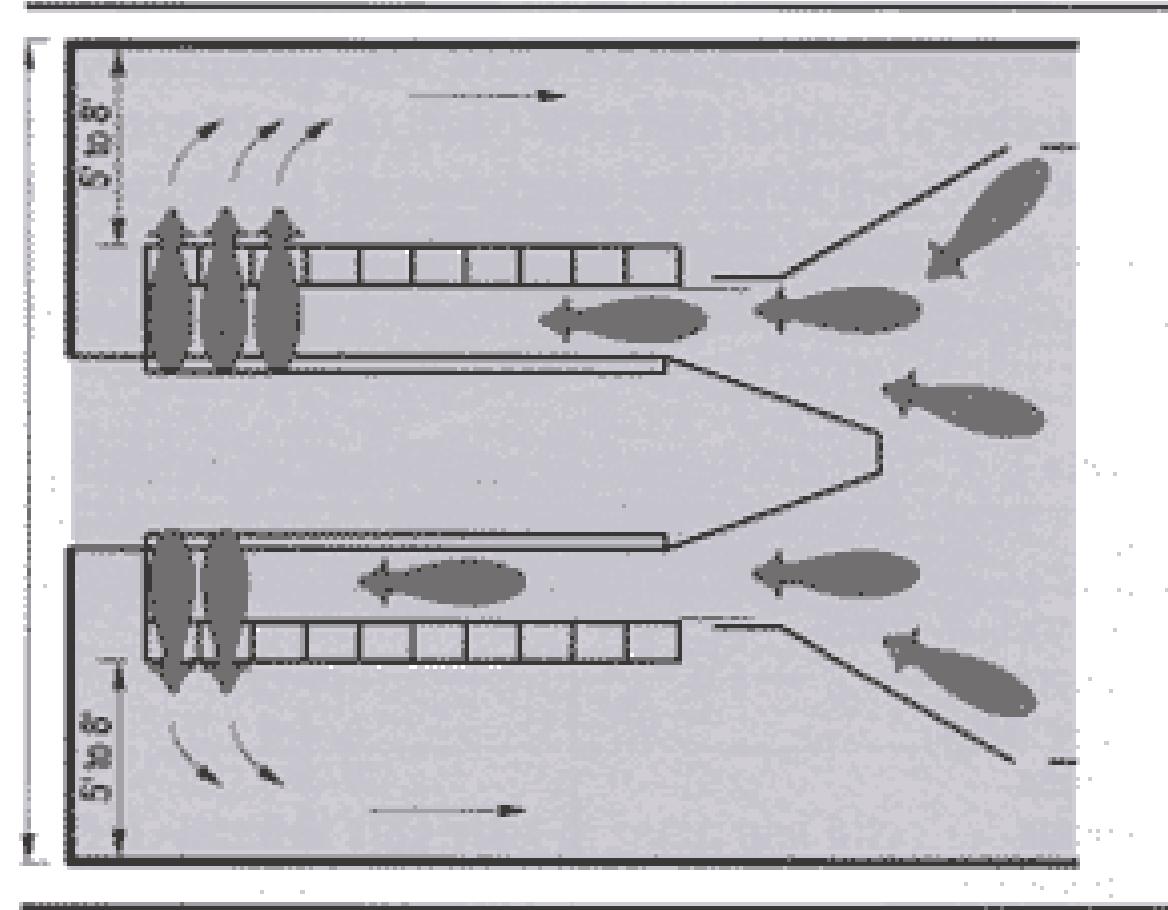
Access to the udder is between the rear legs, which reduces visibility of the front quarters and can make unit attachment and udder user sanitation more difficult.

This configuration makes the walking distance shorter than in a herringbone parlour.

The cow platform is wider than a herringbone parlour to accommodate the length of the cow.

Stall fronts use chutes or small gates to position each cow.

## Parallel (Side by Side) parlour



Swing parlours often use a hybrid stall referred to parabone.

The cows are placed at a greater angle from the operator (about 70 degrees) than in traditional herringbones but less than 90 degrees as in a parallel.

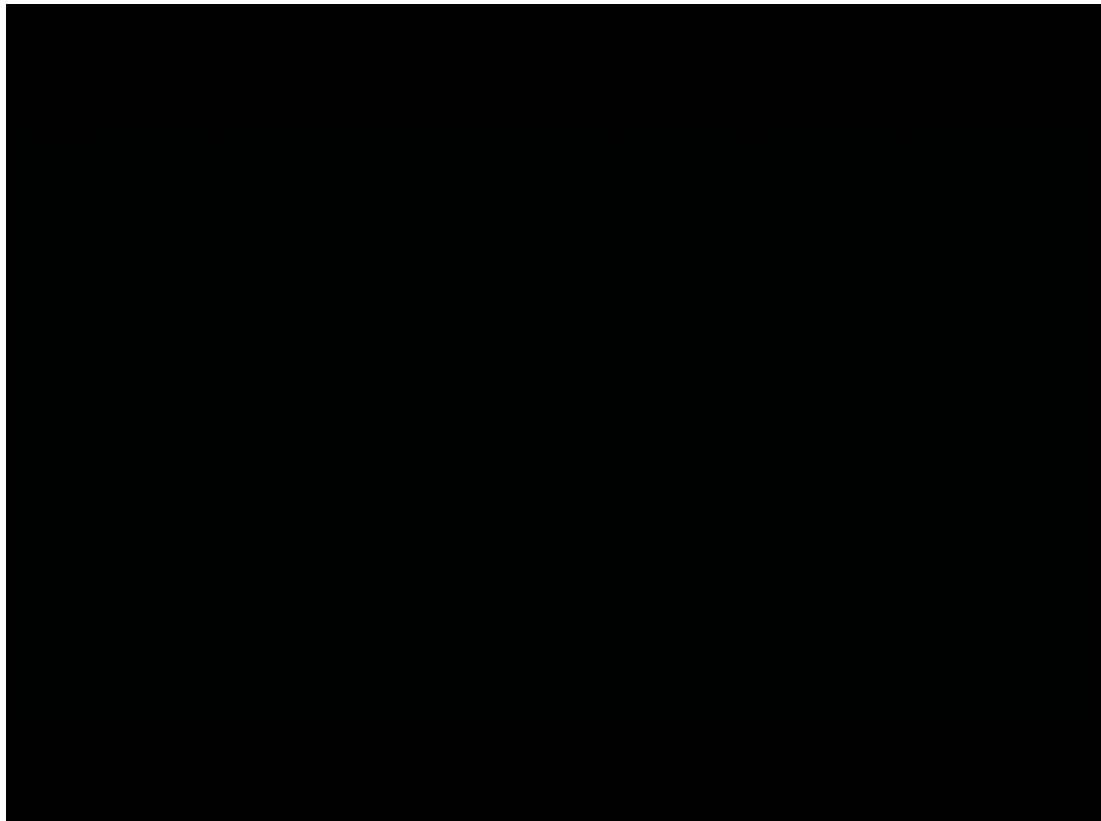
This configuration usually eliminates the need for front positioners as used in a parallel.

The sharp angle does not expose enough of the cow's body to allow milking from the side, however.

Procedures and equipment developed for milking between the hind legs are used.

Milk lines are typically mounted as "midlines" or above the head of the operator resulting in a lift from the udder to milk line of about 1 meter

## Swing (Swing-over) parlour



The advantage of the rotary parlour is that the cow movement functions are largely automated, freeing the operators to tasks more directly associated with milking.

Rotary parlours typically require three operators: one for unit attachment, one to detach units and/or apply post milking teat dip and one to tend to any problems occurring while cows are traveling around (reattach units, tend to liner lips, etc.).

This parlour type is not expandable. And the capital cost is usually higher per stall than for non-moving parlours.

Rotary parlours are best suited to larger herds (>1000 cows).

## Rotary (Carousel) parlour



<http://www.youtube.com/watch?v=pjxoEgXfIPM>

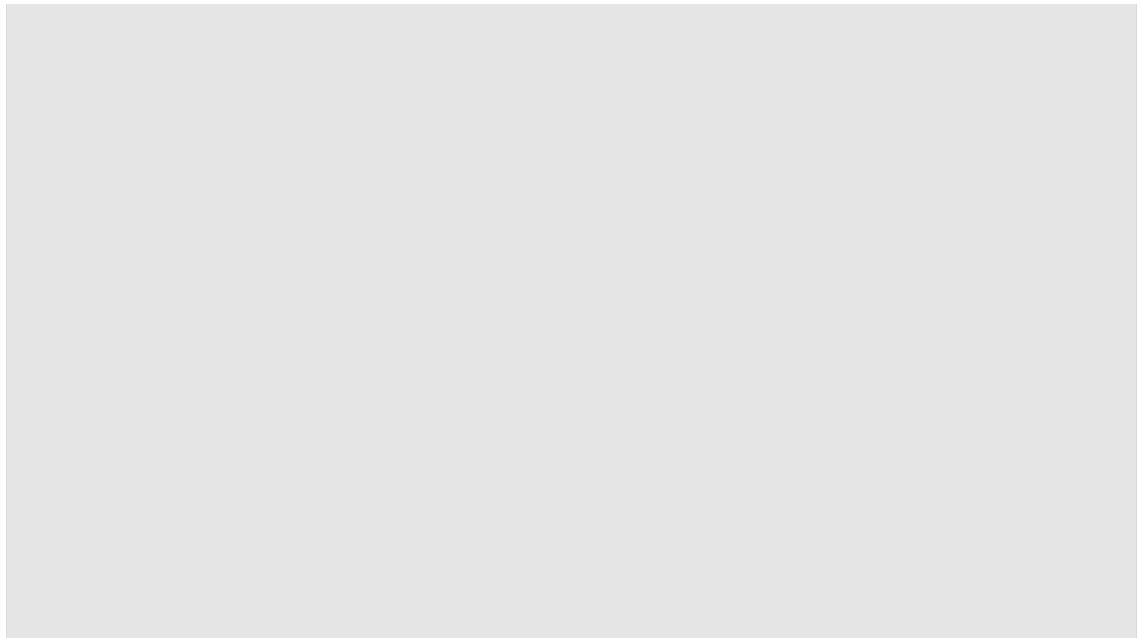
## Mobile milking parlour

Organic dairy production is increasingly dominated by large farms with many cows.

The result is that the distance from the milking parlour to the remotest grazing pasture is too far for the cow to walk.

The advantages of the mobile milking parlour:

- Milking process is done in the pasture.
- Easily connects to the mobile milk (cooling optional) tank.
- Semi automatic washing devices
- Gate control from the inside from each milking place

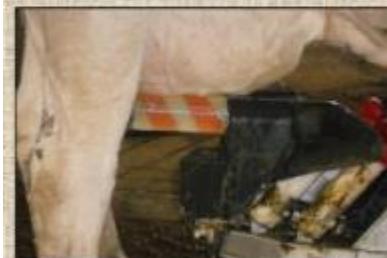


## Robotic Milking parlour

### Automatic milking systems



- > 11,000 units world-wide (2010) 14,000 now – 27% ^
- New concept integrating voluntary milking of individual cows with the automation of all steps of the milking process



Cleaning



Attachment



Milking



Disinfection

IOWA STATE UNIVERSITY  
Extension and Outreach

AMS Operation

<http://www.extension.iastate.edu/dairyteam/sites/www.extension.iastate.edu/files/dairyteam/Robotic%20Milking%20Systems%2011%20Tranel.pdf>

# Questions:

- What types of milking parlours are in tie stalls?
- What are the characteristics of a side opening (tandem) parlour?
- What are the characteristics of a herringbone (fishbone) parlour?
- What are the characteristics of a parallel (side by side) parlour?
- What are the characteristics of a swing (swing-over) parlour?
- What are the characteristics of a rotary (carousel, turnstile) parlour?
- What are the characteristics of a robotic milking parlour?

# Sources:

- <http://milkquality.wisc.edu/wp-content/uploads/2011/09/milking-parlour-types.pdf>
- <http://www.fao.org/docrep/004/to218e/to218eo5.htm>
- <http://www.fao.org/docrep/004/to218e/to218eo6.htm>
- [http://www.strangko.com/pages\\_uk/products\\_milkingsys\\_bucket.html](http://www.strangko.com/pages_uk/products_milkingsys_bucket.html)



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# ANIMAL BREEDING

című digitális tananyag

**Szegedi Tudományegyetem Mezőgazdasági Kar  
Állattudományi és Vadgazdálkodási Intézet**

**Mikó Józsefné Dr. Jónás Edit  
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**2014.**

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**BEFEKTETÉS A JÖVŐBE**



# CHAPTER 1

## CATTLE REARING



# Cattle rearing

- The heifer replacement calf is the most genetically valuable animal in the herd.
- Successful calf rearing starts with the management of the cows.
- The average gestation length is from 279 to 285 days.
- High mortality rates (dead) or morbidity rates (sick but recovered) will greatly alter the cost per heifer reared, mated and successfully entering the herd.
- Mortality rates should be below 5%. Morbidity rates above 20% are frustrating and expensive.

# The care of the calves

- Calves are not **miniature cows** but pre-ruminants requiring good husbandry and feeding by dedicated and well motivated staff.
- The way we manage and feed the calf in the first 10 days will make or break our calf rearing venture.
  - Calving cows in clean/dry paddocks
  - Ensuring adequate colostrum intake!!!
  - Feeding a good quality milk product
  - Good housing/shelter

## The rule of the colostrum

- Colostrum is a mixture of the true milk and certain constituents of blood plasma which have been concentrated ten- to fifteen-fold in the udder before calving.
- It has a high protein, particularly the immune lacto globulins and antibodies which protect the calf against disease in early life, and of carotene and vitamins A, D and E.
- The blood of the newly born calf contains no antibodies, and it is imperative that the calf receives colostrum in the first 6 to 12 hours, as after this time the antibodies cannot pass into the bloodstream.

- Calves need 2-4 litres of colostrum within the first 10 hours to protect the calf from blood poisoning/ navel infection or scours.
- Calves that suckle well will get their 2-4 litres of colostrum within six hours after birth.
- Those that do not suckle within this period will fail to suckle in the subsequent 24 hours.

Calves with insufficient immunoglobulins (from colostrum) are 15% more prone to **scours** or death than those with good immunoglobulin status.



## Changes in the composition of colostrum

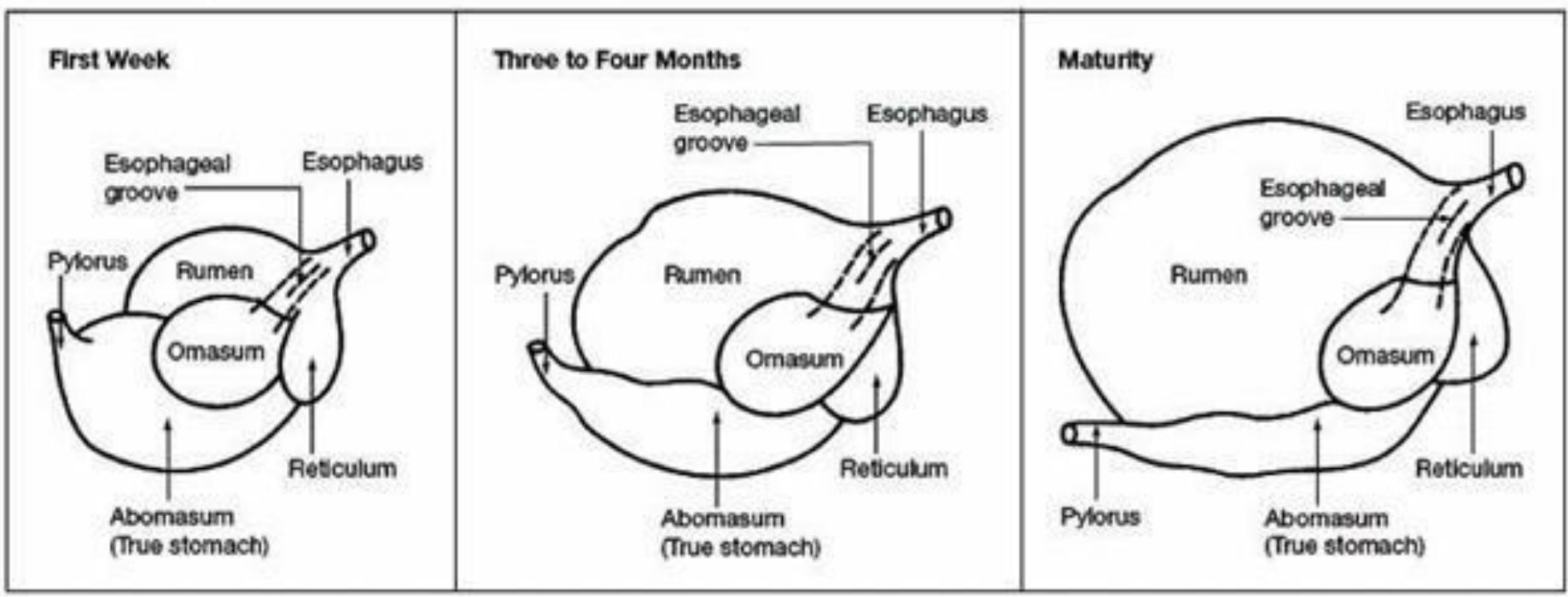
Time	Dry matter %	Casein %	Albumin + Globulin, %	milk sugar, %	milk fat, %
at calving	26.83	2.65	16.56	3.54	3.00
10 hours later after calving	21.23	4.28	9.32	4.66	1.42
24 hours later	19.37	4.5	6.25	4.75	2.85
48 hours later	14.19	3.25	2.31	4.21	3.46
72 hours later	13.36	3.33	1.03	4.08	4.1
normal milk	12.8	2.9	0.6	4.8	3.7

## Changes in the composition of colostrum

	normal milk	colostrum
dry matter, %	13	26-27
protein, %	3.2-3.8	16-18
fat, %	3.5-5	3-4
sugar, %	4.50-4.80	3.50-4
Ca	0.12	0.25
P	0.10	0.30
Fe		ten-twelve –fold then the normale mikl
A vit		ten-fold then the normale mikl
D vit		three –fold then the normale mikl

# Stomach development

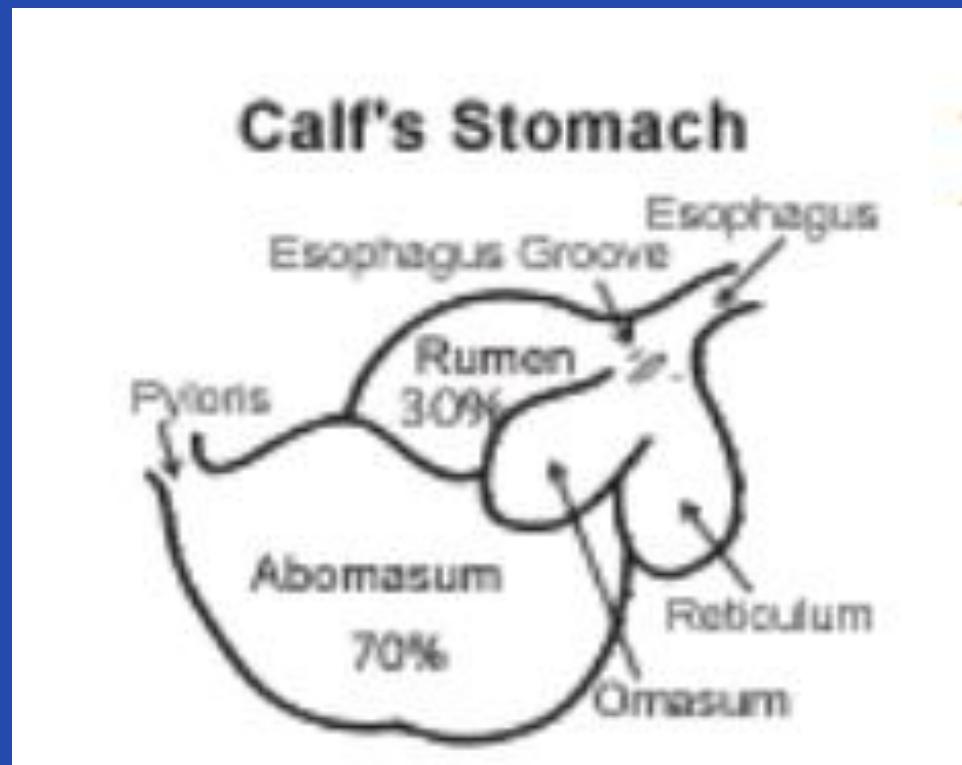
Figure 1. Development of bovine stomach compartments from birth to maturity.



# Stomach Development

## Pre-Ruminant

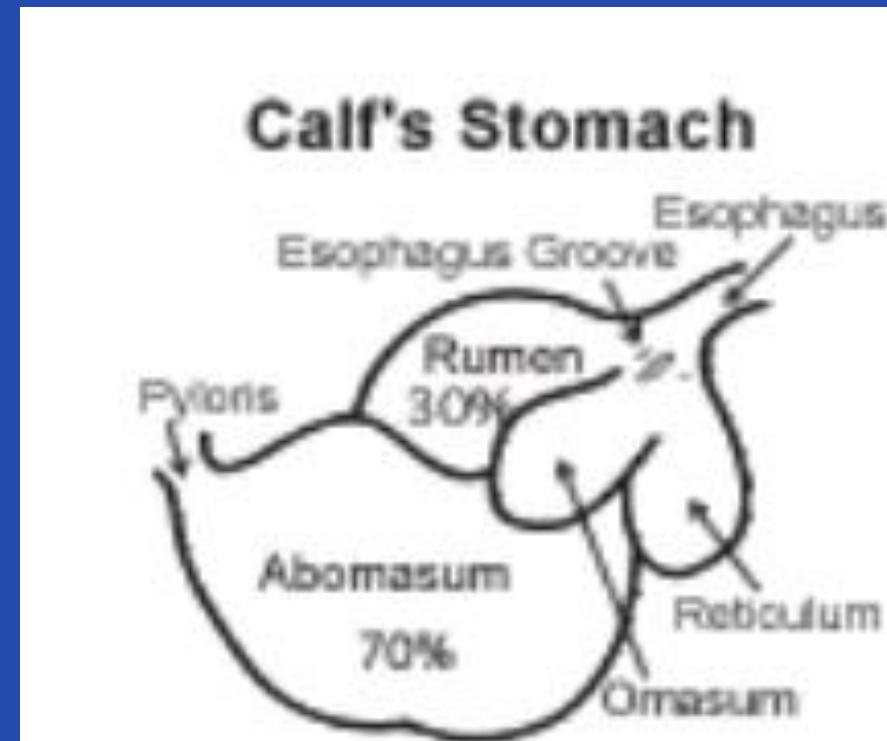
- A calf is born with 4 stomachs.
- The abomasum is the most important stomach at first, 70% total stomach capacity.
- Diet - liquid only
- This vulnerable early stage must be passed through as quickly as possible.



A young calf is predominantly a single stomached animal. Although it has a 4 compartment stomach like a mature cow, the relative size of each compartment is considerably different.

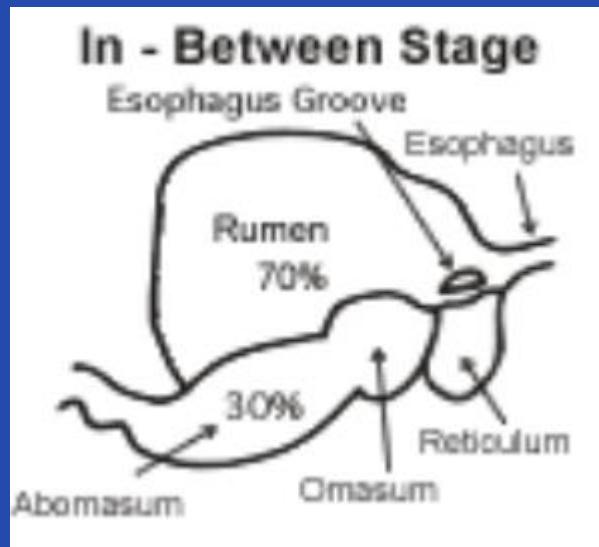
The digestive system of the young calf varies considerably from that of a mature cow.

Colostrum and good neo-natal treatment of the newborn calf is essential



# Developing Ruminant

- Abomasum ceases to play sole role in digestion
- Aim - Fast growth of rumen to achieve solid feeding by 5 weeks. This will reduce rearing costs by at least 25% and get the calf off to an excellent and profitable start.

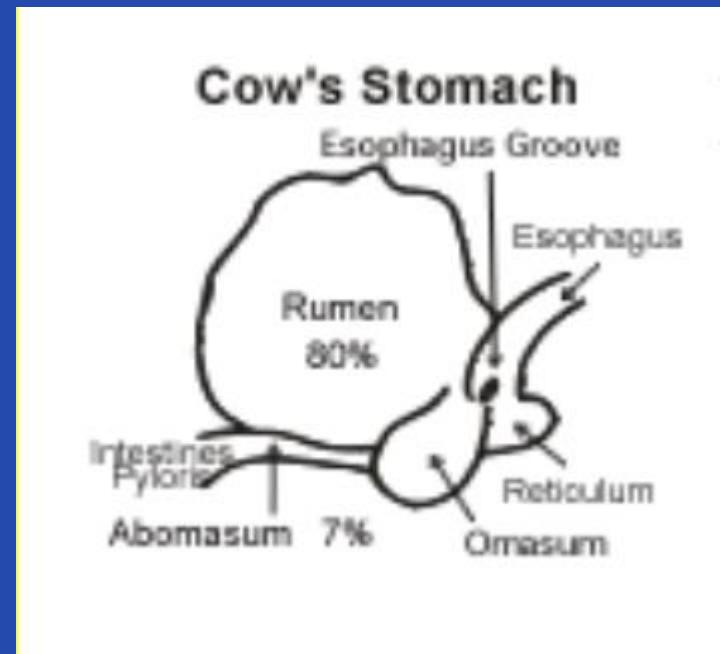


Most of the calf's food, which is **milk**, goes directly to the fourth stomach compartment (Abomasum) through the **esophageal groove** where it is digested.

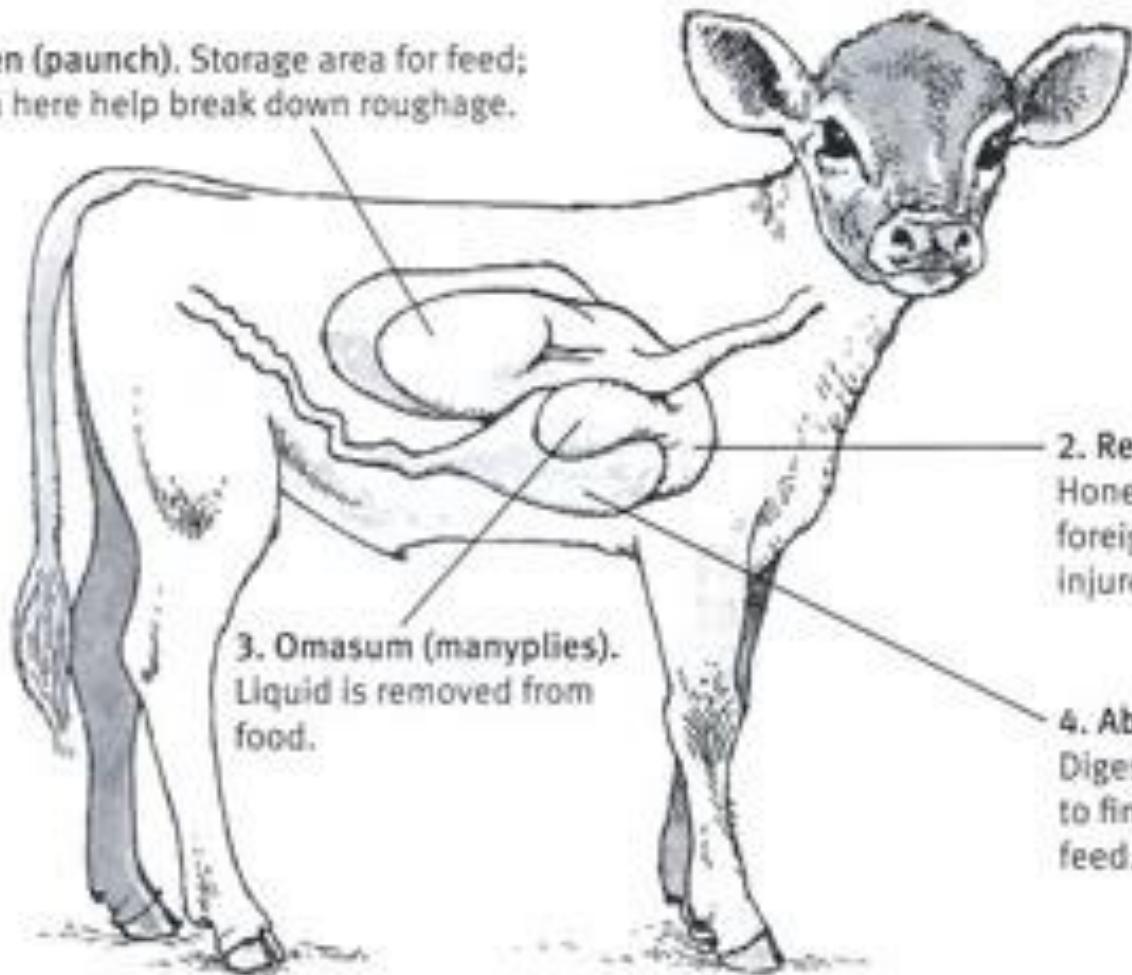
Until enough roughage has been consumed to develop the rumen, no digestive processing takes place in the rumen. The rumen will generally begin to function by four weeks of age if the calf is fed a calf starter as recommended.

# Ruminant

- Omasum and abomasum
  - 18 liter capacity
- Reticulum
  - 11.4 liter capacity
- Rumen
  - up to 227 liter capacity



1. Rumen (paunch). Storage area for feed; bacteria here help break down roughage.



2. Reticulum (honeycomb). Honeycomb-like walls catch foreign material that could injure the digestive system.

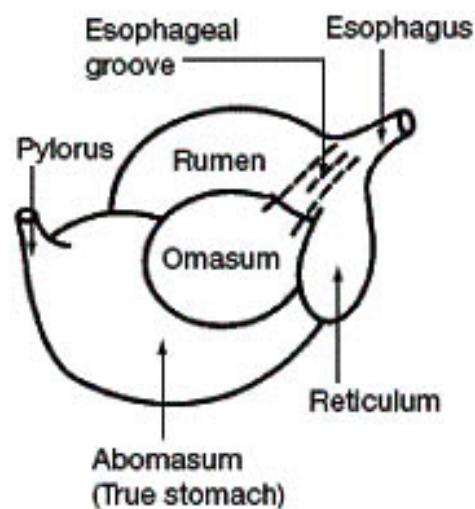
3. Omasum (manyplies). Liquid is removed from food.

4. Abomasum (true stomach). Digestive juices are secreted to finish breaking down the feed.

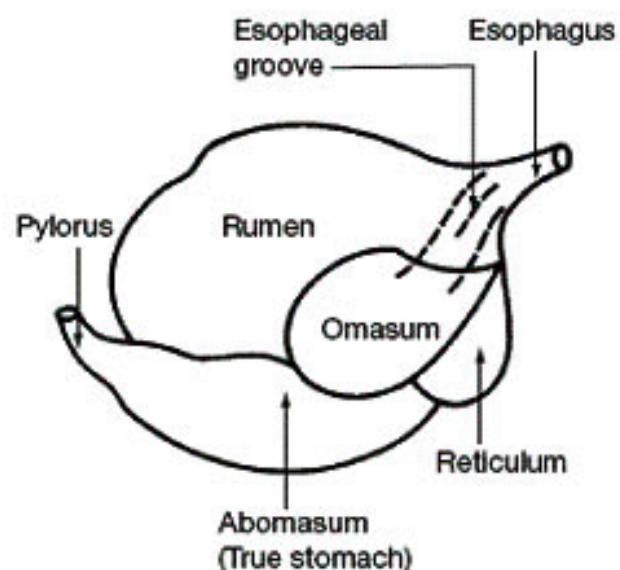
Ruminants, such as cattle, have four-part stomachs.

Figure 1. Development of bovine stomach compartments from birth to maturity.

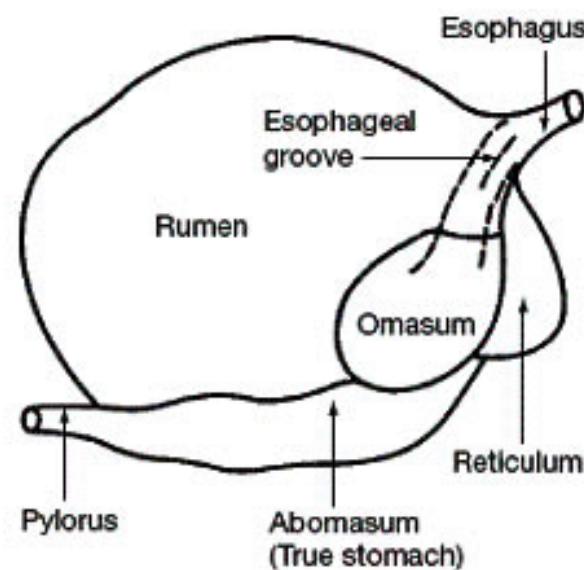
First Week



Three to Four Months



Maturity



# The forage and hay consumption trends in milk feeding period

The calf age		Feeding	
month	day	concentrates kg	hay kg
I.	10-20	0.04-0.06	0.05-0.10
	20-30	0.15-0.20	0.10-0.20
II.	30-40	0.30-0.40	0.20-0.30
	40-50	0.50-0.60	0.30-0.40
	50-60	0.70-0.80	0.40-0.60
III.	60-70	1.20-1.30	0.60-0.80
	70-80	1.50-1.60	0.80-1.00
	80-90	2.00-2.20	1.00-1.20

Table 1: Concentrates and forages for heifers of a large breed.

	Age (months)			
	3 - 6	7 - 12	13 - 18	19 - 22
Average weight, kg	150	270	400	500
Estimated intake, kg/d	3.2 - 4.0	5.4 - 7.3	7.7 - 9.5	10 - 11.8
Excellent forage <sup>1</sup> , kg	1.8 to 2.2	5.0 to 6.0	8.0 to 9.0	10 to 11
Concentrate, kg	1.4 to 1.8	0 to 1.0	0 to 1.0	0 to 1.0
Good forage <sup>2</sup> , kg	1.4 to 1.8	4.5 to 5.0	6.4 to 7.3	9.0 to 10
Concentrates, kg	1.8 to 2.2	1.4 to 1.8	1.4 to 1.8	1.0 to 1.4
Poor forage <sup>3</sup> , kg	0.9 to 1.4	3.2 to 4.0	5.4 to 6.4	7.3 to 8.2
Concentrates, kg	2.3 to 2.7	2.3 to 2.7	2.7 to 3.6	2.7 to 3.6
..... Diet composition, % of diet dry matter .....				
Forages	40 to 80	50 to 90	60 to 100	60 to 100
Fiber -NDF	34	42	48	48
Crude protein	16	15	14	12
Calcium	0.5	0.4	0.3	0.3
Phosphorus	0.3	0.3	0.2	0.2

# Calf Rearing

## From birth to 3 months

Liveweight is approximately from 40kg to 90-110kg

Feeding:

- Forage (1-1,5 kg)
- Hay (1,5-2 kg)

Average body weight gain: 600-700 g /day

# Calf Rearing

Weaned calves: 3-6 months old

Liveweight is approximately from 90-110 kg to  
185-200 kg

Feeding:

Forage: 1-1,5 kg

Hay: 2-3 kg

Corn silag: 0-5 kg

Average body weight gain: 900-950 g/day

## Modern principles of heifer rearing

- Once a calf is weaned, most health problems are over.
- It is then necessary to decide on a desirable growth rate and to feed the most economical sources of energy, protein, minerals and vitamins to satisfy those requirements.

## Feeding from 6 to 12 month

Liveweight is approximately from 200 kg to 300-320 kg

Feeding:

- Corn silage: 5-10 kg
- Hay: 2-3 kg
- Alfalfa silage: 4-5 kg
- Forage: 1-2 kg

Average body weight gain: 650-700 g /day

## Feeding from 12 month to breeding

Liveweight is approximately from 300-320 kg to 360-380kg

- Corn silage 10-15 kg szilázs
- Alfaalfa silage: 4-5 kg
- In summer:garzing+ hay or straw

Avarage body weight gain: 500-600 g /nap

# Feeding from breeding to late pregnancy (7month)

Liveweight is approximately from 360-380 kg to 450-480 kg

Feeding:

- Corn silage: 15-20 kg szilázs
- 3-4 kg hay or 4-5 kg alfalfa silage
- In summer: grazing+ hay or straw

Average body weight gain: 500-550g /day

- Trace mineral premix

# Feeding from late pregnancy (7month) to calving

Average body weight at calving: 560kg

Feeding:

- Corn silage: 15-20 kg
- Hay: 3-4 kg
- Forage: 1-4 kg

Average body weight gain: 800 g /day

One to two months prior to calving, the feeding program must be adjusted to prepare the heifer for calving and first lactation.

These heifers should receive forage and progressively more concentrate to ensure a smooth transition and encourage high dry matter intake as soon as possible after calving.

group	In winter (kg)	In summer (kg)	Daily live weight gain (g)
<b>Heifers under the age of one year (180-220 kg) – (300-320 kg)</b> 6 hó – 12 hó	corn silage 8-12 hay 2-3 alfalfa silage 4-5 forage 1,5-2	grass 20 forage 1,5-2	<b>In winter:</b> 650-700 nyáron: 400-450
<b>From one year to breeding</b> (300-320 kg) – (360-380 kg) 12 hó – (16-18 hó)	corn silage 15-20 alfalfa silage 4-5	grass 30 hay 3-4 vagy tak.szalma 4-5	500-600
<b>From breeding to late pregnancy (7 month)</b> (360-380 kg)-(480-500 kg) (16-18 hó) – (22-24 hó)	corn silage 20-25 hay 3-4 or alfalfa silage 4-5	Grass:- hay 3-4 or straw 4-5	500-600
<b>From late pregnancy to calving</b> (480-500 kg) (550-560 kg) (22-24 hó) – (24-25 hó)	corn silage 20-25 hay 3-4 forage 2-4		650-700

# Water Requirements of Livestock

	average water L/day
calv (age:1-2 month)	2-4
calv (age:3-6 month)	5-10
heifer under one year	10-15
heifer over one year	20-30
Dairy Cattle during the lactation	80-100
Dry cow	50-60
Dairy Cattle at calving	60-80
Beef Cattle	50-60

13-15 °C

# Videos

<http://www.youtube.com/watch?v=c2giVn8eoS0>

<http://www.youtube.com/watch?v=Op7rePZYX0w>

<http://www.youtube.com/watch?v=MzYkXTcVBho>

<http://www.youtube.com/watch?v=n8-zIUic768>

<http://www.youtube.com/watch?v=RWqksUSHuEQ>

<http://www.youtube.com/watch?v=RgNm8TqOnIU>

Calving

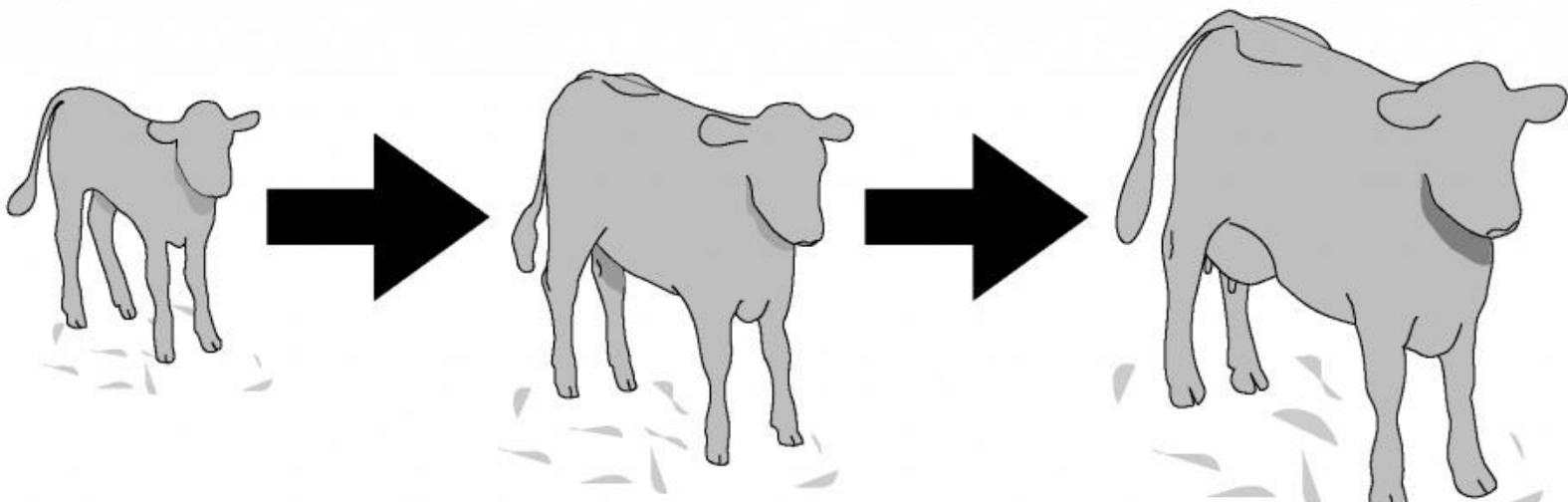








Breed	Birth weight (kg)	Breeding		Calving		Average daily gain (kg)	Adult weight (kg)
		Weight (kg)	Age (mo.)	Weight (kg)	Age (mo.)		
Holstein, Brown Swiss	40-45	360-400	14-16	544-620	23-25	0.74	650-725
Guernsey, Ayrshire	35-40	275-310	13-15	450-500	22-24	0.60	525-580
Jersey	25-30	225-260	13-15	360-425	22-24	0.50	425-500



## Questions:

- What is the role of colostrum in cattle rearing?
- How does the composition of the colostrum change after calving?
- How does the bovine stomach change from birth to maturity?



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# ANIMAL BREEDING

című digitális tananyag

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**BEFEKTETÉS A JÖVŐBE**



# CHAPTER 10

## CATTLE BREEDING AND REPRODUCTION

**SZÉCHENYI** 2020



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és Beruházási Alapok



**BEFEKTETÉS A JÖVŐBE**

► Cattle are **polygynous** animals, which has resulted in significant **sexual dimorphism**. The bull is larger and stronger, particularly in the neck, shoulder and size of horns, which contribute to his ability to fight for access to females.

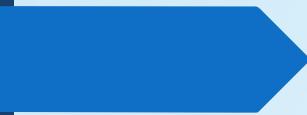




► In cattle production, good **reproductive performance** is essential to efficient management and production as a whole, although specific reproductive targets may depend to an extent on local conditions and on individual farm systems and targets.



- ▶ The main purpose of breeding is to maximize milk yield, although **milk composition** and other factors are becoming increasingly important. In the developed countries breeding is an advanced science, particularly where **artificial insemination** (AI) is practised, so that only the highest quality **sires** are used
- ▶ [https://www.youtube.com/watch?v=D\\_0gFijXnCo](https://www.youtube.com/watch?v=D_0gFijXnCo)
- ▶ <https://www.youtube.com/watch?v=stvnGYcz60>



In intensive systems on many beef farms and certain dairy farms, a **seasonal calving** pattern is adopted as a matter of choice. There are three main possibilities:

- ▶ Spring calving.
  - ▶ This system mimics the natural situation by planning for calving when there is plenty of good quality fodder available relatively cheaply to provide milk for suckling beef calves, or for sale from the dairy herd.



## ► Autumn calving.

- Cows in early lactation are fed on more expensive **conserved forages**, with a tendency to greater reliance on concentrate supplementation. If the forage is of known quality this can aid feed management.

## ► Summer calving.

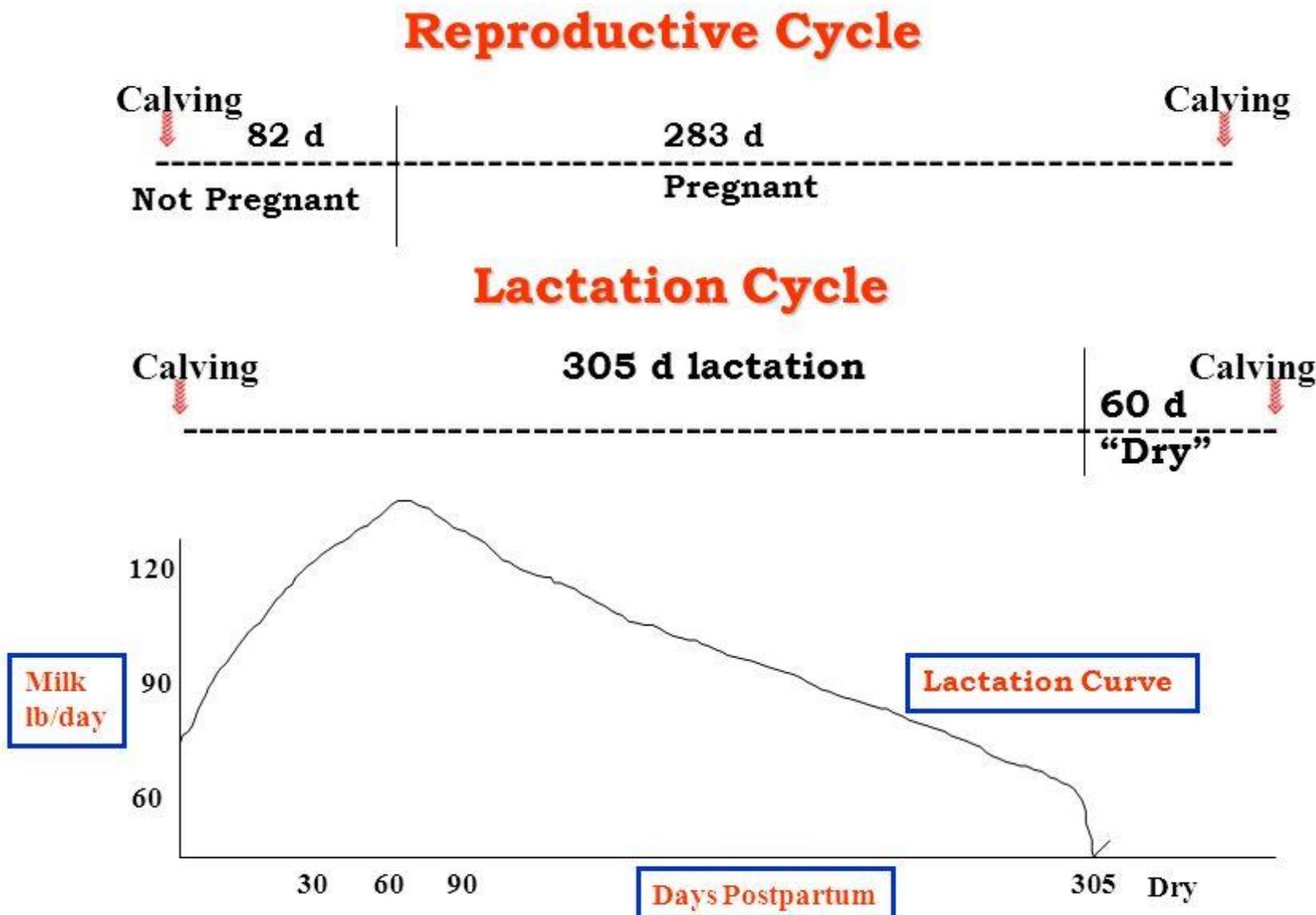
- This system is more difficult to manage, not least because late summer forage tends to be of relatively low and very variable quality.

# Components of the calving interval

## **The gestation period.**

This is normally between 280 and 285 days in the cow, the variation being mainly due to genetic influences of both the dam and the sire.

# Sequence of Major Events : Dairy Cattle



# Components of the calving interval

## **The calving to conception interval.**

This is the time from parturition until the establishment of the next pregnancy.

It is this interval that is the main determinant of the calving interval, and is thus the parameter that is usually manipulated in order to try to achieve the target calving interval.

## Factors affecting the calving to conception interval

- ▶ In order to achieve a 365-day calving interval the calving to conception interval should not be more than 80–85 days.
- ▶ For the purpose of recording reproductive performance on the farm the calving to conception interval is often subdivided into two components: the calving to first service interval and the first service to conception interval



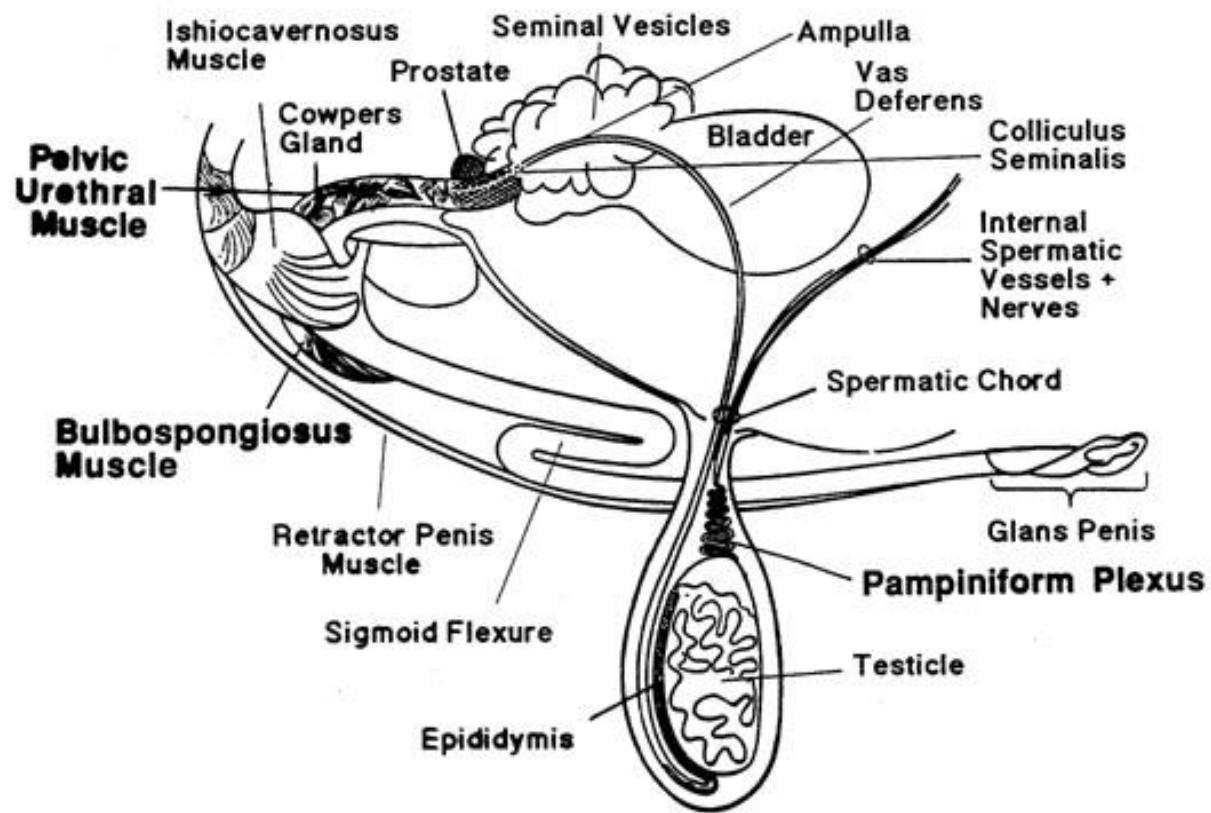
## Factors affecting the calving to conception interval

- ▶ The calving to first service interval depends on the re-establishment of **ovarian cycles** after calving, the occurrence and detection of oestrus and the herdsperson's planned start of services date.

## Factors affecting the calving to conception interval

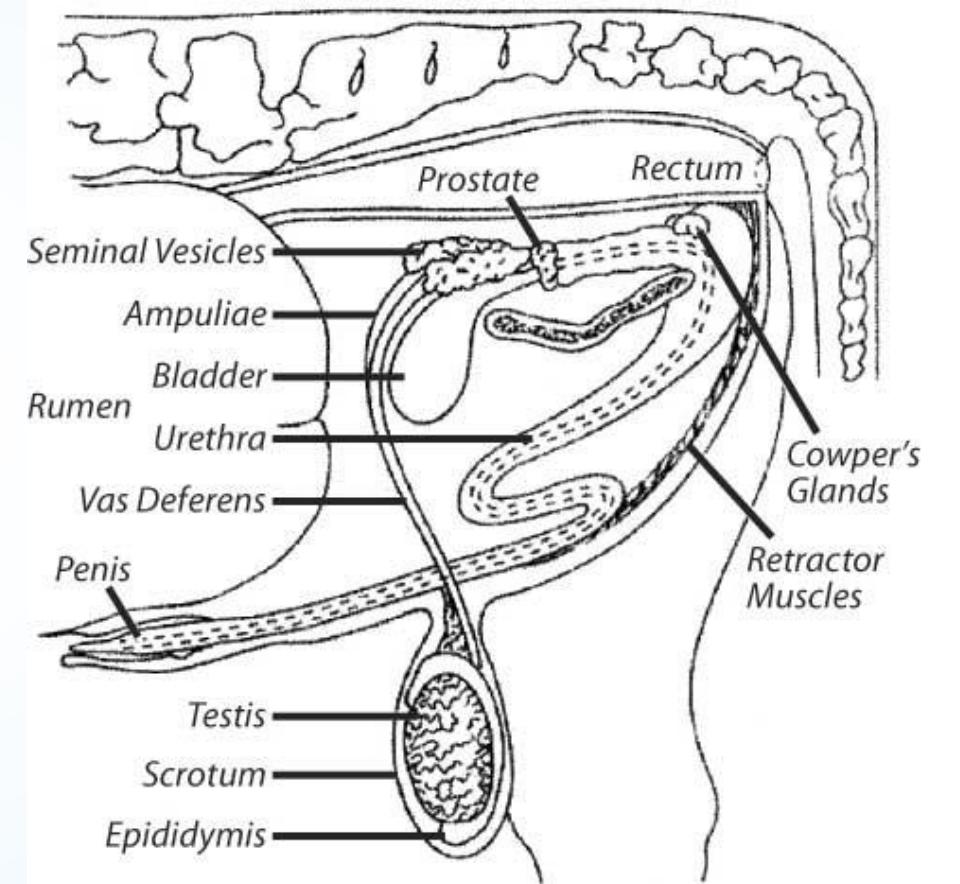
- The first service to conception interval is dependent on the ability to conceive and maintain pregnancy after a given service and the continuation of ovarian cycles and the correct detection of oestrus in those cows that do not conceive to initial services.

# The bull reproductive tract



The Bull Reproductive Tract

[http://www.ansci.wisc.edu/jjp1/ansci\\_repro/lec/lec3\\_male\\_anat/lec3diag.html](http://www.ansci.wisc.edu/jjp1/ansci_repro/lec/lec3_male_anat/lec3diag.html)



[http://www.brahman.com.au/technical\\_information/selection/reproductiveSoundness.html](http://www.brahman.com.au/technical_information/selection/reproductiveSoundness.html)

# Semen quality

A number of parameters are used to assess the quality of **semen**.

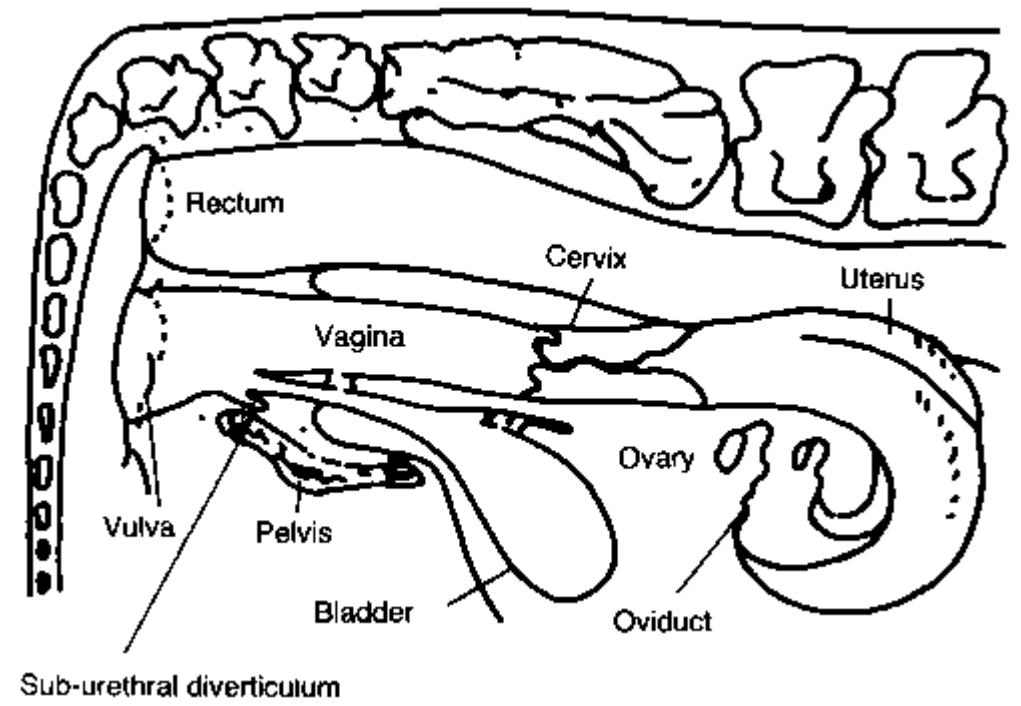
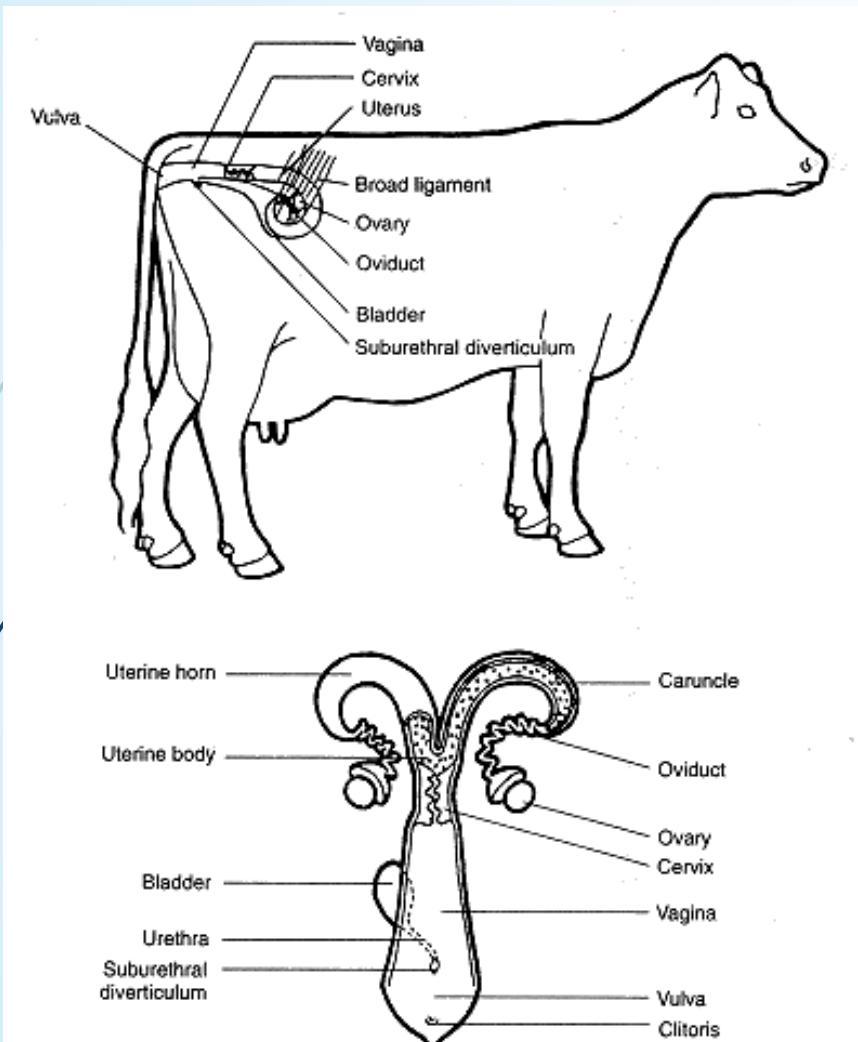
They include volume, sperm concentration, sperm motility, proportion of live sperm, proportion of abnormal sperm and a number of biochemical measurements and functional tests.

**Volume of semen** may be important in relation to the number of semen doses that can be prepared from a single ejaculate.

**Density of spermatozoa** is also of obvious importance in determining the number of semen doses and/or fertilizing capacity of the semen.

The exhibition of **progressive motility** is important since it gives an approximate assessment of the viability of the semen.

# The cattle reproductive tract



<http://www.fao.org/wairdocs/ilri/x5442e/x5442e04.htm>

# Puberty in heifers

Puberty may be defined as the time at which oestrus first occurs, being accompanied by ovulation. The age of onset of puberty is clearly important since this could possibly prevent an animal's availability for breeding at the desired time.

Timing of puberty is highly variable and, as with bulls, is dependent on a number of genetic and environmental factors:

- ▶ Breed
- ▶ Nutrition, body weight and live weight gain
- ▶ Season
- ▶ Endocrine changes in pre-pubertal heifers

# Breed

## Age and weight of various breeds of heifers at puberty

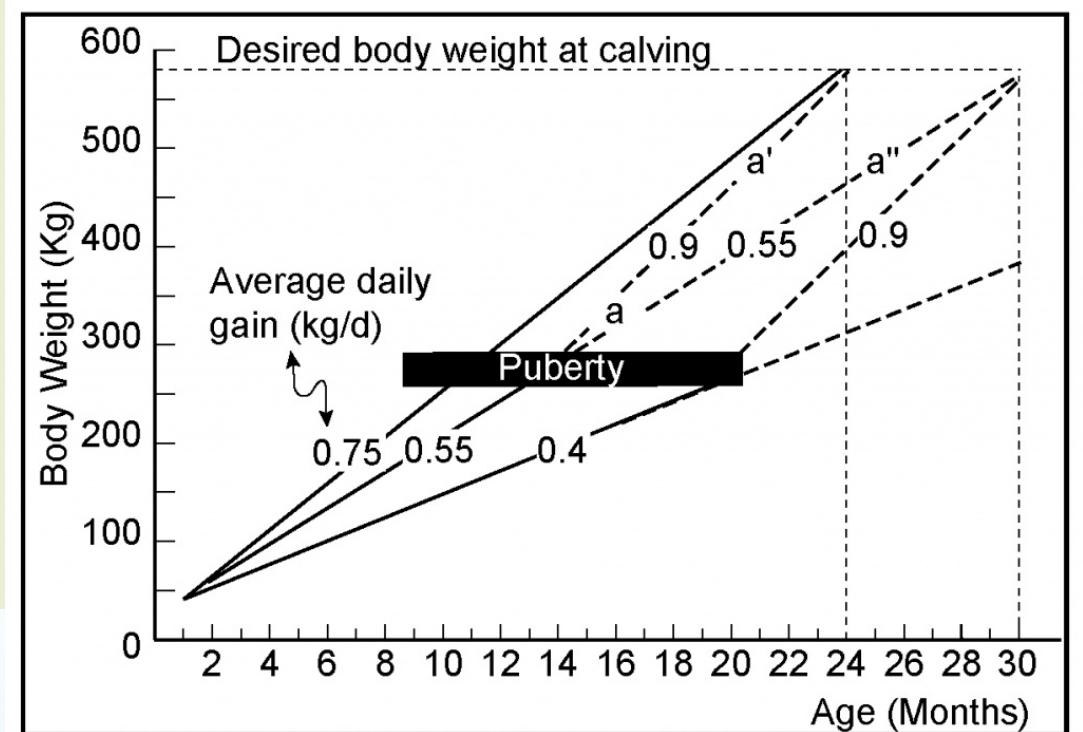
<i>Breed</i>	<i>Age at puberty (days)</i>	<i>Weight at puberty (kg)</i>
Angus	410	309
Hereford	429	302
Red Poll	355	270
Brown Swiss	317	305
Charolais	388	355
Simmental	348	328

# Nurition, body weight and live-weight gain

The nutritional status and the rate of liveweight gain are important determinants of the time of onset of puberty.

Under adequate conditions of nutritional management the onset of puberty in heifers is unlikely to be a limiting factor in the achievement of calving at two years of age.

Heifer growth rates before and after puberty



## **Fertilization and conception**

In order to achieve good reproductive efficiency it is necessary to maximize the chances of successful pregnancy at a given service or insemination.

Therefore it is important to maximize both the fertilization rate and the conception rate and, furthermore, to be able to detect non-pregnant cows as early as possible so that appropriate action can be taken.

# Parturition

Parturition may be defined as the process of giving birth.

This involves the preparation for and action of expulsion of the mature fetus from the security of the intrauterine environment into the harsher outside world.

The process of reproduction in the cow is only successfully completed when a healthy neonatal calf is standing at its mother's side.

Stillbirths and neonatal mortality may occur in up to 5% of calves.

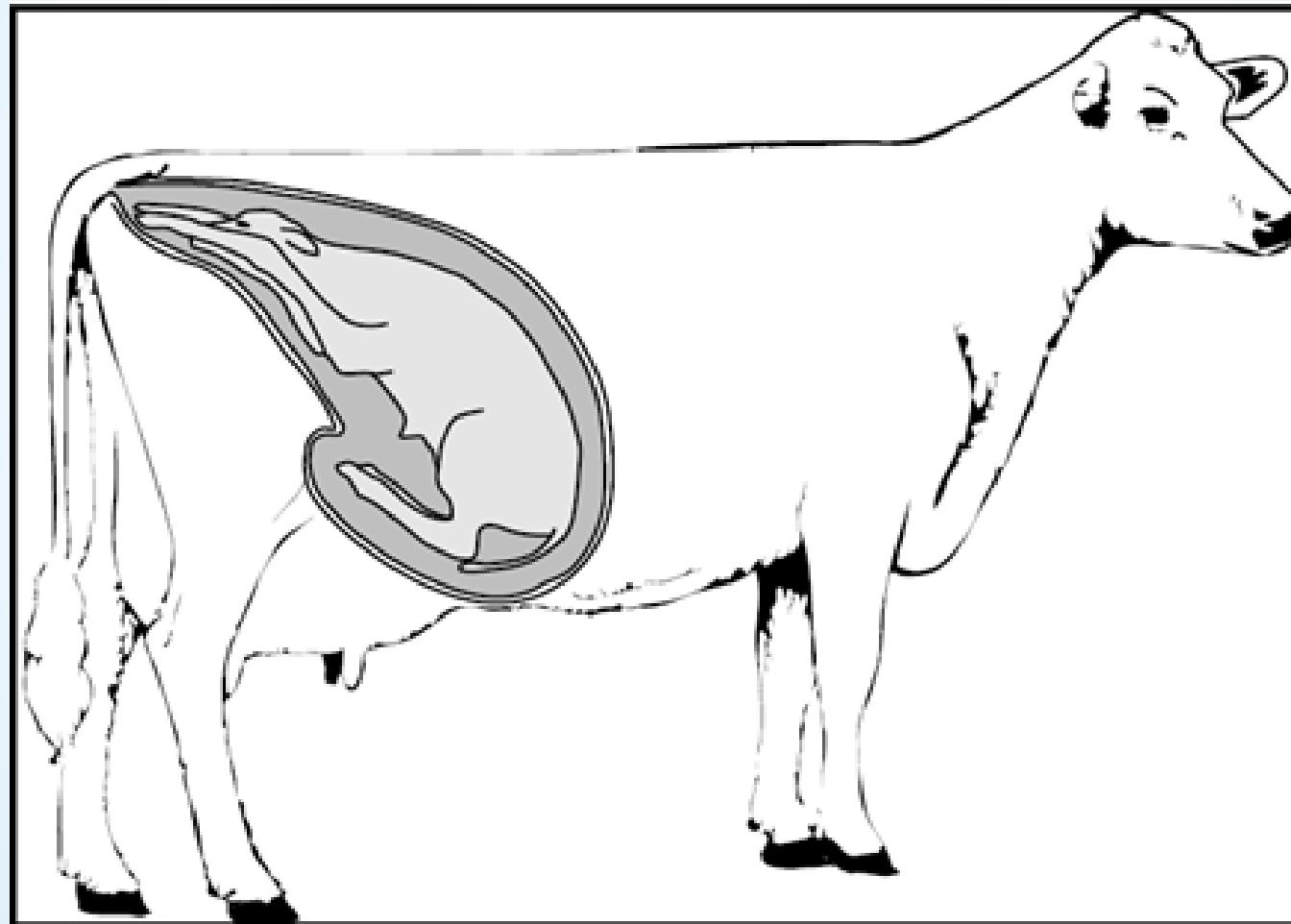
Therefore it is important that the complex process of parturition is understood in order that potential hazards may be predicted and possibly avoided.

# Parturition stages

Parturition or birth is classically considered to occur in three stages of labour:

- ▶ First stage – the preparatory stage, during which time the pelvic ligaments slacken and the cervix dilates.
- ▶ Second stage – expulsion of the fetus through the pelvic canal.
- ▶ Third stage – expulsion of the fetal membranes and initial involution of the uterus.

## Fetal position before calving



## The Postpartum Period

Parturition is followed by a period of ovarian inactivity and sexual quiescence before reproductive cycles recommence.

*This is a possible natural mechanism for reducing the chance of reconnection before the recently born calf has been weaned.*

The length of this interval is variable and can be affected by such factors as **milk yield, suckling, nutritional status, inheritance and season.**



## Factors affecting the postpartum acyclic period

### **Suckling:**

The onset of ovulation and/or oestrous behaviour can be delayed longer in both dairy and beef-type cows that suckle calves than in milked animals.



## Factors affecting the postpartum acyclic period

### **Milk yield:**

Increasing yields have been reflected in reduced fertility, and longer acyclic periods have been observed in cows selected for high milk yield relative to control animals, but it is difficult to separate the effects of milk yield from other confounding factors, particularly that of nutritional status.



## Factors affecting the postpartum acyclic period

### **Nutrition, body weight and body condition:**

The interaction between nutrition and overall fertility performance is very complex, and many experiments have produced conflicting results.



## Factors affecting the postpartum acyclic period

### **Nutrition, body weight and body condition:**

Low energy intake in pre- and postpartum cows increases the length of the anoestrous period and in heifers has been shown to result in fewer ovarian follicles, lower progesterone levels and lower conception rates.

The use of body condition scoring techniques has played an important role in the monitoring of nutritional status in cattle

# Induction of ovulation in postpartum cows

The availability of hormonal therapy that would overcome acyclicity or true anoestrus, irrespective of primary cause, would be of great advantage, particularly in beef cattle where husbandry and nutrition are often only marginally adequate.

Detailed knowledge of the pattern of hormone release is essential in order to understand the mechanisms controlling ovulation and ovarian cycles so that appropriate treatments can be designed.

# Oestrous behaviour and its detection

The oestrous period in a cow is that time during which she will stand to be mounted by a bull or another cow.

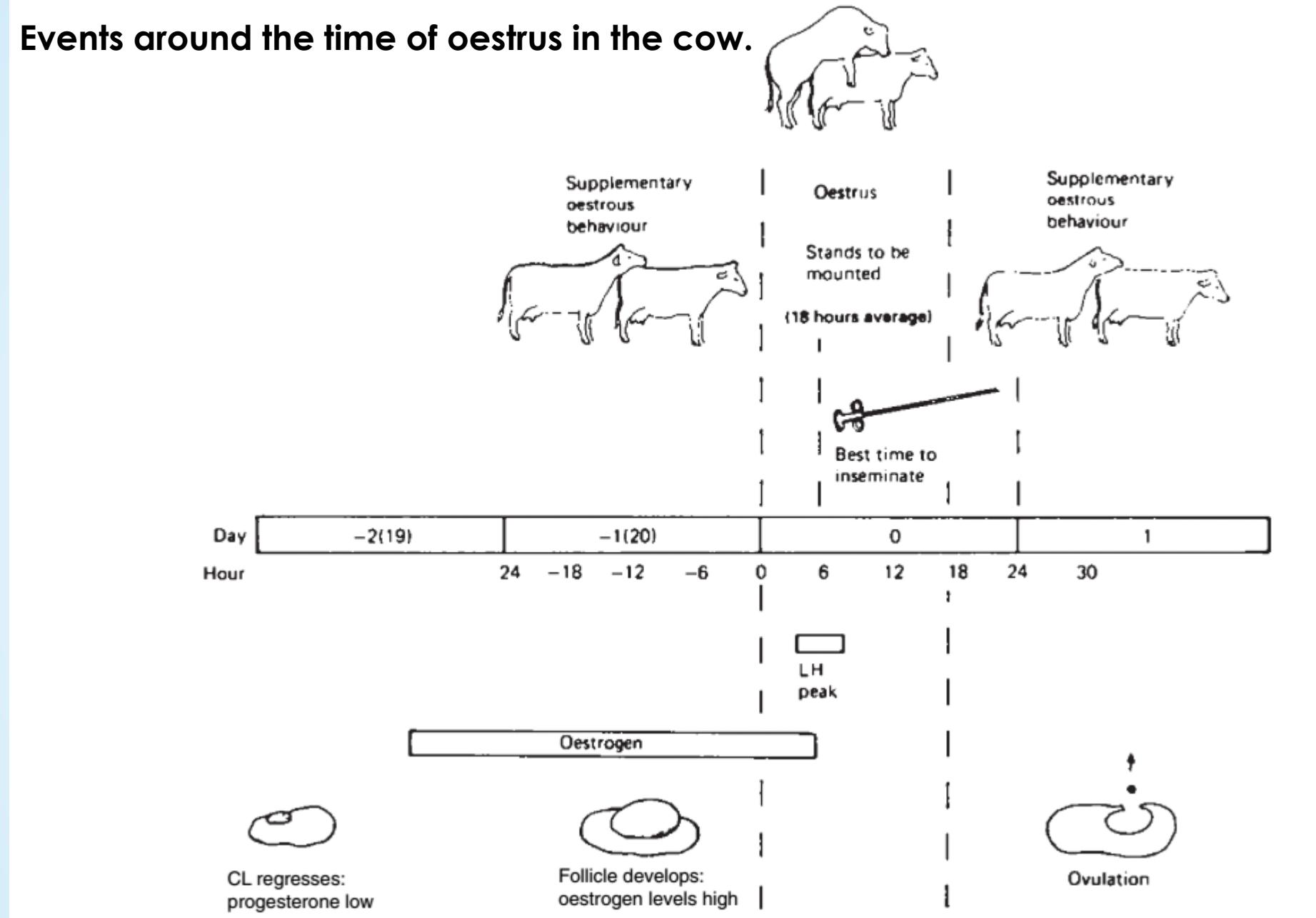
Changes in the levels of circulating hormones, particularly oestradiol from the developing follicle, induce the behavioural changes associated with oestrus. These changes may begin one or two days before standing oestrus.

The cow will become more likely to mount other cows that are in oestrus, and other cows in the herd will begin to take an interest in her – sniffing her and resting their chins on her back, for example. Standing oestrus normally persists for several hours.

There also seems to be a tendency for a higher proportion of oestrous activity to occur at night.

The main period of oestrous activity precedes ovulation by approximately 12–15 hours.

## Events around the time of oestrus in the cow.



## When to Service a Cow in Heat

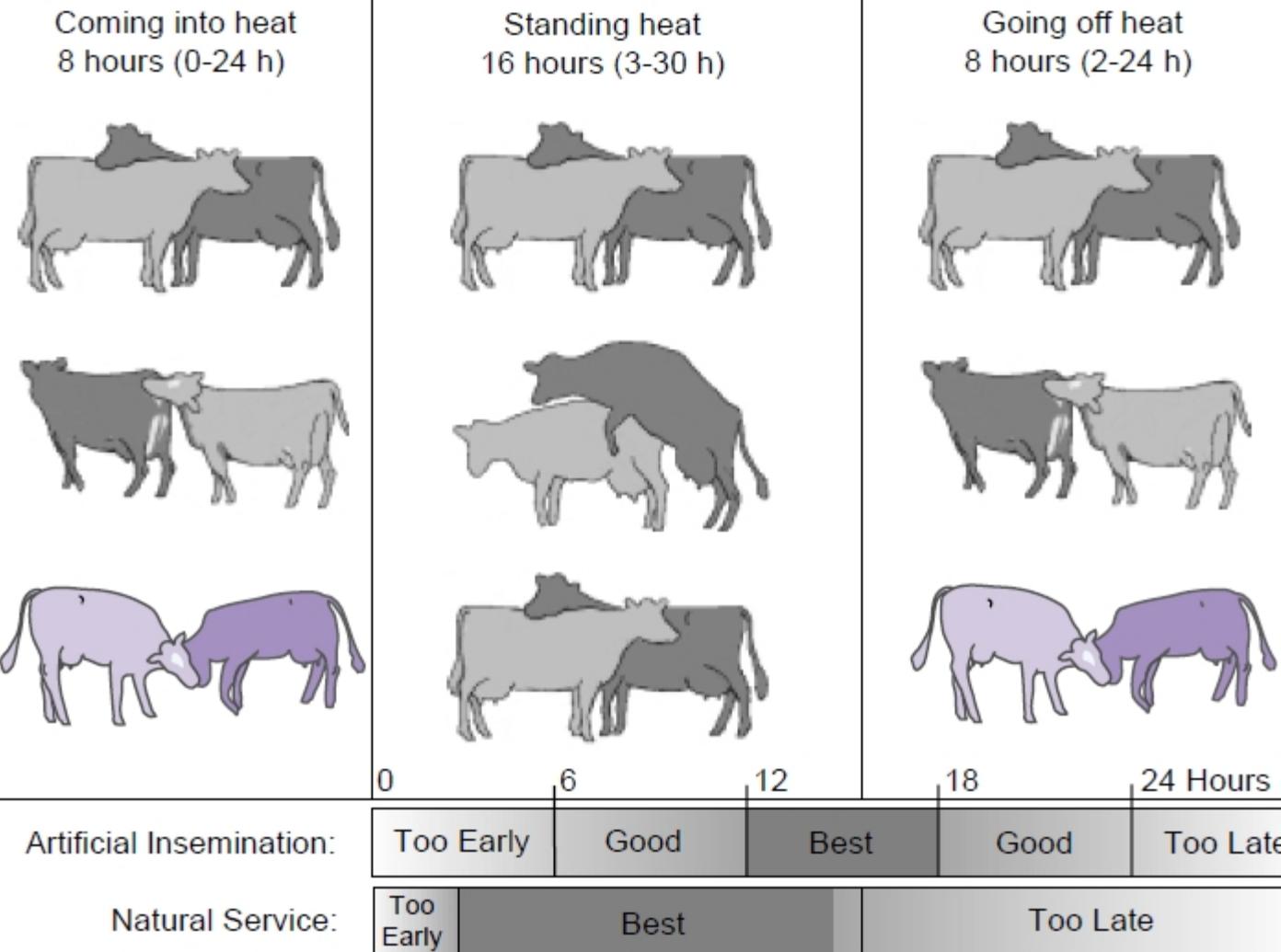
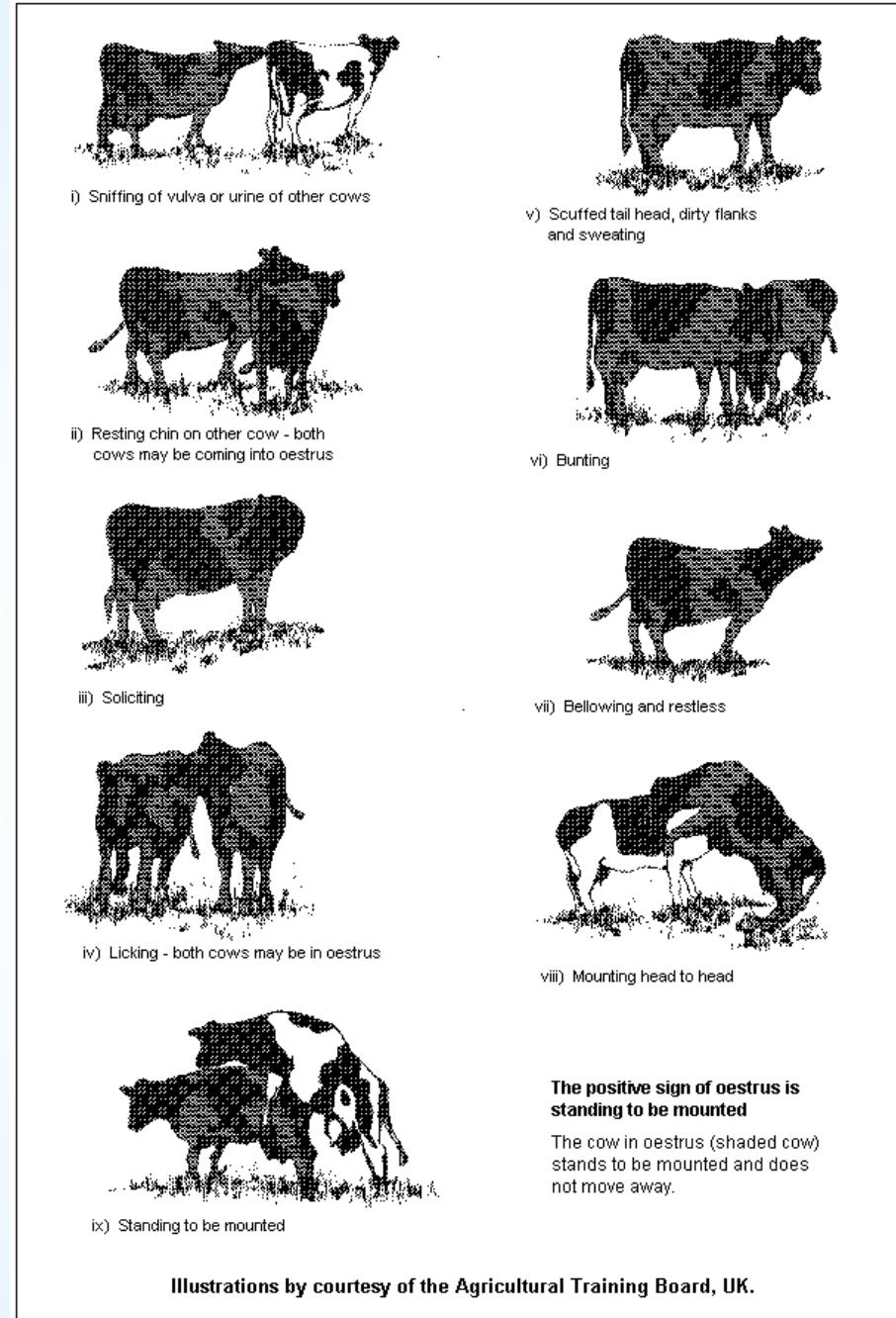


Figure 3: Timing of insemination or natural service for cows in heat

# Behavioural signs of oestrus in the cow

- ▶ Standing to be mounted
- ▶ 'Soliciting' another cow to mount
- ▶ Mounted, but trying to escape
- ▶ Aggression
- ▶ Chin resting
- ▶ Vulval sniffing
- ▶ Flehman lip curl
- ▶ Ruffled hair



## Timeline for Heat Signs in Cattle

	Coming into Heat (8 hours)	Standing Heat (18 hours)	Going out of Heat (14+ hours)
Heat Signs	<ul style="list-style-type: none"> <li>• Stands and bellows</li> <li>• Smells other cows</li> <li>• Headbutts other cows</li> <li>• Attempts to ride other cows but will not stand to be mounted</li> <li>• Red, moist, slightly swollen vulva</li> <li>• Clear mucous discharge from vulva</li> </ul>	<ul style="list-style-type: none"> <li>• Stands to be mounted</li> <li>• Rides other cows</li> <li>• Bellows frequently</li> <li>• Nervous and excitable</li> </ul>	<ul style="list-style-type: none"> <li>• Attempts to ride other cows but will not stand to be mounted</li> <li>• Smells other cows</li> <li>• Clear mucous discharge from vulva</li> </ul>

# Heat signs and detection methods

Several methods of heat detection can be implemented. Some involve using heat detection aids.

Several different methods can be combined to improve heat detection rates and accuracy.

These include visual observation, heat mount detectors, tailhead markers (paint, chalk, crayon, paste), chin-ball markers, detector animals, and electronic heat detection devices.

## Heat-Detection Aids



ESTROTECT after single mounting

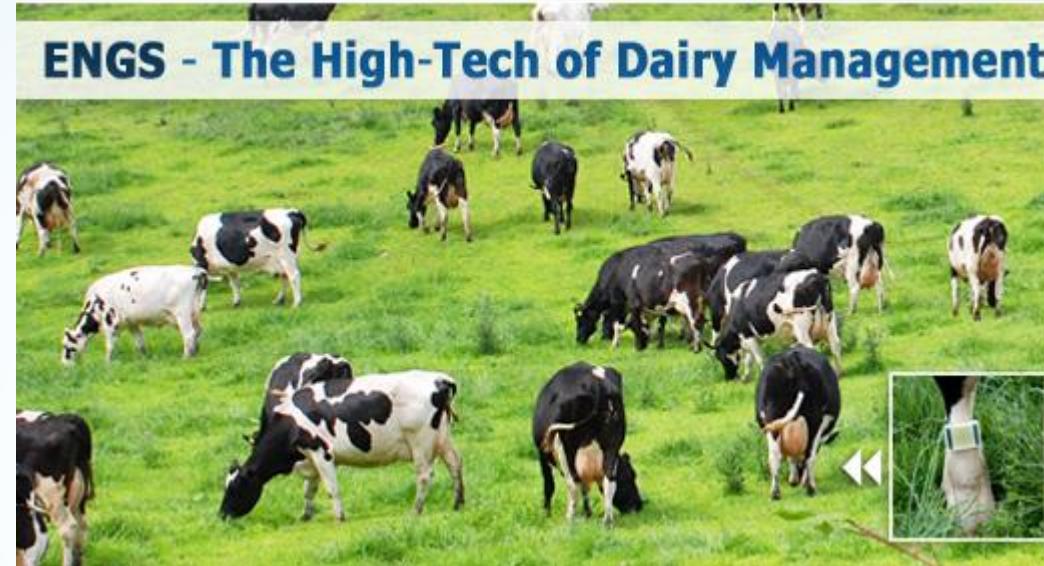


ESTROTECT after 3-5 mountings



ESTROTECT after more than 5 mountings

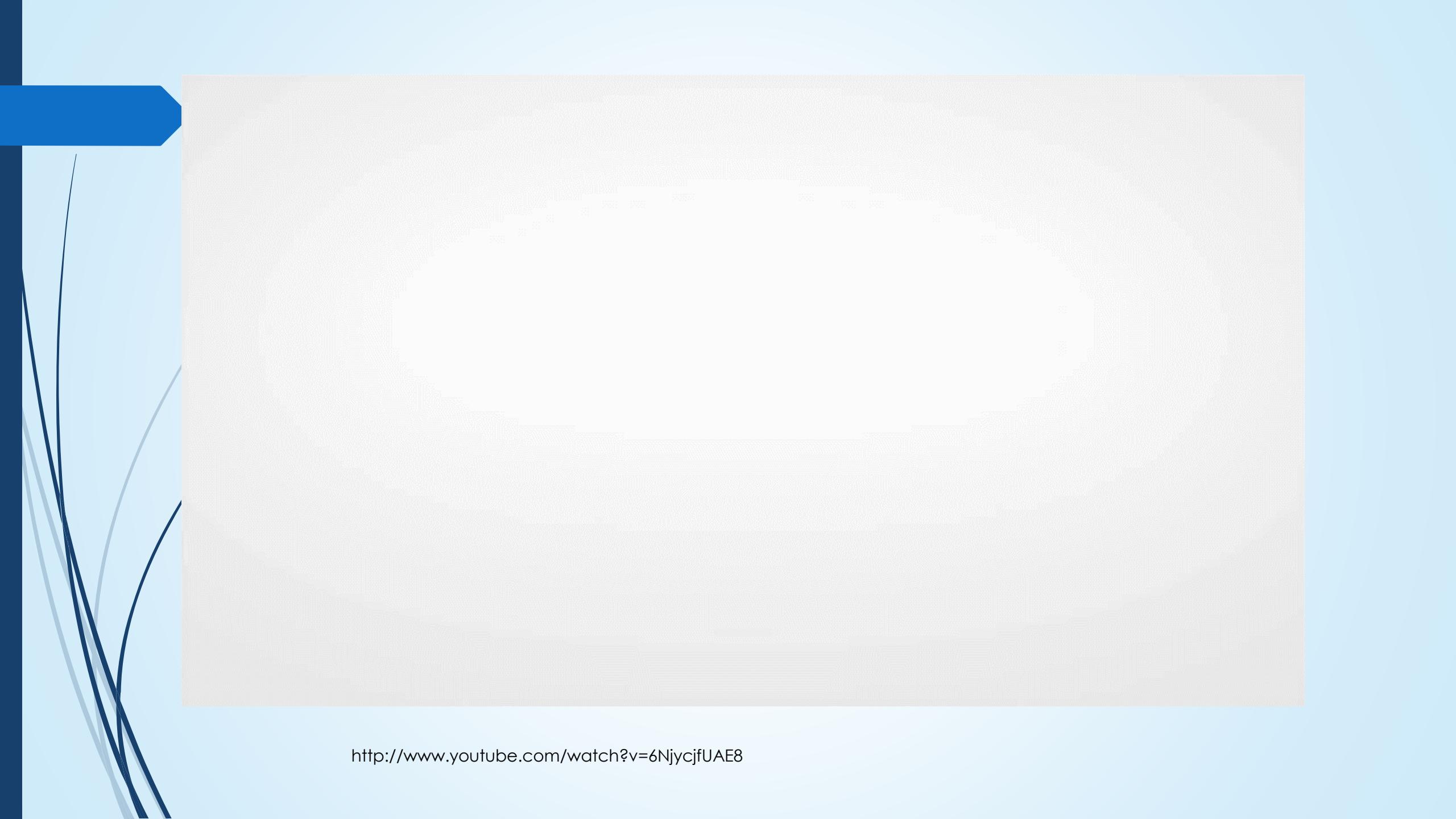
## Pedometer



[http://www.engs-dairy.com/heat\\_detection.asp](http://www.engs-dairy.com/heat_detection.asp)



<http://www.wnif.co.uk/articles/764/1/Fullwood-New-pedometers-give-unrivalled-cow-activity-monitoring/Page1.html>



<http://www.youtube.com/watch?v=6NjycjfUAE8>

# Heat detection



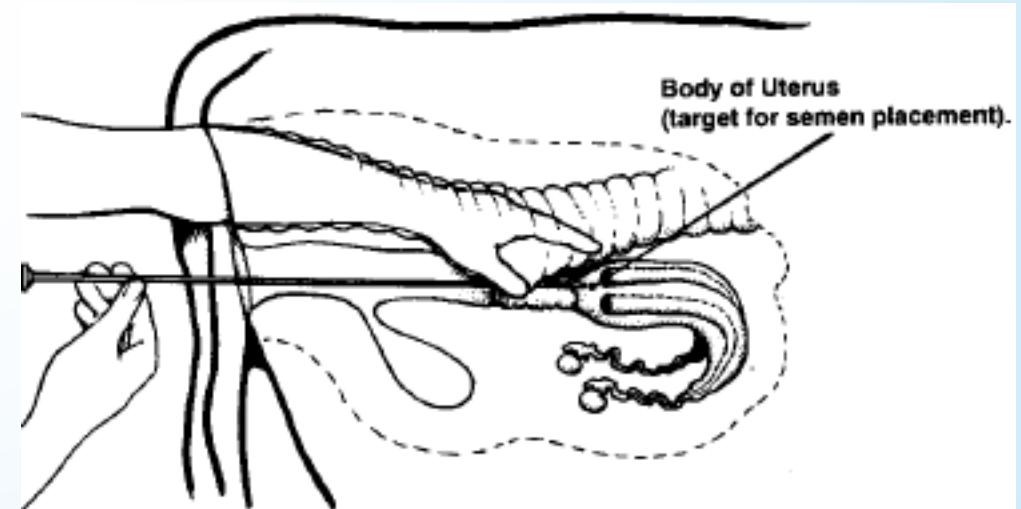
<http://www.youtube.com/watch?v=ec1a131soCk>

# Artificial Insemination

Artificial insemination (AI) has many advantages to offer the dairy farmer, but problems of oestrus detection limit the value of AI in beef herds.

Some of the most important advantages of AI, as opposed to natural service:

- ▶ genetic gain
- ▶ cost effectiveness
- ▶ disease control
- ▶ safety
- ▶ flexibility
- ▶ fertility management

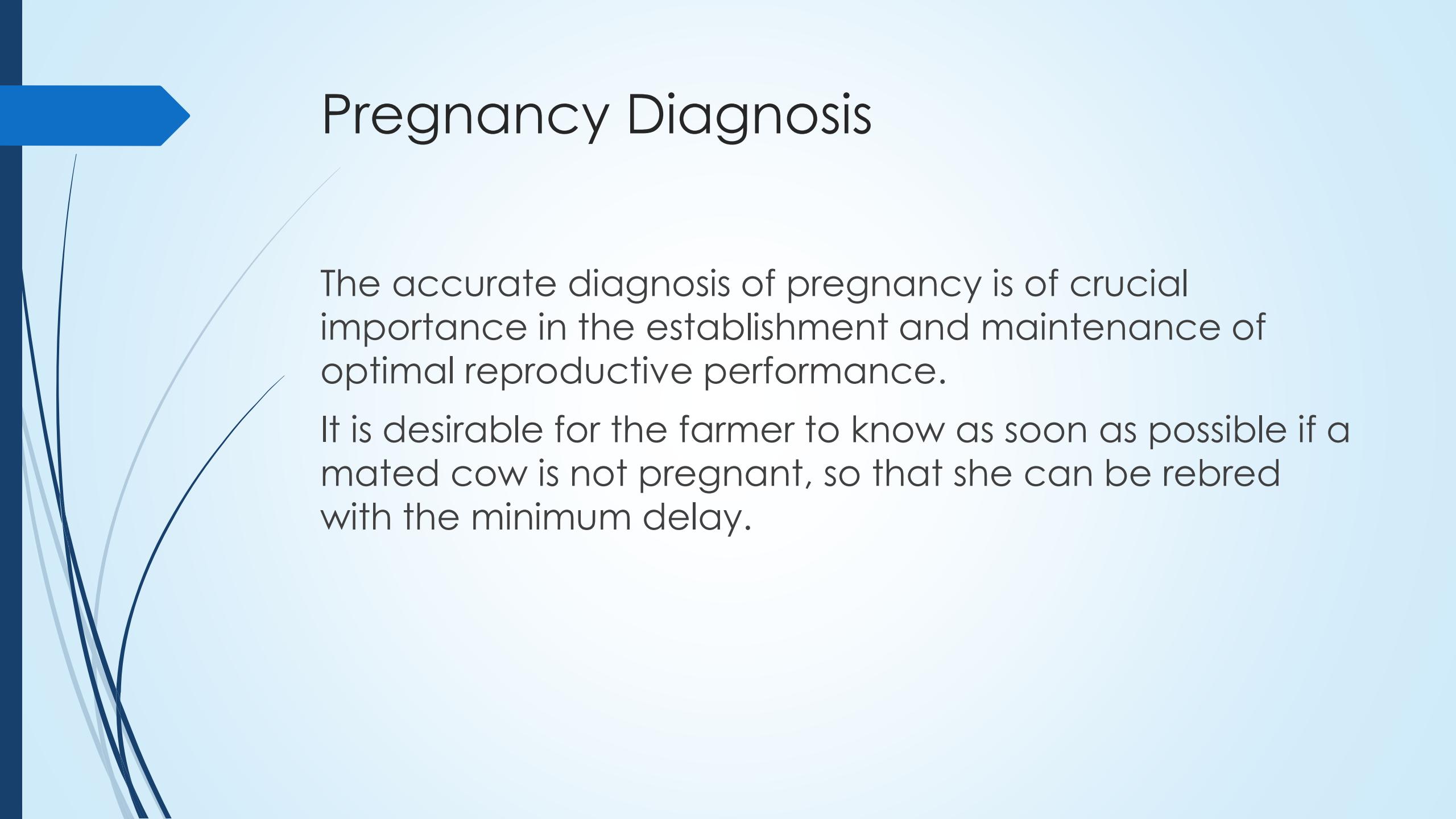


<http://www.thebeefsite.com/articles/721/artificial-insemination-for-beef-cattle>



<http://www.youtube.com/watch?v=2ygWu0rUs8I>

# Pregnancy Diagnosis



The accurate diagnosis of pregnancy is of crucial importance in the establishment and maintenance of optimal reproductive performance.

It is desirable for the farmer to know as soon as possible if a mated cow is not pregnant, so that she can be rebred with the minimum delay.

# Methods of pregnancy diagnosis

## **Non-return to service**

Traditionally, a cow was diagnosed as non-pregnant if she was seen in oestrus (and, as a rule, re-inseminated) approximately 21 days after service.

The percentage of cows not seen in oestrus at about this time is known as the nonreturn rate and is an established method of estimating pregnancy rates. It is usually the first method (in terms of time after service) used by the stockperson to discriminate between non-pregnant and pregnant cows.

# Methods of pregnancy diagnosis

## Progesterone measurement

The detection of pregnancy by measurement of hormones, particularly if they occur in milk, has an advantage over rectal palpation in that interference with the cow is minimal and there is a negligible risk to the pregnancy.

The measurement of progesterone to check for pregnancy also offers the possibility of diagnosis at day 21 or even earlier.

# Methods of pregnancy diagnosis

## Pregnancy-specific proteins

Early pregnancy factor (EPF) is a pregnancy-dependent protein complex that has been detected in the serum of several species.

It is detected using an immunological technique, the rosette inhibition test.

It is claimed that this substance appears in serum shortly after conception and disappears very rapidly following embryonic death. Therefore the detection of

EPF would offer a very valuable method of pregnancy diagnosis.

# Methods of pregnancy diagnosis

## **Real-time ultrasound scanning**

The availability of real-time b-mode ultrasound scanning has been a major advance in pregnancy diagnosis and reproductive monitoring in a number of species including man, sheep, dogs, horses and cattle.

It has the advantage that it is non-invasive apart from the requirement in the large farm species for insertion of a rectal transducer, and thus it is a very safe procedure.

Pregnancy can be detected as early as 17 days using this method.

# Methods of pregnancy diagnosis

## **Rectal palpation of the fetus**

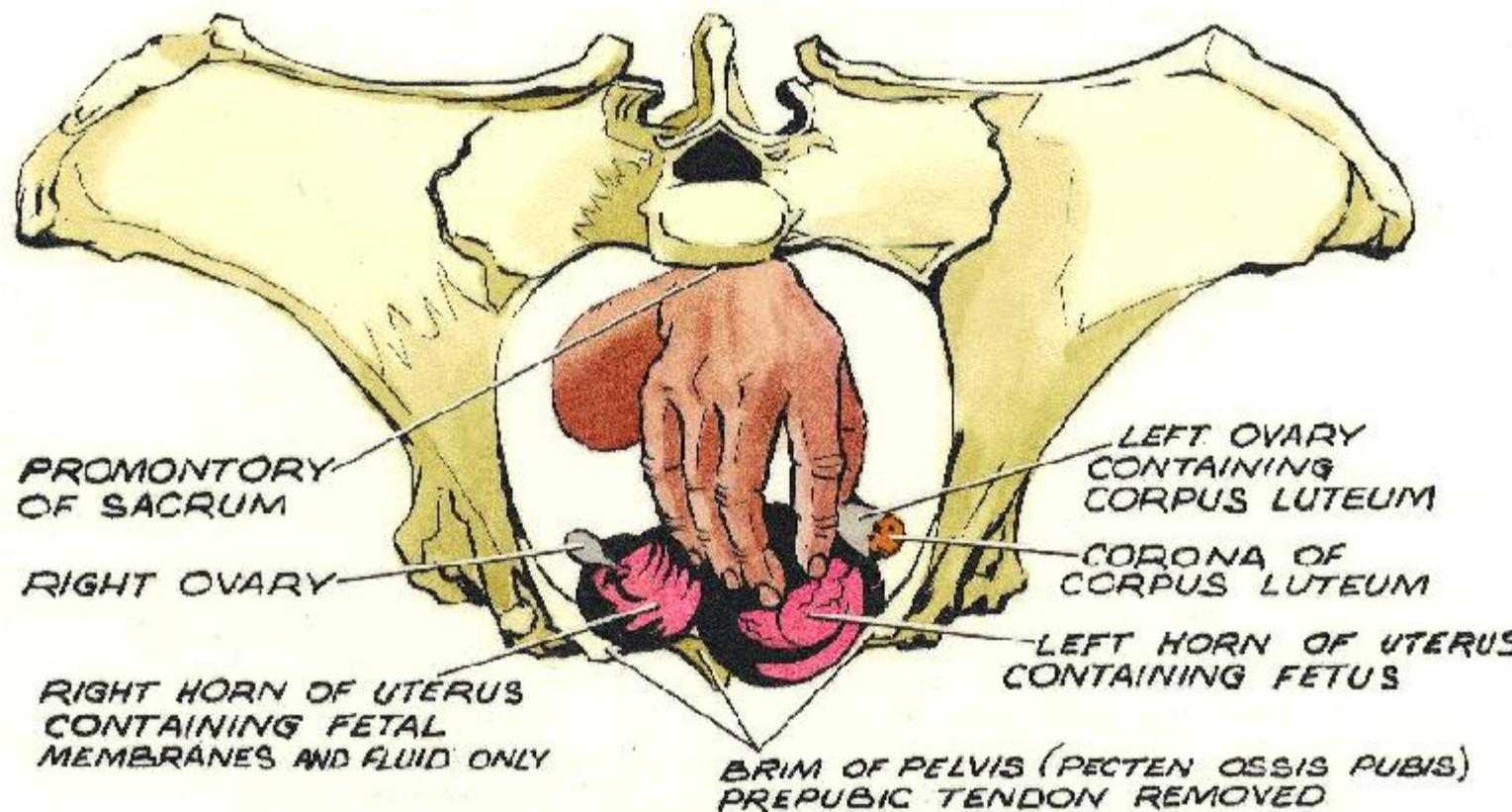
This technique relies on the ability to feel the presence of a fetus swelling in one of the uterine horns by inserting an arm into the rectum of the cow.

In the nonpregnant and early pregnant animal the uterine horns can be felt to be approximately equal in size and diameter.

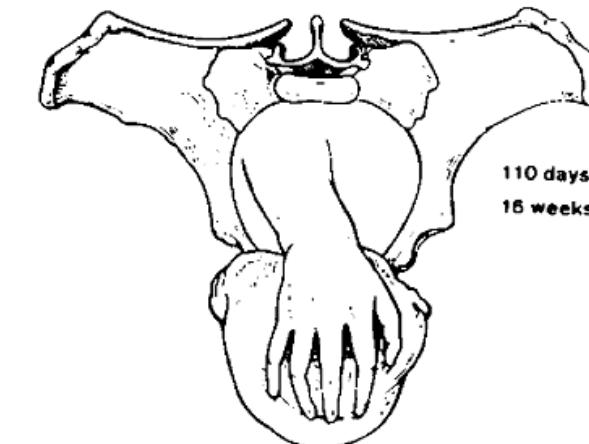
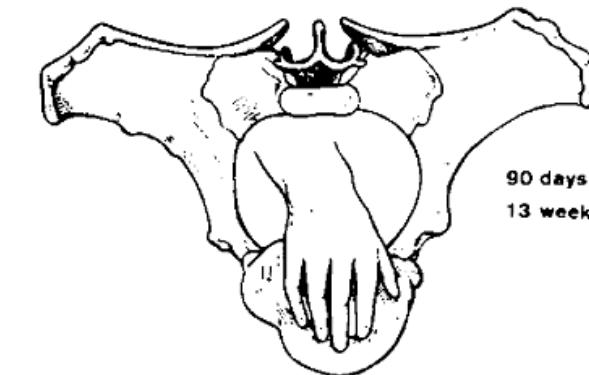
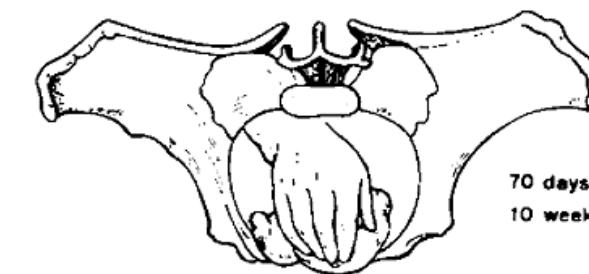
It is possible to detect a difference in the size of the two horns from about day 40 of pregnancy onwards.

This is easier in heifers than in multiparous cows and is to a large extent dependent on the skill of the operator.

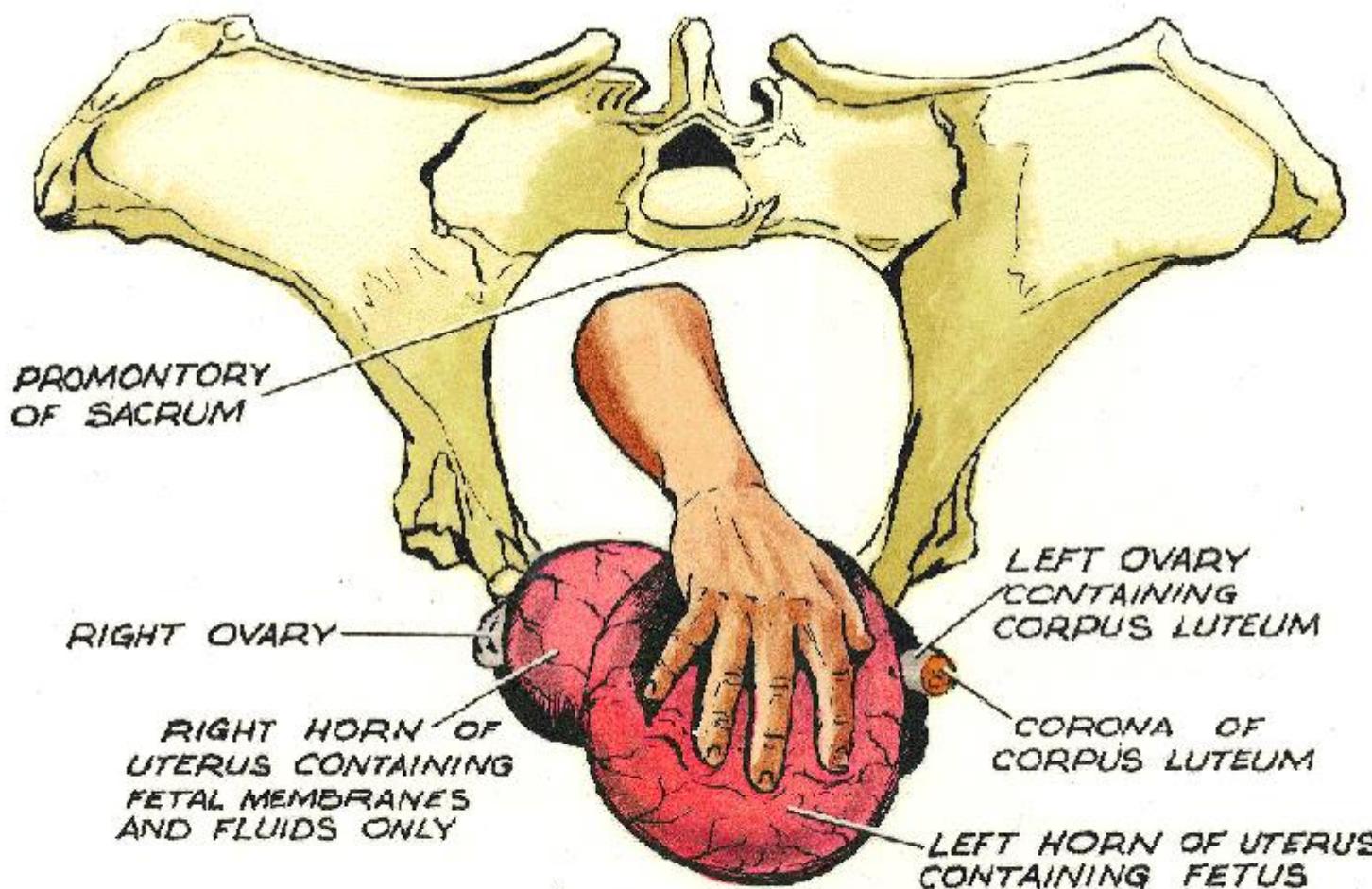
## Detection of pregnancy by rectal palpation.



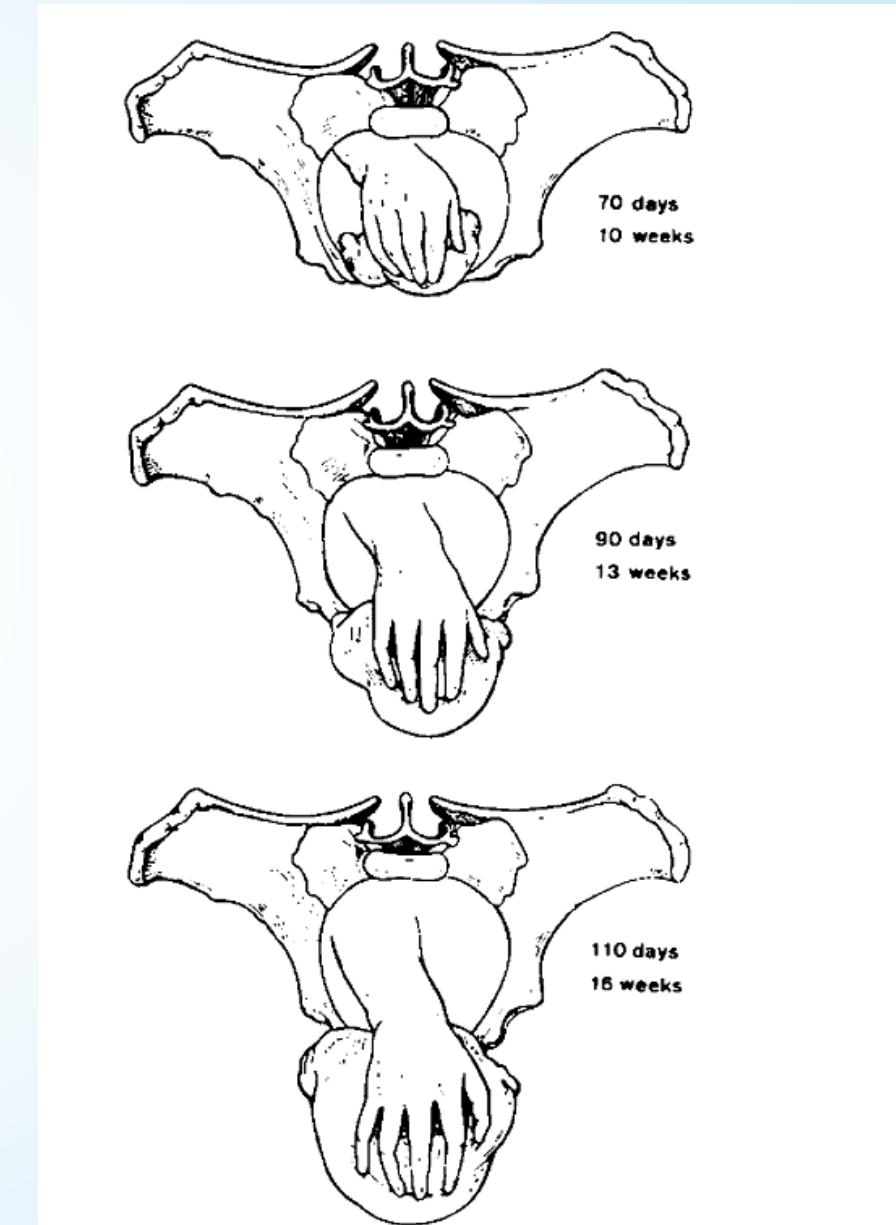
**RECTAL EXAMINATION OF PREGNANT COW.  
GRAVID UTERUS - 70 DAYS.**



## Detection of pregnancy by rectal palpation.



**RECTAL EXAMINATION OF PREGNANT COW.  
GRAVID UTERUS-110 DAYS.**





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- ▶ <http://www.thebeefsite.com/articles/2362/estrus-detection-in-cattle>
- ▶ Peter J. H. Ball, Andy R. Peters (2004): Reproduction in Cattle, Wiley-Blackwell



# Questions

- ▶ What does the reproductive tract of bulls consist of?
- ▶ What does the reproductive tract of cattle consist of?
- ▶ What age (days) and weight (kg) are the heifers of various breeds at puberty?
- ▶ What are the behavioural signs of oestrus in cows?



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# ANIMAL BREEDING

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# CHAPTER 11

## HANDLING OF CATTLE

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Cattle handling skills are essential for managing cattle.

Good cattle handlers learn these skills through observation and trial and error.

Good cattle handling saves time and effort, and reduces stress for people and animals. Inefficient and rough handling causes financial losses because of bruising, poorer meat quality and lower milk production.

# THE COMPONENTS OF GOOD CATTLE HANDLING



- Cattle are social animals.
- Cattle are easier to work in groups.
- Aggressive cows should be culled.
- Gentle handling of calves will improve their temperament as adults.
- Breed is only one factor influencing temperament.
- Cattle remember bad experiences.
- Bulls, and cows with newborn calves, may be dangerous.
- Make sure the cattle know you are the boss.

## BEHAVIOUR AND TEMPERAMENT

### **The social structure**

Cattle are social animals used to living in herds.

They are easier to move in groups. They do not like to be isolated. Cattle may become stressed and dangerous when they are separated from the herd.

Cattle should always be able to see another member of the herd. They will follow a leader through yards, even in single file, without being stressed, as long as they can see the beast in front. Individuals that break away will usually rejoin the herd, given time and space.

Cattle live in social hierarchy with dominant and subordinate animals.

## BEHAVIOURAL CHARACTERISTICS OF CATTLE

Cattle remain immobile when first threatened. Their first reaction is to stand and assess the situation. If frightened, their natural instinct is to escape.

Cattle try to maintain other animals within their vision. They have a field of view of 330° and have the ability to see threats from almost all directions.

Social order in the mob is usually established at about 2 years of age and maintained by threats and butting. When mobs are mixed, social order has to be re-established so aggression occurs until a new order is established. This may hinder movement of stock.

## BEHAVIOURAL CHARACTERISTICS OF CATTLE

Within a mob of cattle, there is an order of dominance. This can be seen in action at the water or feed trough where certain animals are always first to drink or eat. Other animals tend to stand back until the dominant animals have finished.

Dominance may also be seen when cattle are on the move. The same animals will usually lead the mob. They will also be the first to enter gateways. Dominance and the need to maintain hierarchy in a group of cattle becomes a problem when the animals are in confined spaces such as holding yards. This can be a cause of significant stress within a mob. Crowding of cattle will also increase aggression as the animals try to maintain personal space.

## BEHAVIOURAL CHARACTERISTICS OF CATTLE

Social behaviour varies with age, breed, sex; Bos indicus and Bos indicus-cross animals are more sensitive/temperamental than British or European breeds.

Young bulls, when moved in groups, show a degree of playfulness (pushing and shoving), but bulls become more aggressive and territorial with age. Adult bulls have large personal space (6 metres or more). When adult bulls are crowded, fighting will occur at gateways or in yards.

Bulls are uncontrollable when fighting. They become highly aroused and will break away suddenly. Handlers have to be extremely careful to avoid injury.

Cows with young calves can be very protective, so handling them in the presence of their mothers can be dangerous.

Cattle, particularly Bos indicus breeds, do not like being singled out either in the paddock or in yards. They can become extremely agitated and aroused.

## PERCEPTION OF CATTLE

**Cattle do not see, hear or smell the world as people do.**

The eyes of cattle are located on the side of their head. This allows them to see through almost 360 degrees.

Cattle have binocular vision for a small angle (25 to 50 degrees) in front of them, where both eyes focus and perceive depth, distance and speed. However, they have monocular vision to the side, which only allows them to see movement.

Any sudden movement in this zone may frighten the animal. If it is confident, it will turn to identify the movement and move towards it for closer investigation, using its eyes, nose and ears.

Cattle have a blind zone to their rear. Its size depends on whether the head is up or down.

Cattle see some colour but not nearly as much as people. They tend to move from dimly lit to more brightly lit areas, but will avoid very bright lights. Indoors, diffused lighting is best and dull colours are usually recommended.

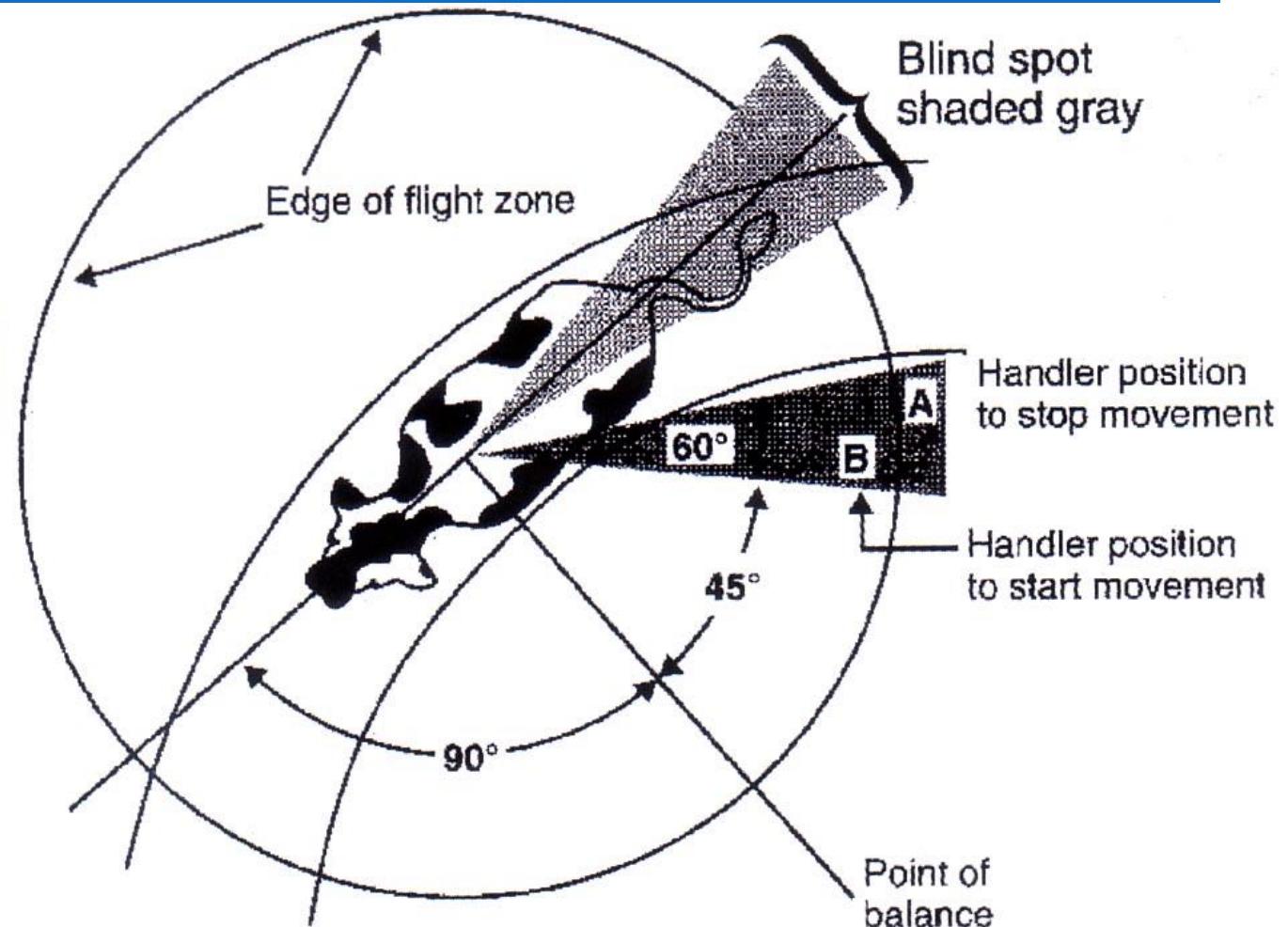
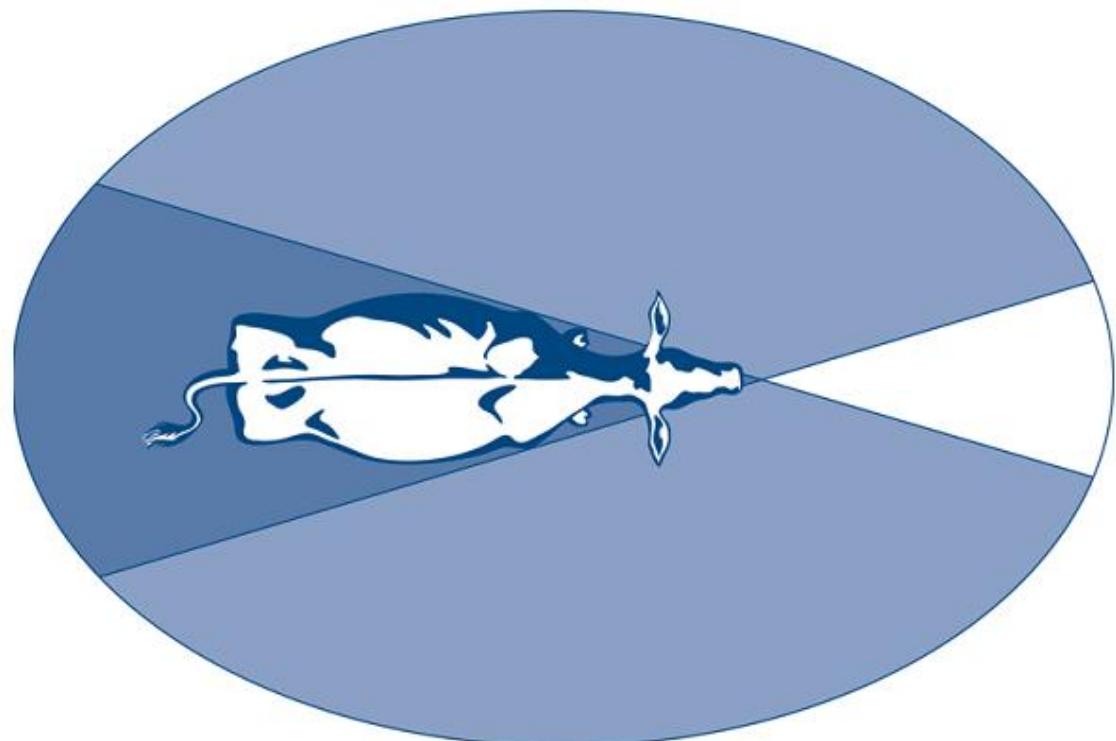


Diagram 1. Flight zone diagram.

## HEARING

Cattle is more sensitive than people to high frequency noises.

The auditory sensitivity of cattle is greatest at 8000 hz. The human ear is most sensitive at 1000 to 3000 hz.

Unexpected loud or novel noises can be highly stressful to livestock. Cattle are sensitive to high-frequency noises that people cannot hear.

Sometimes cattle may be aroused by noises we cannot hear.

Music is used in dairy sheds and is believed to improve cattle (and human) behaviour.

By maintaining a background noise, music may reduce the startling effect of sudden loud noises.

# SMELL

# AND

# TOUCH

- Cattle have a better sense of smell than people.
- The smell of blood can cause great panic. This is seen when cattle pass paddocks treated with blood and bone fertiliser.
- For some unknown reason, this panic is not consistent but is very real.

- Cows have a very sensitive skin and can flick flies off from localised areas.
- Cows respond to touch and use it as an important form of communication among each other.
- Mutual grooming is important in cattle, especially in mature animals.
- Dams lick and groom their calves right up to weaning.
- Touch is important for handlers to warn cows where you are - e.g. when milking.
- One really bad experience by cattle will put them off all people for a considerable time till a positive human/animal bond is restored.

## BEHAVIOURAL PROFILES OF CATTLE

## PLAY BEHAVIOUR

Play behaviours can be defined as structural transformations and functional rehearsals or generalisations of behaviours or behavioural sequences. Play is often preceded and accompanied by signals that the behaviour is play, and typically playmates interchange roles frequently.

Typical manifestations in cattle are:

- **Mock fleeing:** Running, trotting, cantering and galloping, often with tail elevated.
- **Mock aggression:**
  - Bucking with both hind feet jerked up posteriorly and often to one side with an accompanied lateral twist of the hindquarters.
  - Kicking with one or both hind feet, often at moving objects.
  - Head butting playmate, stockperson or other objects, goring and headpushing movements.
  - Prancing and mock challenges, with head lowered or shaken from side to side, often accompanied by snorting.
  - Vocalisation, varying in type with the degree of excitement. Most vocalisations are normally of low amplitude and frequency

## BEHAVIOURAL PROFILES OF CATTLE

## PLAY BEHAVIOUR

Typical manifestations in cattle are:

- **Mock copulation:** Mounting other playmates, inanimate objects and even stockmen, sometimes with pelvic thrusts. A large proportion of mounts are disorientated – head to head, head to side, intention mounts and solicitation. Mock copulation is not accompanied by erection of the penis or vaginal intromission.
- **Environmental exploration:** Investigation of novel objects in the environment, in particular to determine their reactivity – patterns of movement, noise, etc.

Calves may also be involved in play with adults at an early age. The mother is an important stimulant to play, since in her presence the calf will feel safe to emerge from the creche and engage in play. At a later age, play is usually between peers, and it involves social interactions more frequently, particularly head pushing, mounting and other associative behaviour.

## BEHAVIOURAL PROFILES OF CATTLE

## SOCIAL BEHAVIOUR

Animals are generally classified as solitary, aggregated or social.

Cattle are social animals in the fullest sense of the word, with complex communication channels and allelomimicry exhibited in many behaviours.

Social interactions form the communicative medium for social information transfer.

They are an initial part of environmental exploration, which is followed by recognition of environmental cues.

Once position in society is established, regular communication is used to maintain status and assess environmental changes.

Finally bonding occurs between the animal and the features of its environment.

## BEHAVIOURAL PROFILES OF CATTLE

## SOCIAL BEHAVIOUR

### **Exploratory behaviour:**

Exploration is the exhibition of investigation behaviour towards other animals (usually herd mates) or inanimate objects, and is maximised in yearling cattle.

Exploratory approaches usually occur with the head extended and legs sloping forwards, which most effectively advances the sensory apparatus on the head towards the subject of investigation but enables a rapid retreat to take place if necessary.

### **Recognition:**

Recognition of herdmates allows social interactions to be conducted without the need for repeated dominance establishment. It is mainly achieved by vision, although sound is also important for maternal–juvenile recognition.

## BEHAVIOURAL PROFILES OF CATTLE

## SOCIAL BEHAVIOUR

### **Communication:**

As prey animals, non-domesticated cattle would have been discouraged from excessive use of intraspecial communication that attracted the attention of predators.

However, domestic cattle have lost some of these inhibitions, especially as adequate communication is of vital importance in an intensively managed gregarious species.

## WORKING (FLIGHT) DISTANCE

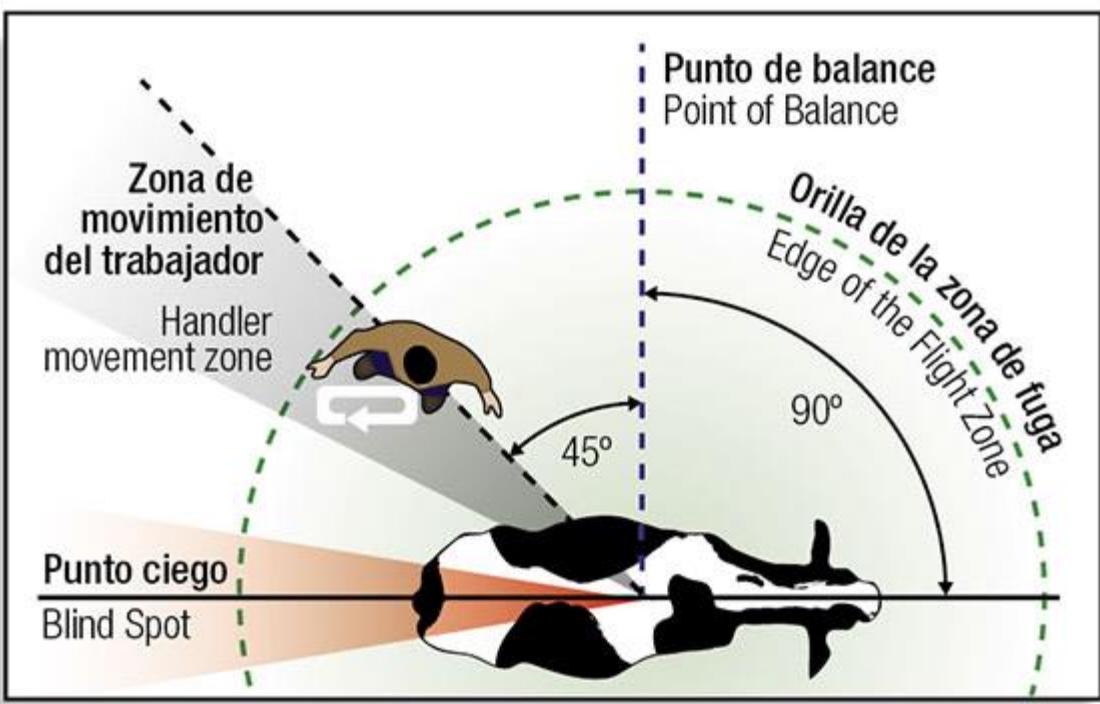
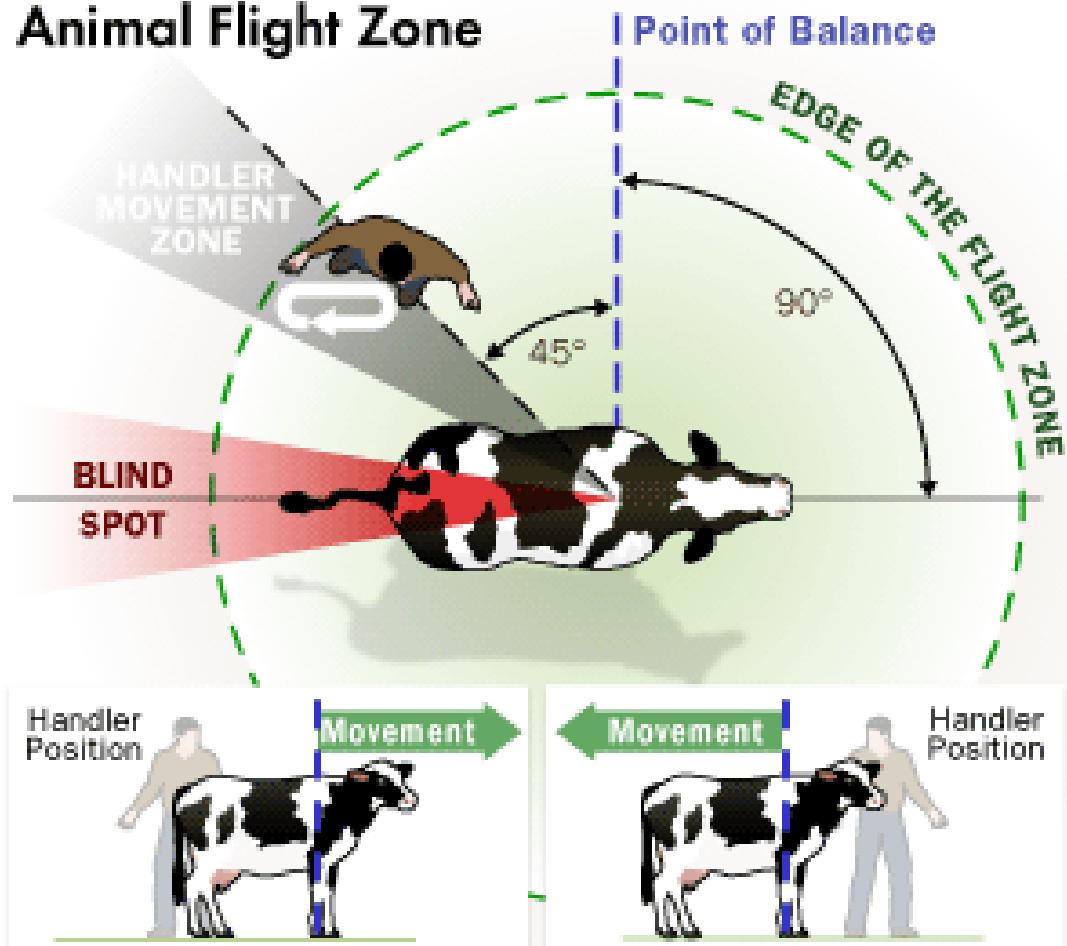
The flight zone of an animal is the area surrounding an animal that if encroached upon by a potential predator or threat, including humans, will cause alarm and escape behavior; the flight zone is determined by the animal's flight distance (sometimes called flight initiation distance (FID)) which extends horizontally from the animal and sometimes vertically.

The working distance or zone is an important concept in cattle handling. It is the distance at which cattle start to move away from people.

Dairy cows have a short working distance, usually less than five metres.

Beef cows, which are handled less frequently, have longer working distances; and wild beef cattle may have working distances of more than 100 metres.

## Animal Flight Zone



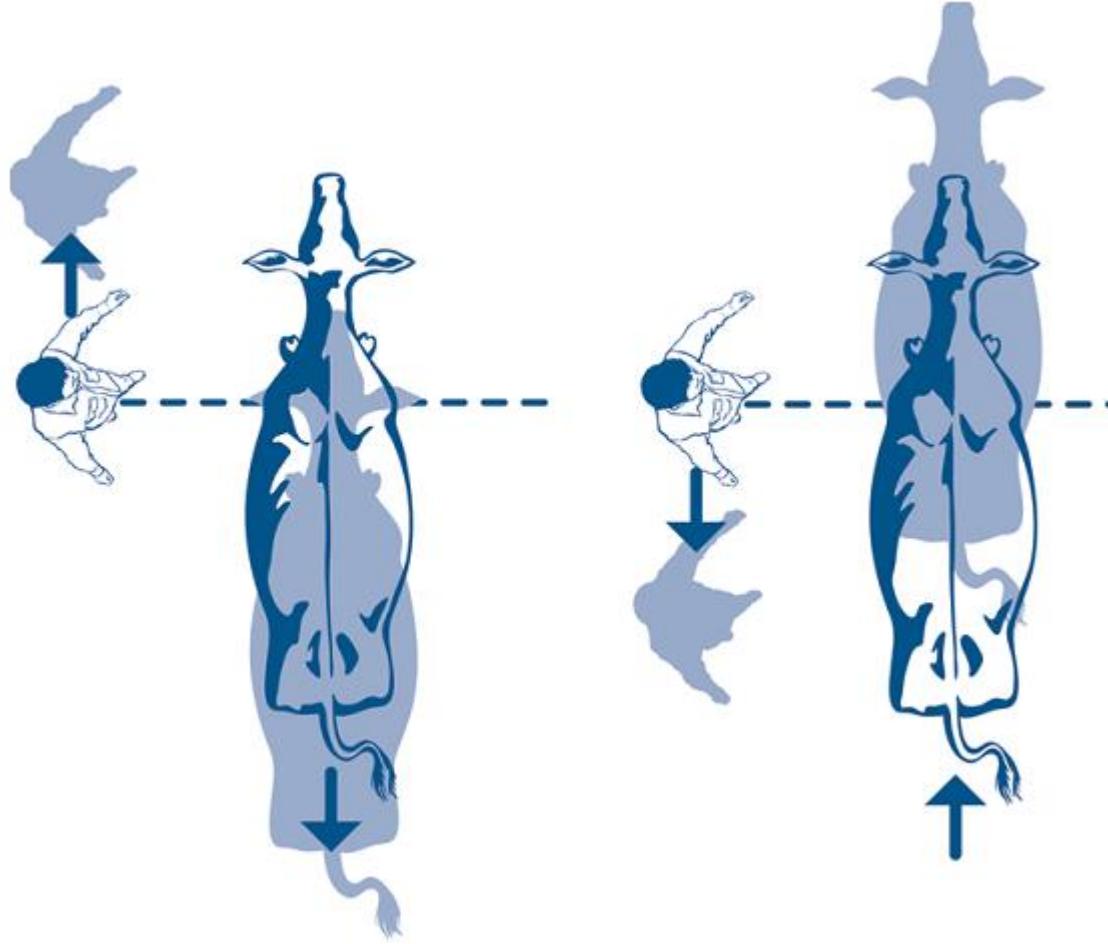
[http://web.altagenetics.com/mexico/DairyBasics/Details/4370\\_Como-mover-las-vacas-en-nuestras-lecherias-con-menos-estres.html](http://web.altagenetics.com/mexico/DairyBasics/Details/4370_Como-mover-las-vacas-en-nuestras-lecherias-con-menos-estres.html)

## POSITION AND MOVEMENT

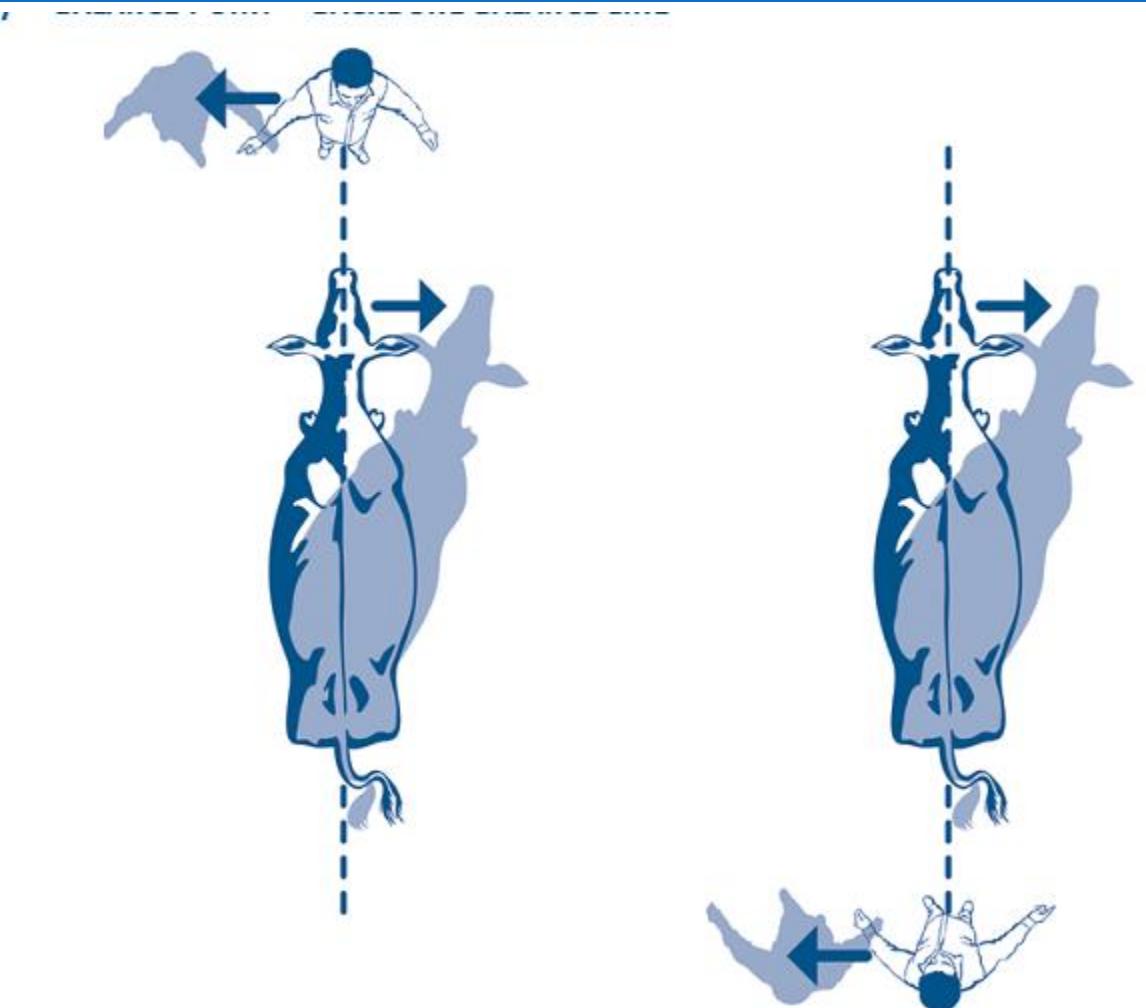
- Position and movement are keys to moving cattle effectively.
- The location of a person or dog will determine where cattle will not go, and movement into and out of working distance will determine speed of movement.
- Using body position and movement will help determine where cattle can move.
- Walking quickly past the point of balance at the animal's shoulder in the opposite direction as desired movement is an easy way to induce an animal to move forward.
- The principle is to walk inside the flight zone in the opposite direction of desired movement and to return to the starting position by walking outside the flight zone.
- The cattle have to be able to see you to make this movement pattern work.

# BALANCE POINTS

## SHOULDER BALANCE LINE



## BACKBONE BALANCE LINE





Working cattle with  
a flag



Move Small Bunches



<http://www.grandin.com/videos/videos.html>

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- Kevin J Stafford (2005):Cattle Handling Skills  
([http://www.acc.co.nz/PRD\\_EXT\\_CSMP/groups/external\\_ip/documents/publications\\_promotion/wim2\\_065192.pdf](http://www.acc.co.nz/PRD_EXT_CSMP/groups/external_ip/documents/publications_promotion/wim2_065192.pdf))

## QUESTIONS

- What are the characteristics of social structure among cattle?
- What are the behavioural characteristics of cattle?
- What does a cattle see, hear, and smell?
- How do we work with/handle a cattle?



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# CHAPTER 12

## EARLY HISTORY OF SHEEP BERREDING



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# Domestication

Domestic sheep are ruminant mammals kept as livestock. Like all ruminants, sheep are even-toed ungulates, also commonly called cloven-hoofed animals.

The name sheep applies to many species however it usually refers to the species *Ovis aries*.

Domesticated sheep are scientifically classified as in the

Kingdom: Animalia,

Phylum: Chordata,

Class: Mammalia,

Order: Artiodactyla,

Family: Bovidae,

Subfamily: Caprinae,

Genus: *Ovis*,

Species: *Ovis aries*



Wild sheep (*Ovis orientalis*) can be partitioned into the Mouflons (*Ovis orientalis orientalis* group) and Urials (*Ovis orientalis vigneigroup*).

Domestic sheep are the most numerous species in their genus.



They are most likely descended some 8,000-10,000 years ago from the wild mouflon of Europe (*O. musimon*), of which the only existing members are on the islands of Sardinia and Corsica, and from *O. orientalis*, found in the dry and mountainous regions of south-western and central Asia .

The European mouflon was an ancient breed of domestic sheep turned feral rather than an ancestor of modern domestic sheep.

The mouflon is thought to be the main ancestor of all domestic sheep breeds including short-tailed sheep in northern Europe, such as the Romanov



Urial occasionally interbreed with mouflon in the Iranian part of their range. However, the Urial, Argali and snow sheep have a different number of chromosomes than other *Ovis* species, making a direct relationship unlikely and phylogenetic studies show no evidence of Urial ancestry.



The Argali, or mountain sheep (species *Ovis ammon*) is a globally endangered wild sheep, which roams the highlands of Central Asia, e.g. Altai and Himalaya foothills. It is the largest wild sheep, standing up to 1.2 m high and weighing up to 140 kg and is thought to be the ancestor of fat-rumped sheep.



The snow sheep (*Ovis nivicola*) comes from mountainous areas in the northeast of Siberia



European and Asian breeds of sheep have shown significant genetic differences between them.



This variation may be the result of multiple waves of capture from wild mouflon or there may have been an unknown species or subspecies of wild sheep that contributed to the formation of domestic sheep.

The mouflon is red-brown with a dark back-stripe, light colored saddle patch and underparts and possesses an outer coat of coarse hair with an undercoat of short fine wool.



The males are horned and the females are horned or polled.

# Mouflon Subspecies



# European Mouflon (*Ovis orientalis musimon*)

About 7,000 years ago they appeared in Corsica and Sardinia for the first time.



© Lubomir Blasek  
www.blasek.com  
*Ovis musimon* fg0609



© Ivan Miksik

# Cyprian Mouflon (*Ovis orientalis ophion*)

Less than 1,200 of this subspecies survive

CITES listing: Appendix I (01/07/1975)



Photo: © Peter Dollinger (taken at Municipal Zoo, Berne, Switzerland)

# Armenian Mouflon (*Ovis orientalis orientalis*)

Caucasus, north western Iran and southern Anatolia.  
Sometimes also called gmelini



# Esfahan Mouflon (*Ovis orientalis isphahanica*)

Zagros Mountains, Iran



# Laristan Mouflon (*Ovis orientalis laristanica*)

Restricted to some desert reserves in southern Iran



AWWP/Jonas

# Urial Subspecies



© 2004 Eric Bloemker

## Blanford Urial or Balochistan Urial (*Ovis vignei blanfordi*)

Pakistan and possibly Iran , Balochistan are often included in this subspecies,



Photographer:  
Nausherwan Sarshar Ahmed

This is one of the smallest sheep of the world and possibly as small as the Laristan mouflon.

## Afghan Urial or Turkmenian sheep (*Ovis vignei cycloceros*)

Southern Turkmenistan, eastern Iran, Afghanistan, northern Pakistan, Kashmir



Photographer:  
PATRICIO ROBLES GIL/ SIERRA MADR/National Geographic

Bukhara Urial (*Ovis vignei bochariensis*)

Uzbekistan, Tajikistan, Turkmenistan, mountains around Amu Darya (<1,200)



© Tomasz Doron

Transcaspian Urial  
(*Ovis vignei arkal*)

Ustjurt-Plateau (Turkmenistan, Uzbekistan, northern Iran) and western Kazakhstan (<11,000),



Ladakh Urial (*Ovis vignei vignei*):

Ladakh males have curly horns but the females have a flat horn (<2,100),



Punjab Urial (*Ovis vignei punjabensis*)  
Punjab (<2,000)



Photos by Ghulam Ali Awan

- ▶ The first animals known to have been domesticated as a source of food are sheep in the Middle East.
- ▶ The proof is the high proportion of bones of one-year-old sheep discarded in a settlement at Shanidar, in what is now northern Iraq.

# Questions

- ▶ What is the ancestor of sheep?
- ▶ What are the sheep species?
- ▶ What are the characteristics of mouflon?

# Sources:

- ▶ <http://www.historyworld.net/wrldhis/plaintexthistories.asp?historyid=ab57>
- ▶ DJ. Cottle (2010): International Sheep and Wool hand book, Nottingham University Press



TÁMOP-4.1.1.C-12/1/KONV-2012-0004

# ANIMAL BREEDING

című digitális tananyag

Szegedi Tudományegyetem Mezőgazdasági Kar  
Állattudományi és Vadgazdálkodási Intézet

Mikó Józsefné Dr. Jónás Edit  
Főiskolai docens

2014.

**SZÉCHENYI** 2020



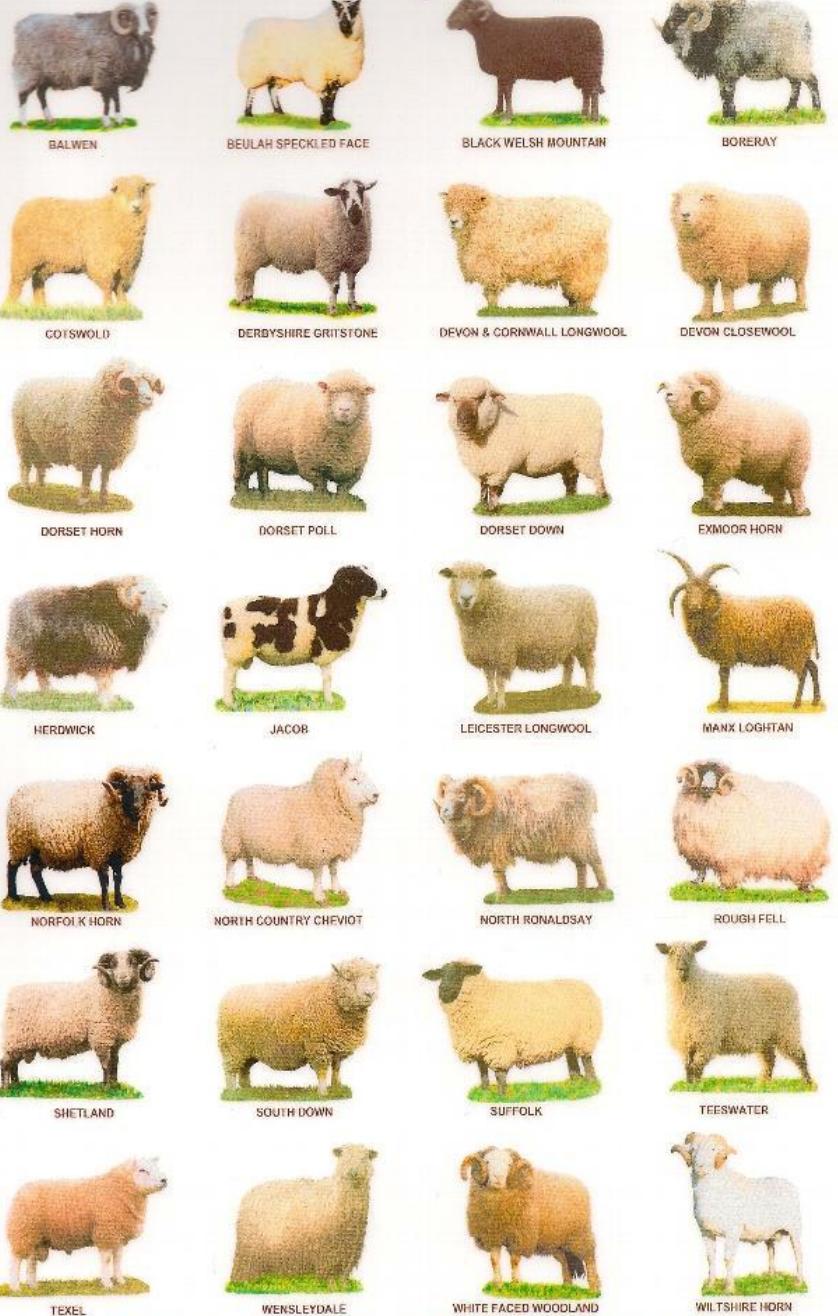
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Alap



**BEFEKTETÉS A JÖVŐBE**

## Breeds of Sheep



# CHAPTER 13

## WORLD SHEEP BREEDS

**SZÉCHENYI** 2020



MAGYARORSZÁG  
KORMÁNYA

**Európai Unió**  
Európai Strukturális  
és Beruházási Alapok



**BEFEKTETÉS A JÖVŐBE**

A breed can be defined as a group of sheep with a common origin and certain physical characters that are readily distinguishable.

Once the physical traits are removed – for example, by removal of the skin at slaughter – it often becomes difficult to tell breeds apart.

The breed that produced the wool or sheep meat is inconsequential to the final consumer.

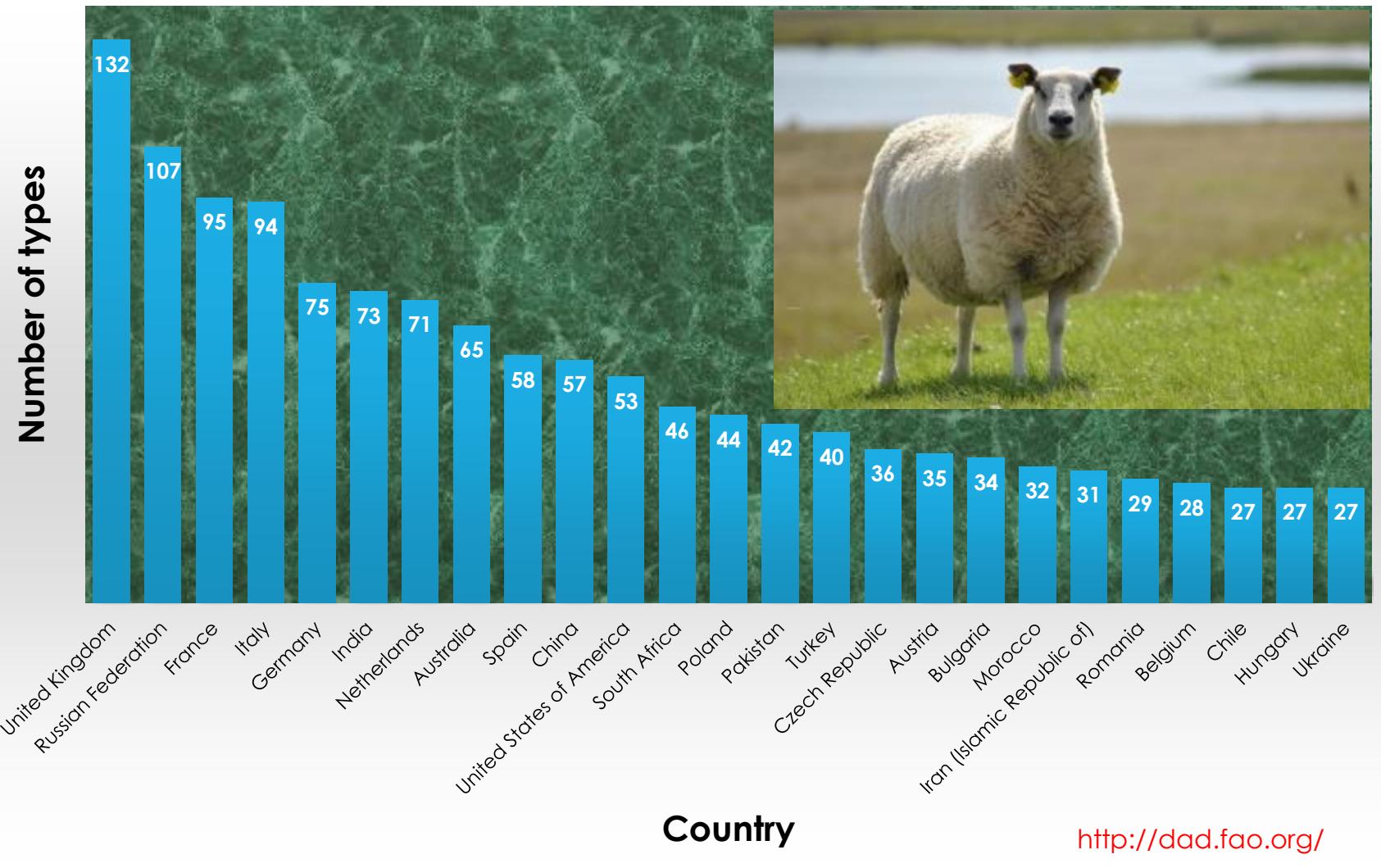


Geographical isolation, regulations, social customs and fashion have all helped to keep breeds separated, causing them to drift apart (genetic drift).

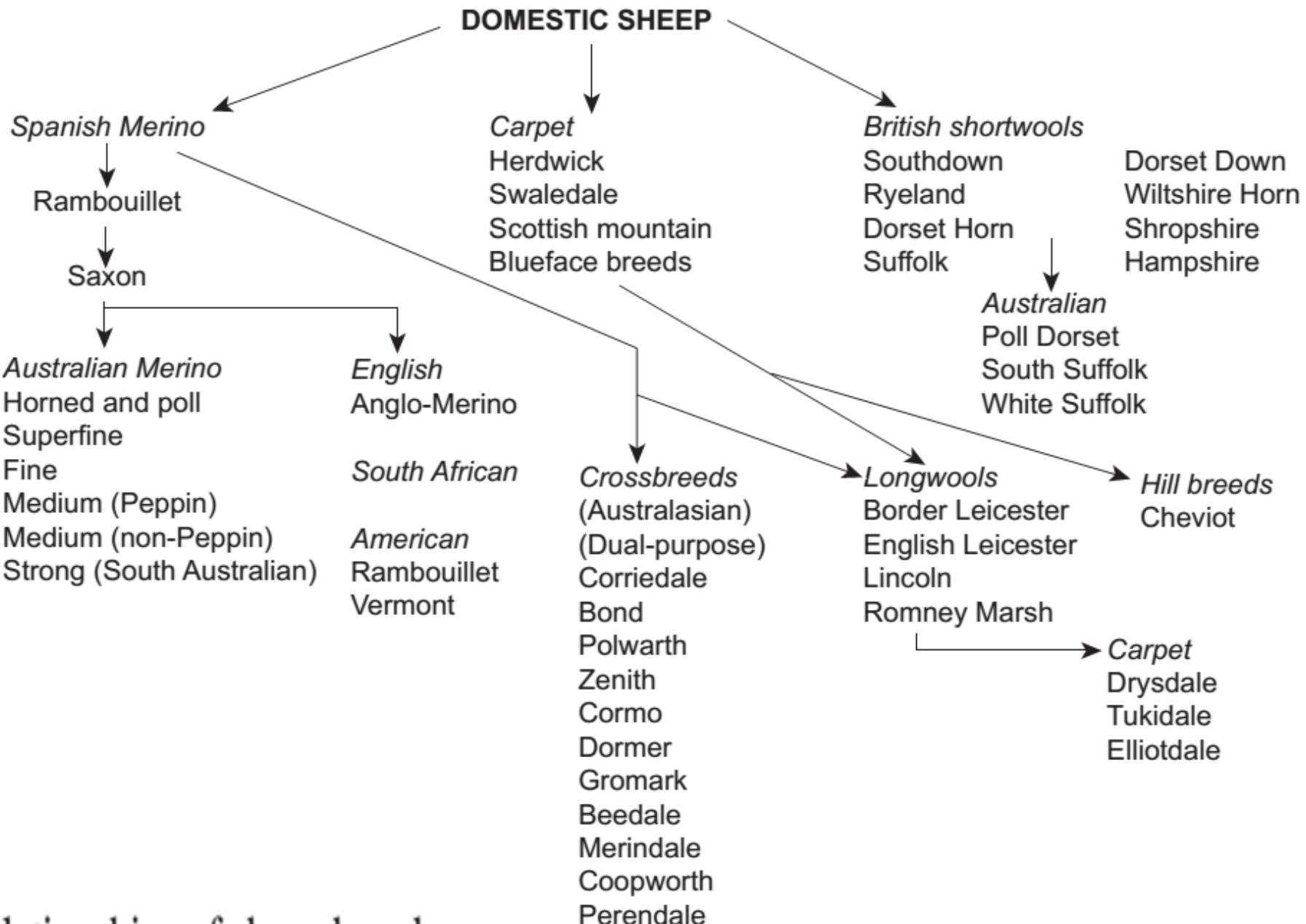
Sheep are the mammalian species with the highest number of recorded breeds – contributing 25% to the global total (FAO, 2008).



Selection for wool type, flocking instinct and other economically important traits over the centuries has resulted in more than 500 distinct breeds of sheep occurring worldwide.



The number of types by countries





- ▶ About 30 sheep breeds are registered in Australia.
- ▶ DADIS lists (<http://dad.fao.org/> ) 65 sheep breeds in Australia but 26 of these breeds are Merino strains or fixed crosses/composites, i.e. BLM, Booroola Leicester, Booroola Merino, Borino, Bundoran Comeback, Bungaree Merino, Camden, Camden Park, Coolalee, Dormer, Fonthill Merino, Glen Vale BL, Gromark, Hyfer, Peppin, Poll Merino, Romsdown (extinct), Saxon, Siromeat, South Australian Merino, Spanish, Tasmanian Merino, Trangie Fertility, Waridale and Wiltipoll

## Merino strains



- ▶ More than 80 percent of all Australian sheep are pure Merino, with most of the remainder at least part Merino blood. Merino is grown primarily for its heavy fleeces of fine wool. Although the Australian Merino derives its name and basic appearance from the Spanish breed, it is a distinct breed in its own right, developed and adapted in Australia to the specific conditions of this country. Merino sheep were brought to Australia from the Cape Colony, England, Saxony (South East Germany), France, and America.
- ▶ The Australian Merino is not a single homogenous breed but a number of strains of sheep all of which, regardless of their origins, are uniquely Australian. The major factor determining the Merino's development has been the requirement for environmental suitability.

# Description of Merino strains in Australia

## Superfine(Saxon)

### Appearance:

- ▶ White; well-covered head and legs;
- ▶ carries neck folds and some
- ▶ body wrinkle;
- ▶ mostly horned, some polled flocks,
- ▶ horn-coloured hooves.

### Mature body weight (kg):

- ▶ Rams: 40-50
- ▶ Ewes: 30-40

### Fibre diameter ( $\mu\text{m}$ ) (count):

- ▶ 18 or finer
- ▶ (90/74s)

### GFW(greasy fleece weight), ewe:

- ▶ 3-4 kg

### SL (staple length) (mm)

- ▶ 75-90

### Secondary/primary follicle ratio (S/P)

- ▶ 26

### Follicles/ $\text{mm}^2$

- ▶ 80

### Purpose

- ▶ Wool (high fashion fabrics)

### Other features

Developed predominantly from Spanish and Saxon Merinos imported in the early 1800s; best adapted to areas of 500mm rainfall or higher western district of Victoria, New England, Yass and Goulburn and midlands of Tasmania



<http://www.merinos.com.au/merinos.asp?pageId=16>



# Description of Merino strains in Australia

## Fine(Saxon)

### Appearance:

- ▶ White; well-covered head and legs;
- ▶ carries neck folds and some body wrinkle;
- ▶ mostly horned, some polled flocks,
- ▶ horn-coloured hooves.

### Mature body weight (kg):

- ▶ Rams: 40-50
- ▶ Ewes: 30-40

### Fibre diameter ( $\mu\text{m}$ ) (count):

- ▶ 19-20
- ▶ (70s)

### GFW(greasy fleece weight), ewe:

- ▶ 3-5 kg

### SL (staple length) (mm)

- ▶ 80-100

### Secondary/primary follicle ratio (S/P)

- ▶ 25

### Follicles/ $\text{mm}^2$

- ▶ 71

### Purpose

- ▶ Wool (high fashion fabrics)

### Other features

Developed predominantly from Spanish and Saxon Merinos imported in the early 1800s; best adapted to areas of 500mm rainfall or higher western district of Victoria, New England, Yass and Goulburn and midlands of Tasmania



<http://www.merinos.com.au/merinos.asp?pagId=16>



# Description of Merino strains in Australia Medium Wool (1861)

## Appearance:

- ▶ White; well-covered head and legs;
- ▶ carries neck folds and some body wrinkle;
- ▶ mostly horned, some polled flocks,
- ▶ horn-coloured hooves.

## Mature body weight (kg):

- ▶ Rams: 50-80
- ▶ Ewes: 40-50

## Fibre diameter ( $\mu\text{m}$ ) (count):

- ▶ 21-22
- ▶ (64s)

## GFW(greasy fleece weight), ewe:

- ▶ 4-6 kg

## SL (staple length) (mm)

- ▶ 90-100

## Secondary/primary follicle ratio (S/P)

- ▶ 21

## Follicles/mm<sup>2</sup>

- ▶ 64

## Purpose

- ▶ Wool (suitings)

## Other features

Hardy and adaptable; includes strains developed in NSW and SA to suit harsher conditions of the wheat – sheep and better pastoral zone areas of the Riverina, northern Victoria, Queensland and Western Australia



# Description of Merino strains in Australia

## Medium Wool (1861)

### Appearance:

- ▶ White; well-covered head and legs;
- ▶ carries neck folds and some body wrinkle;
- ▶ mostly horned, some polled flocks,
- ▶ horn-coloured hooves.
- ▶ but tend to be more open-faced and plainer-bodied (less wrinkle)

### Mature body weight (kg):

- ▶ Rams: 60-90
- ▶ Ewes: 45-55

### Fibre diameter ( $\mu\text{m}$ ) (count):

- ▶ 23-26
- ▶ (60s)

### GFW(greasy fleece weight), ewe:

- ▶ 5-7 kg

### SL (staple length) (mm)

- ▶ 100-126

### Secondary/primary follicle ratio (S/P)

- ▶ 16

### Follicles/ $\text{mm}^2$

- ▶ 57

### Purpose

- ▶ Wool (suitings, blankets) Mutton

### Other features

- ▶ The strong wool Merino has adapted itself particularly to the hot, dry, semi-arid areas of Australia. The strain is very large framed, plain bodied and open faced, making it a particularly easy care sheep for semi-arid areas. Stronger wool sheep are hardier sheep for the tougher environments.



# Description of Part Merino breeds in Australia

## Corriedale(1882)

### Appearance:

White face, dark skin on nostrils, legs white, hooves preferably dark; polled.

### Mature body weight (kg):

- Rams: 70-100
- Ewes: 50-60

### Fibre diameter ( $\mu\text{m}$ ) (count):

- 25-32
- (56/50s)

### GFW(greasy fleece weight), ewe:

- 5-7 kg

### SL (staple length) (mm)

- 150-180

### Secondary/primary follicle ratio (S/P)

- 10.6

### Follicles/ $\text{mm}^2$

- 29

### Purpose

Dual purpose wool (blankets, rugs, knitting wool, army uniforms) and mutton; ewes often used as prime lamb mothers; this breed is also crossed with Merinos and longwool breeds

### Other features

An inbred Lincoln x Merino half-bred first developed in NZ; hardy and adapted to a wide range of conditions; best suited to improved pastures, but some selection against fleece rot and body strike required in high rainfall areas; lamb marking % can exceed 100% in good environments



[http://www.corriedale.org.au/coora/Latest\\_News.htm](http://www.corriedale.org.au/coora/Latest_News.htm)

# Description of Part Merino breeds in Australia

## Bond (1909)

### Appearance:

White face, but maybe black mottles on nose; white legs/ cream hooves/ polled

### Mature body weight (kg):

- ▶ Rams: 70-120
- ▶ Ewes: 50-60

### Fibre diameter ( $\mu\text{m}$ ) (count):

- ▶ 23-28
- ▶ (56s)

### GFW(greasy fleece weight), ewe:

- ▶ 5.5-7.5 kg

### SL (staple length) (mm)

- ▶ 150-180

### Secondary/primary follicle ratio (S/P)

- ▶ 10.6

### Follicles/ $\text{mm}^2$

- ▶ 49

### Purpose

- ▶ Dual purpose wool (blankets, rugs, knitting wool, army uniforms) and mutton; ewes often used as prime lamb mothers; this breed is also crossed with Merinos and longwool breeds

### Other features

Lincoln rams x Peppin ewes bred at Lockhart; breed separated from Corriedales in 1984; closer to Merino than Corriedales



<http://www.sheep101.info/breedsB.html>



<http://www.almondvale.com.au/semen.html>

# Description of Part Merino breeds in Australia

## Polwarth (1887)

### Appearance:

Soft white face, but maybe black mottles on nose; white legs; no kemp on face or legs; horned or polled

### Mature body weight (kg):

- Rams: 60-90
- Ewes: 45-55

### Fibre diameter ( $\mu\text{m}$ ) (count):

- 22-26
- (58s)

### GFW(greasy fleece weight), ewe:

- 4-5.5

### SL (staple length) (mm)

- 100-140

### Secondary/primary follicle ratio (S/P)

- 13

### Follicles/ $\text{mm}^2$

- 49

### Purpose

Mainly for wool (dress fabrics, felts, coats); better mutton conformation than Merino; developed as a wool producing sheep for cool, wet areas, with greater thriftiness, resistance to fleece rot and fly strike than the purebred Merino

### Other features

A fixed 3/4/ Merino x 1/4 Lincoln 'comeback' based on the fine white woolled Victoria Merino with a high wax content; generally resembles the Merino; lambing % can exceed 100% in good environments



<http://www.polwarth.com.au/>

# Description of Part Merino breeds in Australia

## Zenith (1947 )

### Appearance:

White open face and legs;  
large ears; polled

### Purpose

Wool (suitings, blankets); better  
mutton conformation than fine  
Merino

### Other features

A comeback type developed in the  
cereal zone of northern Victoria to  
produce a more dual purpose type of  
sheep than the fine Victorian Merino;  
origins not clear but probably 7/8 Merino  
x 1/8 Lincoln

### Mature body weight (kg):

- Rams: 70-90
- Ewes: 45-60

### Fibre diameter ( $\mu\text{m}$ ) (count):

- 21-25
- (58/64s)

### GFW(greasy fleece weight), ewe:

- 4.5-5.5

### SL (staple length) (mm)

- 90-120

The Zenith aims to be a sheep of robust constitution,  
with a large frame, carrying a dense fleece of 60- 64s  
quality, at times running to 58s. Of recent years  
considerable interest has been shown in polled  
Merino rams, and although the general standard of  
the hornless sheep is below that of the horned ones,  
it is improving. Boonoke, one of the oldest Peppin  
flocks, is one of the leading studs breeding polled  
Merino rams.

## The British breeds of Australia



Australia's British heritage has strongly influenced the type of non-Merino breeds that are run. These breeds have all been developed in a cold climate and tend to be run in the colder and wetter parts of Australia, which are also closer to primestock markets. In the UK, breeds of sheep are classified as 'longwools' if used for wool and meat production and 'shortwools' if used mainly for meat production.

# Description British longwools breeds in Australia

## Romney Marsh (1872)

### Appearance:

White face with kemp fibres on face and legs; some sheep muffed; polled; black hooves

### Mature body weight (kg):

- Rams: 90-110
- Ewes: 55-70

### Fibre diameter ( $\mu\text{m}$ ) (count):

- 32-38
- (46/48s)

### GFW(greasy fleece weight), ewe:

- 6

### SL (staple length) (mm)

- 180-230

### Secondary/primary follicle ratio (S/P)

- 5.5

### Follicles/ $\text{mm}^2$

- 22



### Other features

- Crossbreds are good mothers although not as prolific as Border Leicester cross; best suited to cooler and wetter areas; has reputation for resistance to internal parasitism and footrot; hairy mutant types have been developed as carpet wool breeds

### Purpose

- Mutton and wool (hosiery, blankets, knitting wool, carpets); used in first cross on the Merino; good prime lamb mothers

# Description British longwools breeds in Australia Border Leicester (1871)

## Appearance:

Clean white head, face and legs, all free of wool;  
characteristic Roman nose;  
polled' black hooves

## Secondary/primary follicle ratio (S/P)

- ▶ 4.4

## Follicles/mm<sup>2</sup>

- ▶ 15.8



[http://www.assba.com.au/Main.asp?\\_=BORDER%20LEICESTER](http://www.assba.com.au/Main.asp?_=BORDER%20LEICESTER)

## Mature body weight (kg):

- ▶ Rams: 90-115
- ▶ Ewes: 55-75

## Purpose

- ▶ Mutton and wool (hosiery, dress fabrics, rugs, linings); extensively crossed with the Merino; purebred and first cross ewes make good prime lamb mothers

## Fibre diameter (µm) (count):

- ▶ 32-38
- ▶ (44/46s)

## Other features

- ▶ Developed in the UK from Cheviot x English halfbreds; adaptable; withstands warmer and drier conditions better than any other longwool breed; first crosses prolific good mothers, early maturing

## GFW(greasy fleece weight), ewe:

- ▶ 6

## SL (staple length) (mm)

- ▶ 200-250

# Description British longwools breeds in Australia Lincoln(1865)

Appearance:

Clean white face, long forelock; polled

Secondary/primary follicle ratio (S/P)

- ▶ 5.4

Follicles/mm<sup>2</sup>

- ▶ 14.6

Mature body weight (kg):

- ▶ Rams: 90-110
- ▶ Ewes: 55-70

Purpose

- ▶ Used in Merino for production of comeback types and in the formation of the Polwarth, Corriedale and Zenith breeds, used has declined with the spread of these breeds; long, coarse wool used for special purposes such as wigs, lapping of scouring rollers and carpet wool blends; also dress fabrics, upholstery and rugs

Fibre diameter (µm) (count):

- ▶ 40-48
- ▶ (32/66s)

Other features

- ▶ Restricted range; rich pasture and crop feeding required; heavy bone, good back, but slab-sided; slow maturing mutton; used in NZ on Romney ewes for large, lean lambs

GFW(greasy fleece weight), ewe:

- ▶ 7-10

SL (staple length) (mm)

- ▶ 250-300



[http://www.assba.com.au/Main.asp?\\_=L](http://www.assba.com.au/Main.asp?_=L)  
INCOLN

# Description British shortwools breeds in Australia

## Dorset Horn(1895)

### Appearance:

- White face, legs and feet; rams and ewes horned

### Secondary/primary follicle ratio (S/P)

- 5.4

### Follicles/mm<sup>2</sup>

- 18.5

### Mature body weight (kg):

- Rams: 100-120
- Ewes: 60-75

### Purpose

- Terminal prime lamb sire; also mated to the Merino for the production of prime lamb mothers suitable for early mating in late spring; lamb carcasses 15-18 kg; wool used for hosiery, flannels, knitting wool and cloth

### Fibre diameter (µm) (count):

- 29
- (50/56s)

### Other features

- Adaptable; withstands warm and dry conditions comparatively well; very early maturing, good mothers, extended breeding season; first cross ewes prolific, but cut less wool than Border Leicester × Merino ewes

### GFW(greasy fleece weight), ewe:

- 2.5

### SL (staple length) (mm)

- 80-100



<http://www.heritagesheep.org.au/breeds/dorsethorn.html>

# Description British shortwools breeds in Australia

## Southdown (Down) (1793)

### Appearance:

- ▶ Light brown face and legs; muffed face; polled; brown muzzle

### Secondary/primary follicle ratio (S/P)

- ▶ 6.3

### Follicles/mm<sup>2</sup>

- ▶ 27.8

### Mature body weight (kg):

- ▶ Rams: 70-80
- ▶ Ewes: 45-60

### Purpose

- ▶ Prime lamb sire; mated to crossbred ewes for prime lambs maturing at light weights (12-15kg); wool used for flannels, hosiery, tweeds, underwear

### Fibre diameter (µm) (count):

- ▶ 23-25
- ▶ (28/60s)

### Other features

- ▶ Small prime lamb sire, with 'blocky' conformation; better adapted to cooler, wetter districts; fatness a problem if carried on to heavier weights; breed used in evolution and improvement of all other Down breeds

### GFW(greasy fleece weight), ewe:

- ▶ 2-2.5

### SL (staple length) (mm)

- ▶ 50-60



<http://www.heritagesheep.org.au/breeds/southdown.html>

# Description British shortwools breeds in Australia

## Hampshire Down (1888 )

### Appearance:

- ▶ Black face and ears; slightly muffled; polled

### Secondary/primary follicle ratio (S/P)

- ▶ 5.4



### Purpose

### Mature body weight (kg):

- ▶ Prime lamb sires; heavy carcass 16-20kg; wool used for hosiery and tweeds

- ▶ Rams: 95-115
- ▶ Ewes: 55-70

### Fibre diameter ( $\mu\text{m}$ ) (count):

- ▶ 25-27
- ▶ (56/58s)

### GFW(greasy fleece weight), ewe:

- ▶ 2-2.5

### Other features

- ▶ Early breeder; originated from Wiltshire Horn, Southdown and Dorset Horn; fairly hardy; responds to intensive feeding

### SL (staple length) (mm)

- ▶ 60-90

<http://www.heritagesheep.org.au/breeds/hampshiredown.html>

# Description British shortwools breeds in Australia

## Dorset Down (1937)

### Appearance:

- ▶ Black nose, ears and feet; slightly muffled; polled



<http://www.dorsetdownsheep.org.uk/>



<http://www.heritagesheep.org.au/breeds/dorsetdown.html>

### Mature body weight (kg):

- ▶ Rams: 90-100
- ▶ Ewes: 50-65

### Fibre diameter ( $\mu\text{m}$ ) (count):

- ▶ 26-30
- ▶ (50/56s)

### GFW(greasy fleece weight), ewe:

- ▶ 2.5

### SL (staple length) (mm)

- ▶ 80-90

### Purpose

- ▶ Sire for heavier lambs; wool used for paper felts

### Other features

- ▶ Closely related to the Hampshire Down and similar in breeding habit; prolific, good mothers; more suited to intensive feeding

# Description British shortwools breeds in Australia

## Suffolk(1904)

### Appearance:

- ▶ Clean black face, head and legs; polled; Roman nose; black hooves

### Secondary/primary follicle ratio (S/P)

- ▶ 4.8

### Follicles/mm<sup>2</sup>

- ▶ 20.4

### Mature body weight (kg):

- ▶ Rams: 90-120
- ▶ Ewes: 55-75

### Purpose

- ▶ Prime lamb sire; heavy lamb carcass 16-20kg; wool used for hosiery, felts, dress fabrics, tweeds

### Fibre diameter (µm) (count):

- ▶ 25-28
- ▶ (56s)

### GFW(greasy fleece weight), ewe:

- ▶ 2.5

### SL (staple length) (mm)

- ▶ 70-90



[http://www.assba.com.au/Main.asp?\\_=SUFFOLK](http://www.assba.com.au/Main.asp?_=SUFFOLK)

### Other features

- ▶ Rapid growth rate; largest and slowest maturing Down breed used in Australia; ewes prolific; crossbred lambs require good feed conditions for best results, but can recover after a check; used extensively in cereal zone of SA on Merino ewes

# Description More Recently Developed Breeds in Australia

## Cormo (1960)

### Appearance:

- ▶ Clean white open face, soft pink skin but some mottles on nose; white legs; polled



### Mature body weight (kg):

- ▶ Rams: 70-90
- ▶ Ewes: 45-60

### Fibre diameter ( $\mu\text{m}$ ) (count):

- ▶ 21-23
- ▶ (60/64s)

### GFW(greasy fleece weight), ewe:

- ▶ 4-5.5

### SL (staple length) (mm)

- ▶ 100-130

### Purpose

- ▶ A dual purpose sheep suitable for higher rainfall and mountainous areas

[http://www.cormosheep.org/Cormo/Cormo\\_Registrx.html](http://www.cormosheep.org/Cormo/Cormo_Registrx.html)

### Other features

- ▶ Established in Tasmania from a Corriedale x Saxon (superfine) Merino base; withstands wet and cold conditions; good fertility (100%); fine comeback wool

# Description More Recently Developed Breeds in Australia

## Perendale(1960)

### Appearance:

- ▶ White open face, dark nostrils and feet; legs white; polled

### Purpose

- ▶ Dual purpose (furnishing fabrics, hosiery, knitting wool, carpet) and lamb and mutton

### Mature body weight (kg):

- ▶ Rams: 80-100
- ▶ Ewes: 50-65

### Fibre diameter ( $\mu\text{m}$ ) (count):

- ▶ 28-32
- ▶ (50s)

### GFW(greasy fleece weight), ewe:

- ▶ 4.5-6

### SL (staple length) (mm)

- ▶ 120-180



<http://www.perendalenz.com/wp-content/uploads/Sheep-single.jpg>

### Other features

- ▶ Hardy, easy care sheep; good walkers, bred for country in NZ from a Cheviot x Romney Marsh base; excellent for prime lamb; mothers good fertility (over 100%)

# Description More Recently Developed Breeds in Australia

## Coopworth 1965

### Appearance:

- ▶ White, open faced, clean legs; polled; intermediate between Border Leicester and Romney

### Mature body weight (kg):

- ▶ Rams: 50-70

### Purpose

- ▶ Self replacing prime lamb flock, plus wool purebred and Downscross lambs; crossed with Merino or Corriedale to produce prime lamb mothers; wool used in apparel, carpet blends and hand spinning



<http://www.sheep101.info/breedsC.html#Coop>

### Fibre diameter ( $\mu\text{m}$ ) (count):

- ▶ 35
- ▶ (48/46s)

### GFW(greasy fleece weight), ewe:

- ▶ 5

### SL (staple length) (mm)

- ▶ 200-230



<http://vimeo.com/27996819>

### Other features

Developed in NZ from Border Leicester x Romney Marsh; best suited to higher rainfall areas (650mm+) with good nutrition and management; ewes prolific (over 120%) breeding season restricted to autumn to early winter



New Zealand (NZ) had 40 million sheep in 2006, the sixth largest national population in the world total of 1 billion.

The population is decreasing as in other countries, down to 34 million in 2008. Sheep production is reliant on introduced pastures, grazed all-year round on 13,760 mainly family-owned and operated farms with a mix of other enterprises.

The farms produce mostly commodity raw materials (meat, wool, skins) with around 90% of products exported after early stage processing.

Ultimate sale is to consumers in Europe, North America and North Asia for whom natural features of the production system, quality of product and reliability of supply are important.

NZ is a major contributor to international trade in lamb meat, mutton, coarse wool and sheep skins.

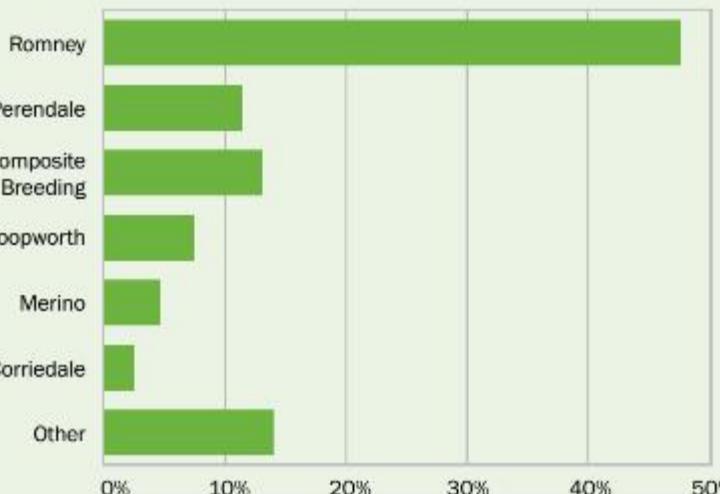
## SHEEP



### Sheep numbers at 30 June 2013<sup>p</sup>

20.4 million breeding ewes  
10.5 million ewe hoggets, dry ewes, wethers, rams  
30.9 million sheep wintered  
-21.9 % on 2003  
-1.1 % on 2012

#### Sheep breeds



Source: Beef + Lamb New Zealand Economic Service, Sheep & Beef Farm Survey 2011-12

#### Breeding flocks

The major breed in the North Island and southern districts of the South Island is the Romney. Corriedale and Halfbred sheep are mainly found in Canterbury, Marlborough and parts of Otago. Merino sheep are predominantly farmed in the South Island high country.

# Romney



The New Zealand Romney has a long history originating as a separate breed on the cold, damp isolated Romney Marshes of Kent in the south of England. History records - "A long woolled, strong and highly valuable sheep has been kept on Romney Marsh since time immemorial" - hence the name 'Romney Marsh'.

The first importations of Romney sheep to New Zealand were by Messrs Bennett and Young, reaching Wellington in 1843.

Today the New Zealand Romney makes up over half of the 40 million sheep farmed in New Zealand. It is farmed, in the near sub tropical northern most parts of the north Island at 34° latitude south to the southern most tip of New Zealand at 47° latitude South. The New Zealand Romney is well recognised for its ability to manage all the many varied climates that New Zealand has.

Romney New Zealand which was established in 1904 represents 130 Romney stud breeders who supply breeding rams for approximately 4000 commercial sheep farmers. Over the last few years it has extended its role to include research and marketing of Romney wool. Recently Romney New Zealand has increased its commitment in this area.

While the composition and quality of the New Zealand wool clip has changed over the last 10 years, the traits such as low vegetable matter, good whiteness and brightness, good length and strength, remain key attributes of the New Zealand Romney wool and set it apart from the balance of the New Zealand production.

# Coopworth

Coopworths are renowned for their high productivity in many varied farming environments from dry plains to hard hill. Weaning percentages and wool clips are consistently higher than from other breeds. Coopworth ewes are good milkers and a high percentage of lambs can be drafted at weaning if season or policy dictates.

Coopworths are bred for easy care characteristics: clean heads and points means they do not require eye-wigging and they move well. Ewes require minimum shepherding at lambing: difficult births are of low incidence, and ewes have very good mothering instinct - they seldom leave their lambs after birth. Thus the costs of production are reduced compared to many other breeds.

Coopworth Society regulations have been formulated to guarantee genetic progress for economically important characteristics.

Key points in the regulations are:

- ▶ All registered flocks must be performance recorded
- ▶ Registration is performance based, not pedigree based.
- ▶ Ewes can be screened into registered flocks if they perform outstandingly as hoggets and 2 teeths in commercial flocks. The Coopworth Society has an open flock book.
- ▶ Single entered rams must come from the highest ranking 15% of the flock for performance.
- ▶ Ewes must rear 3 lambs in the first two lambings to retain registered status.
- ▶ Ewes requiring assistance at lambing are deregistered.



# Perendale



- ▶ Perendale was originally developed at Massey University in Palmerston North, New Zealand in the late 1930s, by crossing bulky-wooled and hardy Cheviot rams over Romney ewes. They are the classic easy-care meat and wool breed for hill country farming. Many farms in my area of the King Country (in the western North Island of New Zealand) were "broken in" using Perendale sheep.
- ▶ The Perendale is an easy-care breed and will give your farming operation effortless lambing, good mothering and survival, plus excellent fertility with low losses from scanning to lambing. The lambs are easily finished to produce a lean, heavyweight carcass ideal for the chilled trade.



<http://www.perendalenz.com/>

# Corriedale



<http://www.hzsheep.co.nz/index.php?page=corriedale>

- ▶ A medium to large sheep, the Corriedale is especially suited to all types of grazing in lighter rainfall areas; it is widely used in New Zealand on every sort of country from intensively grazed lowlands and plains, to all but the very highest mountain grazings, and in similar environments world-wide.
- ▶ The ewes are excellent mothers, and the Corriedale is a dual-purpose sheep, producing big fleeces and top-quality meat lambs, either from Corriedale or Down sires. The wool is bright, dense, bulky and soft-handling.
- ▶ A flexible, medium-sized breed suited to drier environments. It has a comparatively long productive life of up to seven years.
- ▶ A dual-purpose breed, with equal emphasis on meat and wool. Rams are used for crossing with Romney or Perendale flocks to increase their body size, and to improve the fineness, weight, handling and colour of their wool.
- ▶ Location: Corriedales are located in the drier parts of New Zealand. The breed is most common in the South Island, in Marlborough and the eastern areas of Canterbury & Otago, and in the drier parts of the North Island. Canterbury & Otago, and in the drier parts of the North Island.

# Awassi Sheep

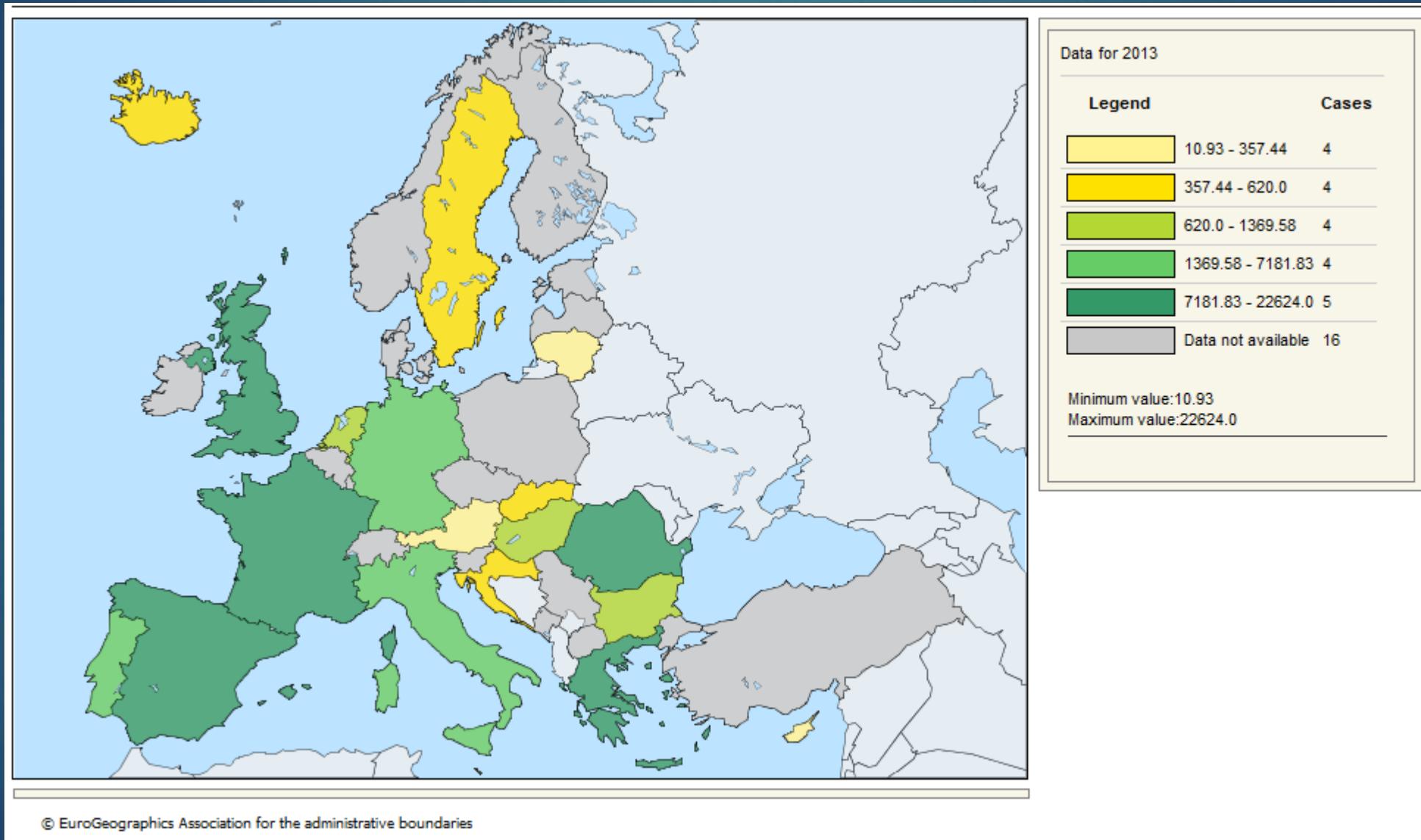
- ▶ Around 1991 a New Zealand and Australian consortium imported about 150 embryos of an improved dairy strain of Awassi sheep from Israel. These were transferred into New Zealand ewes on Somes Island in the middle of the Wellington harbour. The pregnant recipient ewes were then taken into quarantine at Flock House near Bulls, where the numbers were multiplied until the time of release in 1995.
- ▶ Within New Zealand the breed is controlled by “Awassi New Zealand”, but it has exported two thirds of the stock to Australia, where it is held by a sister company, “Awassi Australia”. Both of these companies carefully guard the breed, so that nobody else has access to them.
- ▶ The fat tail, brown face and legs, and long floppy ears immediately differentiate the the Awassi from other breeds of sheep, together with their upright stance and relatively hairy white coat. The rams have large curled horns. Temperamentally they are very quiet sheep and will cluster around you nibbling your fingers in the fond hope of some rewarding treat.



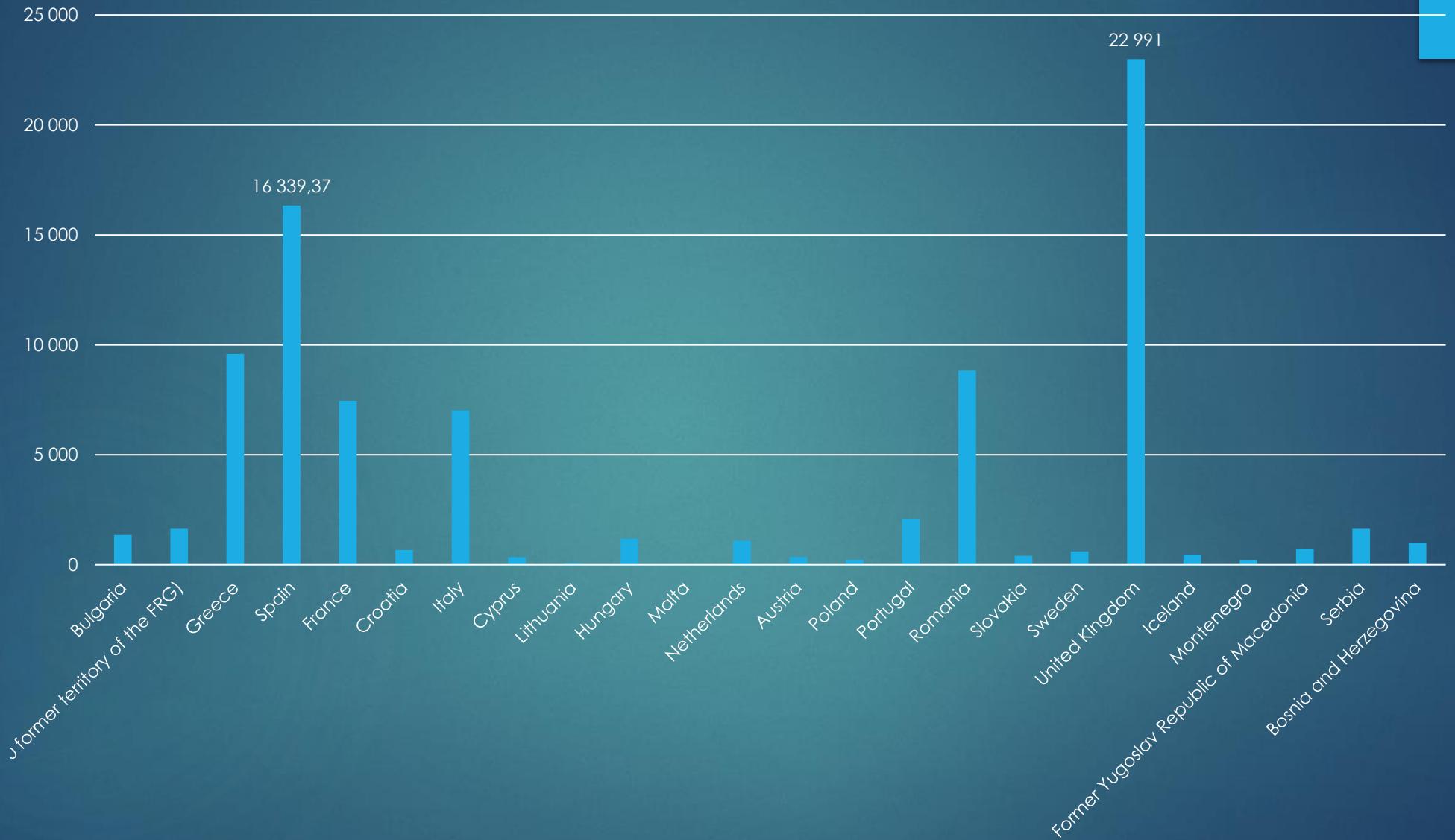
<http://www.rarebreeds.co.nz/awassi.html>



## Geographic distribution of European sheep (in thousands of head)



## Live sheep (Thousand head (animals) ) 2012 in Europe



# Sheep breeds in Greece

Sheep and goat production are very important enterprises in Greece, particularly in the mountainous less favoured areas.

In these areas the climate and terrain is usually unsuitable to sustain any other type of agricultural productivity.

Both sheep and goats are principally kept for milk production.

Lambs are born between November and January and are weaned from their mothers after one month.

The high cost of concentrates, combined with the low availability of forage and consumer preference for lean meat makes it impractical to keep lambs and kids and hence they are slaughtered at very light carcass weights.

There are four main breeds of sheep in Greece.

The **Boutsikois** mountain breed with an estimated mature weight of 38 kg for females. The **Serres** and **Karagouniko** breeds are lowland breeds with estimated female mature weights of 50kg and 55kg respectively.

The Chios sheep. Like so many breeds the exact origin of the Chios is unknown. Some sources suggest it is the result of crossbreeding between local sheep of the island of **Chios** and breeds from Anatolia, possibly the Kivircik and Daglic breeds.



# Chios

<http://www.youtube.com/watch?v=DG5d4megH8g>

The Chios is typically white with black, occasionally brown, spots around the eyes, and on the ears, nose, belly and legs. The entire head is often black.

The mature size of the ewes is typically 105 - 155 pounds (48-70 kg) and rams from 145-200 lbs (65-90 kg) indicating regional differences.

Female conformation is typically dairy. The breed is classified as semi-fat-tailed.



<http://www.3rbreeding.eu/AnimalnbspResourcenbspPopulations/Sheep/Chios.aspx>

# Chios

The Chios are early maturing and can be mated at 8-9 months.

The breed is non-seasonal with some ewes reported to have two lambings in a year.

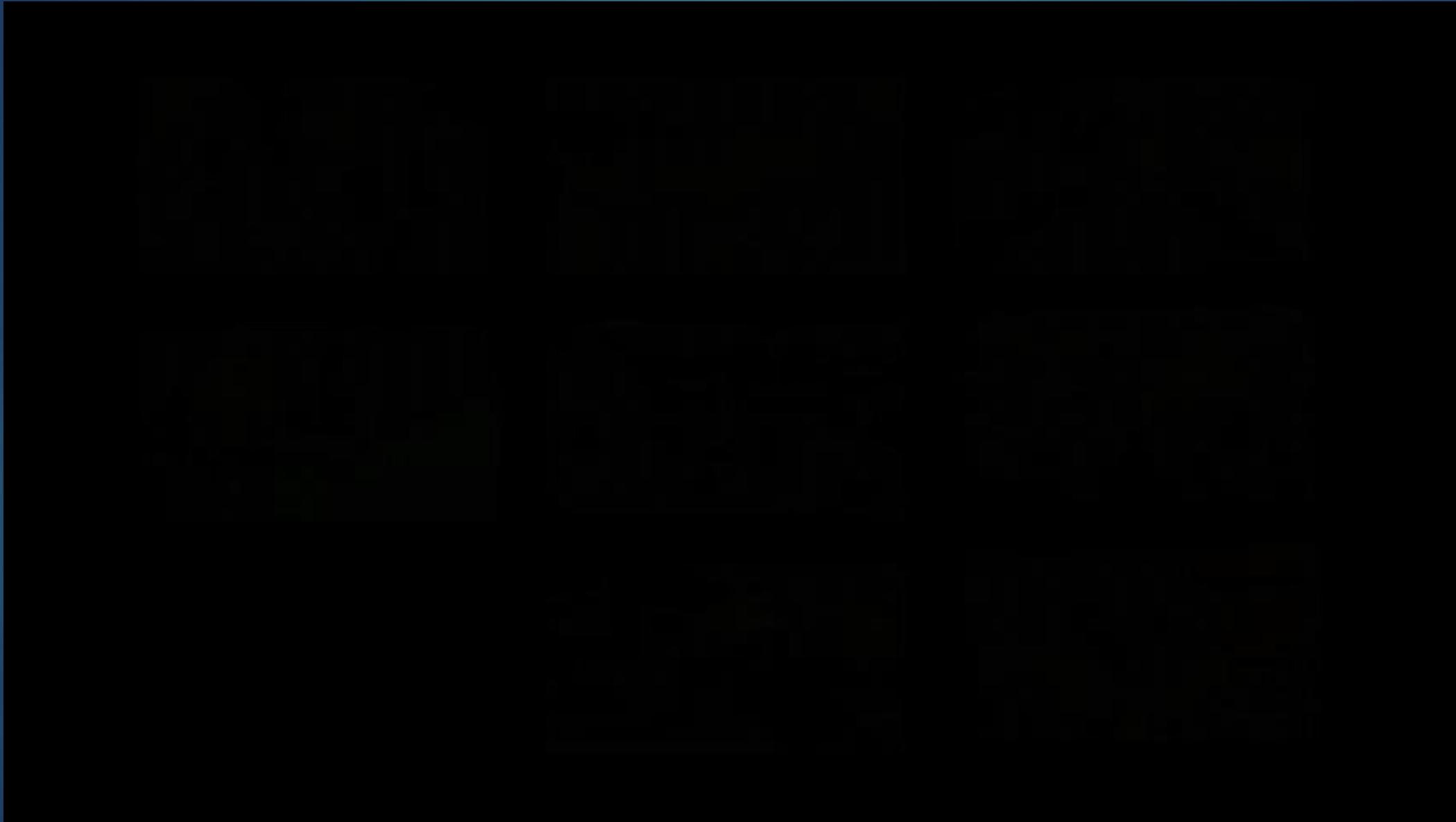
The average litter size ranges from 1.5 to 2.3 lambs.

The birth weight of the lambs range from 8-8.5 lbs (3.75-3.85 kg) and 45 day weights of 32.5-35 lbs (14.8-15.61 kg).

Milk production for the breed varies from 265 to 660 pounds (120-300 kg) of milk per lactation depending on management and husbandry conditions.

Fleece weight ranges from 2.6 to 5.5 pounds (1.2-2.5 kg).

Average wool quality measurements are: fiber diameter, 27-35  $\mu\text{m}$ ; spinning count 44's to 56's and staple length, 8-13 cm. Quality within a fleece is generally consistent but there is considerable variability between individuals



# Some Spanish sheep breeds



# Rasa Aragonesa

- ▶ The Rasa Aragonesa sheep is the second most important Spanish breed after the Merino breed. Spanish sheep breeds of medium quality wool are considered to have originated from the crossbreeding of fine-wool strains (Merino) and those with coarse wool (Churra and Lacha), though this viewpoint is overly simplistic.
- ▶ The Rasa Aragonesa breed, which owes its name to the region where it is of most importance, as well as to the length of its wool ("rasa" = threadbare), is raised mainly for its meat. Among the outstanding qualities of the Rasa Aragonesa are its high degree of ruggedness, gregarious instinct, pasturing ability, and adaptability to the harsh environment in which it is raised.
- ▶ Breed category: dual-purpose, medium wool



[http://www.ansi.okstate.edu/breeds  
/sheep/rasaaragonesa/](http://www.ansi.okstate.edu/breeds/sheep/rasaaragonesa/)



<http://www.sheep101.info/breedsA.html>

# Manchega



- ▶ The Manchega sheep comes from the Entrefino breed and has a double production use: milk and sheepmeat. Among this breed, there are two accepted varieties: black and white. The latter one makes up more than 90% of the animals. The average milk production is 100 liters (26.4 gallons) per animal a year, being markedly seasonal during the months of April, May and June.
- ▶ Manchego cheese is the most important and well-known sheep's milk cheese in Spain. True Manchega cheese is made only from whole milk of the Manchega sheep raised in the "La Mancha" region. This region is a vast high plateau, more than 600 meters (1,969 ft) above sea level.
- ▶ Breed categories: dual purpose (dairy and meat)

# British Breeds

*Longwool breeds:* Bluefaced Leicester (BL x Wensleydale), Border Leicester (BL), British Olderberg, British Texel, Cambridge (Cheviot, BL, Finn), Colbred (BL, DH, Clun Forest, East Friesian), Cotswold, Devon Closewool (Devon Long-wool x Exmoor Horn), Devon Longwoolled, Kent or Romney Marsh (RM), Leicester (L), Lincoln, South Devon, Wensleydale (L x Teeswater).

*Shortwool breeds:* Cheviot (Chev), Dorset Down, Dorset Horn (DH), Downs-Southdown, Hampshire, Suffolk, Dorset, Oxford, Shropshire, Exmoor Horn, North Country, Cheviot, Poll Dorset, Ryeland, Wiltshire Horn.

*Hill and mountain breeds:* Blackface Mountain, Black Welsh Mountain, Clun Forest, Dalesbred, Dartmoor Galway, Herdwick, Kerry Hill, Lonk, Radnor, Rough Fell, Scottish Blackface, South Wales Mountain, Swaledale, Teeswater, Welsh Mountain, White Face Dartmoor, Wicklow Cheviot.

*Rare breeds:* Badger-faced, Beulah Speckled Face, Cannock Chase, Cardy, Hebridean, Jacob, Lleyn, Hamvenog, Longmynd, Manx Loghtan, Maffe, Norfolk Horn, North Ronaldsay, Penistone, Portland, Thin Hill, St Kilda, Shetland, Soay.

*Crossbreds:* Masham (Teeswater x Dalesbred, Swaledale or Rough Fell or Blackface or Welsh Mountain), Mule (Bluefaced L, or BL x Swaledale), Scottish Greyface (BL x Black-face), Scottish Half-bred (BL or Bluefaced L x Cheviot), Welsh Half-bred (BL or Blue-faced L x Welsh Mountain), Main cross (Suffolk x Scottish Half-bred).

# Bluefaced Leicester

The Bluefaced Leicester evolved from a breeding scheme, to develop the Longwool sheep in the 1700's, by Robert Bakewell. Originally known as the Dishly Leicester. The breed was developed over the next 200 years and became commonly known as the Hexham Leicester due to it's early concentration in the North of England.

Bluefaced Leicester sheep should have a broad muzzle, good mouth and a tendency towards a roman nose, bright alert eyes and long erect ears. The colour of the head skin should be dark blue showing through white hair; although a little brown is acceptable. There should be a good length of neck laid into broad shoulders with a good spring of rib and a long strong back with no weakness behind the shoulder. The hindquarters should be broad and deep, the legs well positioned and strong boned. It is important that the wool be tightly purled, fine and open cleanly to the skin.



# Border Leicester Sheep

The Border Leicester is one of the British breeds of livestock the origins of which there are no doubts. They are the lineal descendants of the Dishley Leicesters bred and made famous by Robert Bakewell (1726-1795) of Dishley, Leicestershire.



Key strengths of the Border Leicester:

- ▶ Hybrid Vigour - producing high performance breeding ewes
- ▶ Excellent maternal characteristics - producing early maturing lambs
- ▶ Fast growth - producing fast finishing butchers lambs
- ▶ Easy keeping nature – producing easy to manage ewes for farms of all sizes
- ▶ Quality meat - producing a quality product for the housewife



# British Texel

The Texel sheep originates from the island of Texel off the Dutch North-Sea coast. Crossed with Lincoln, Leicester and Wensleydales in the late 19th century the small native Texel breed developed into a large and prolific sheep which became popular for its well fleshed but lean carcass.

The Texel is hardy, tough and docile. Ewes are frugal and proven to excel in grass-based rearing systems. Lambs are famously vigorous at birth with a great will to survive. The breed is moderately prolific with 1.7 lambs per ewe.

Because of the breed's adaptability and excellent carcase quality, which it passes on to first cross progeny, Texel rams have become the UK producer's preferred choice of Terminal Sire, in particular the increasing number of recorded rams, which deliver reliable performance in all environments. Changes in the growth potential of Texel sheep have been immense since the initial imports during the seventies enhancing both the efficiency and profitability of carcase production from Texel sired lambs.



<http://www.texel.co.uk/node/616>

# Devon and Cornwall Longwool

There have been longwoolled sheep in the South West for centuries and the Devon and Cornwall Longwool is the amalgamation of two local breeds: The South Devon and the Devon Longwool.

Size: Ewes- 75-80kg, rams- 100-110kg

A large, sturdy sheep with a distinctive longwoolled fleece. The breed is shorter than other longwool breeds but has a bulkier build. The face and legs are white and both sexes are polled.

Lambing %: Generally around 150%.

Birth weight: Lambs are medium sized and quick to rise. Few lambing problems, ewes are excellent mothers.

Meat: The Devon and Cornwall Longwool purebred lamb is able to be killed within 4 months. At 8 weeks of age lambs should weigh around 20.5kg <sup>1</sup>. The breed remains lean and is suitable for taking to heavier weights before killing. Crossbred lambs out of a Devon and Cornwall Longwool ewe will finish quickly and at good weights.

Wool: Staple length- 20-25cm. Fleece weight- 7-10kg (Some examples have weighed 20kg). Quality- 32s-36s.



# Hampshire Down

## Breed Standard

- ▶ **HEAD:** Face and ears of a rich dark brown. Intelligent bright eye. Ears well set on, fairly long and slightly curved backwards. In rams, a bold masculine head is an essential feature.
- ▶ **NECK AND SHOULDERS:** Neck of strong muscular growth not too long, and well placed on gradually sloping and closely fitting shoulders.
- ▶ **CONFORMATION:** Long deep and symmetrical, with the ribs well sprung, broad, straight back, flat loins, wide rump, deep and heavily developed muscular gigot, tail well set up.
- ▶ **LEGS AND FEET:** Strongly jointed and powerful legs of the same colour as face, set well apart, the hocks and knees not bending towards each other. Feet sound and up on the pastern.
- ▶ **WOOL:** White, of moderate length, close and fine texture.
- ▶ **SKIN:** Pink and Flexible.



[http://www.hampshiredown.org.uk/index.php?option=com\\_phocagallery&view=category&id=5:the-showing&Itemid=210](http://www.hampshiredown.org.uk/index.php?option=com_phocagallery&view=category&id=5:the-showing&Itemid=210)



# Hungarian sheep breeds

# Hungarian racka sheep

- ▶ The Racka is a unique breed with both ewes and rams possessing long spiral shaped horns. The breed is of the Zackel type and originated in Hungary. The breed is used for milk, wool and meat production. Mature males may have horns as long as two feet or more. The minimum standard length is given as 50 cm (20 inches) for rams and 30 cm (12-15 inches) for ewes. The cork-screw horns protrude almost straight upward from the top of the head.
- ▶ The breed is found in two major colour patterns. The most common shows brown hair covering the heads and legs with the fleece varying in colour from dark brown to light brown and white. Individuals are also found which are solid black. The wool tips on these animals fades to a reddish black with exposure to sunlight and with age the points of the fleece will turn gray. The minimum acceptable mature body weight for ewes is 40 kg (88 lbs) and for rams 60 kg (132 lbs). The rams average 72 cm (29 inches) in height.



# Hungarian racka sheep

- ▶ The wool is variable within the breed. It is generally described as having a fiber diameter of 12-40 microns. The yield is 38-65 percent. Staple length is approximately 30 cm (12 inches). Fleece weight must be at least 3 kg (6.6 lbs) for rams. The softness and crimp of the wool would indicate its interest in handspinners.
- ▶ The Racka has been described as a hardy animal and is often used in crossbreeding due to its ability to pass this survivability to its offspring. The breed's unique appearance and quiet disposition would make it a desirable animal for hobby situations.



# Cigaja sheep

The **cigaja** sheep that is bred mainly in the Balkan Peninsula also popular in Southern Transylvania, the Banat, and the counties of Bars and Gömör in Southern Slovakia. It is a medium sized sheep with black head and legs. Its distinctive feature is the greyish colour of the fleece that is caused by black hairs in the white wool. Originally rams wore spiral horns; ewes are hornless or wear crescent-shaped so-called “goat horns”



# Awassi in Hungary



# Questions

- ▶ How are sheep breeds grouped?
- ▶ What are the main sheep breeds in Australia?
- ▶ What are the main sheep breeds in New Zealand?
- ▶ What are the main sheep breeds in Europe?



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- [https://www.rbst.org.uk/sitemanager/uploads/ck\\_files/files/Devon%20&%20Cornwall%20Longwool%20-%20Fact%20Sheet.pdf](https://www.rbst.org.uk/sitemanager/uploads/ck_files/files/Devon%20&%20Cornwall%20Longwool%20-%20Fact%20Sheet.pdf)



TÁMOP-4.1.1.C-12/1/KONV-2012-0004

# ANIMAL BREEDING

című digitális tananyag

Szegedi Tudományegyetem Mezőgazdasági Kar  
Állattudományi és Vadgazdálkodási Intézet

Mikó Józsefné Dr. Jónás Edit  
Főiskolai docens

2014.

**SZÉCHENYI** 2020



MAGYARORSZÁG  
KORMÁNYA

**Európai Unió**  
Európai Szociális  
Alap



**BEFEKTETÉS A JÖVŐBE**



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# CHAPTER 14

## SHEEP LACTATION AND LAMB GROWTH

**SZÉCHENYI** 2020



MAGYARORSZÁG  
KORMÁNYA

**Európai Unió**  
Európai Strukturális  
és Beruházási Alapok



**BEFEKTETÉS A JÖVŐBE**

# Nutrition during pregnancy

Severe under nutrition during late pregnancy prevents normal udder development, delays the onset of lactation and reduces milk production in lactation.

In ewes that maintain or lose maternal body weight in late pregnancy, subsequent milk yield may also be reduced unless nutrition during lactation is well above maintenance.

The body condition of ewes at lambing can affect milk production.

Ewes that are very fat at lambing eat less than thinner animals.



# Nutrition during pregnancy

If feed quantity or quality is restricted during early lactation, fat ewes are able to mobilise body fat reserves and other tissues, thereby compensating in part for inadequate nutrition, and can thus produce higher milk yields than thinner ewes.

On the other hand, if feed quality and quantity are adequate to sustain lactation, thinner ewes will eat more than fat ewes and differences between their milk yields will be small.

Over the first 3 weeks of lactation all ewes were fed at the same level using calculated requirements for metabolisable energy.

Differences between milk yields of ewes rearing single lambs were small, compared with large differences in those rearing twins, illustrating the importance of the lamb in determining milk production of suckling ewes.



<i>No. of lambs</i>	<i>Feeding level before lambing*</i>	<i>Milk yield (g/day) in week</i>			<i>Total milk yield (kg)</i>
		<i>1</i>	<i>2</i>	<i>3</i>	
<i>Single</i>	0.8	1,365	1,389	1,562	30.2
	1.0	1,201	1,502	1,679	30.6
	1.3	1,558	1,548	1,455	31.9
<i>Twins</i>	0.8	1,724	2,026	1,746	38.5
	1.0	2,215	2,002	2,026	43.7
	1.3	2,337	1,746	2,429	45.5

## Pre-lambing nutrition and milk yield.

\* expressed relative to requirements

Source: International Sheep and Wool Handbook

Good pasture production greatly enhances the ewe's nutrient intake and capacity to produce more milk and rear good lambs.

Varying levels of nutrition during lactation are generally reflected directly in variations in milk yield.

Restricted nutrition during the first 3-4 weeks of lactation has reduced milk production during the period of restriction but the effect was less marked in fat compared with lean ewes and in those rearing twins.

Milk yield can be restored to normally predicted levels with removal of the restriction before the ewes would normally have reached peak production.

## Nutrition during lactation



# Nutrition during lactation

Responses of milk yield to increased nutrition have been greatest in ewes underfed during pregnancy and so in lighter body condition.

In situations where fat ewes have restricted nutrition, utilization of body fat reserves for milk production has increased with dietary protein supplementation.

Therefore good pasture feeding of ewes during lactation is important for high milk production but if pasture is limited ewes in fat body condition will sustain better production than those in light body condition.



# Number of lambs born and reared

Ewes that bear single lambs have a lower potential to produce milk than those bearing multiple lambs due to reduced development of mammary tissue during pregnancy.

Potential for milk production is only realised if ewes rear twin lambs.

Ewes rearing twin lambs usually yield 30-50% more milk than ewes rearing single lambs in the same environment.



[http://www.schoolhousepress.com/NL\\_sep09mw.htm](http://www.schoolhousepress.com/NL_sep09mw.htm)



<http://www.versatilesuperewe.co.uk/maternal.htm>

Ewes rearing triplets and quadruplets can yield 60- 100% and 155% more milk, respectively, than ewes rearing single lambs.

Ewes with twin lambs usually produce maximum amounts of milk in the second to third weeks of lactation, whereas this occurs in the fourth or fifth week of lactation in ewes rearing singles.

The poorer persistency of lactation that may occur in ewes rearing twins possibly reflects an inability to obtain adequate nutrients and/or more rapid depletion of body tissue reserves. When fed well they will maintain high milk yields.

## Number of lambs born and reared



<http://fermer.ru/forum/ya-i-moi-ovtsy/75145>

# Nutrition of suckling lambs

Milk from ewes almost solely nourishes the new born lamb for the first 3-4 weeks of life when growth rate of the suckling lamb is correlated highly with milk intake.

Then the lamb progressively consumes increasing quantities of solid foods, including pasture, crop or supplements.

Under the most common systems of rearing, lambs are weaned at 3-4 months.

With continuous access to their dams the frequency of lamb suckling will be influenced by number and size of lambs, age of lamb, ewe milk production and intake of solid food (usually pasture) by the lamb.

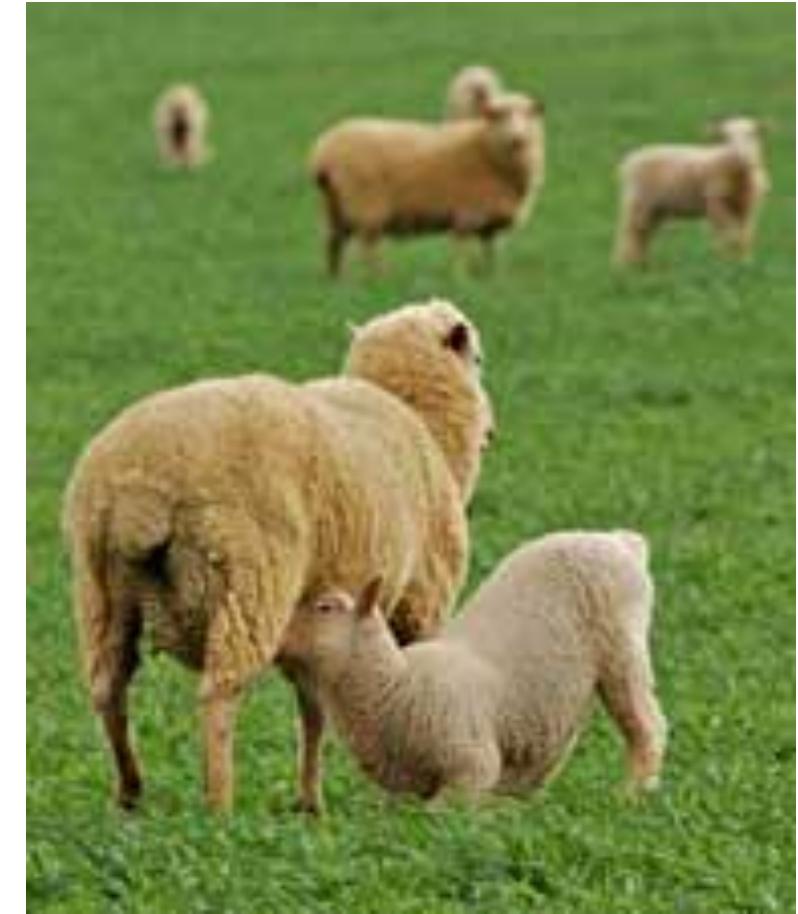


Milk passes directly to the lamb's abomasum, by-passing the undeveloped rumen via the oesophageal groove.

During the first weeks of life the young lamb has a monogastric type of digestion, which results in rapid growth provided milk intake is high.

The demand by lamb(s) for milk normally sets the pattern of lactation in the ewe.

Birth weight of the lamb has little effect on the demand for milk, provided it is within normal limits.



<http://www.dpi.nsw.gov.au/agriculture/livestock/sheep/management>

However, the number of lambs suckled, breed and strain of lamb, and breed of the ewe, influence demand and level of milk production.

This supply and demand interdependence in turn determines lamb growth rates.

With single suckling lambs milk intake gradually increases to a peak around weeks 4-6 then gradually declines, as they commence eating significant quantities of solid food.

For ewes suckling multiple lambs, their ability to produce milk will be the major factor influencing early growth of their lamb(s).



[http://commons.wikimedia.org/wiki/File:Sheep,\\_Dedham\\_3.jpg](http://commons.wikimedia.org/wiki/File:Sheep,_Dedham_3.jpg)



<http://embaron.files.wordpress.com/2011/05/sucklinglam.jpg>

# Intake of solid food

Lambs do not begin to eat significant amounts of solid food until around 3- 4 weeks of age, with a difference between twins and singles related to milk availability.

Lambs at pasture have higher intakes of herbage, of higher quality due to grazing selection, than lambs offered cut herbage indoors even though herbage and milk is freely available. As herbage intake increases, milk intake decreases.



# Artificial rearing of lambs



# Importance of colostrum

The newborn lamb has no antibodies in its blood-stream but obtains antibody protein from colostrum.

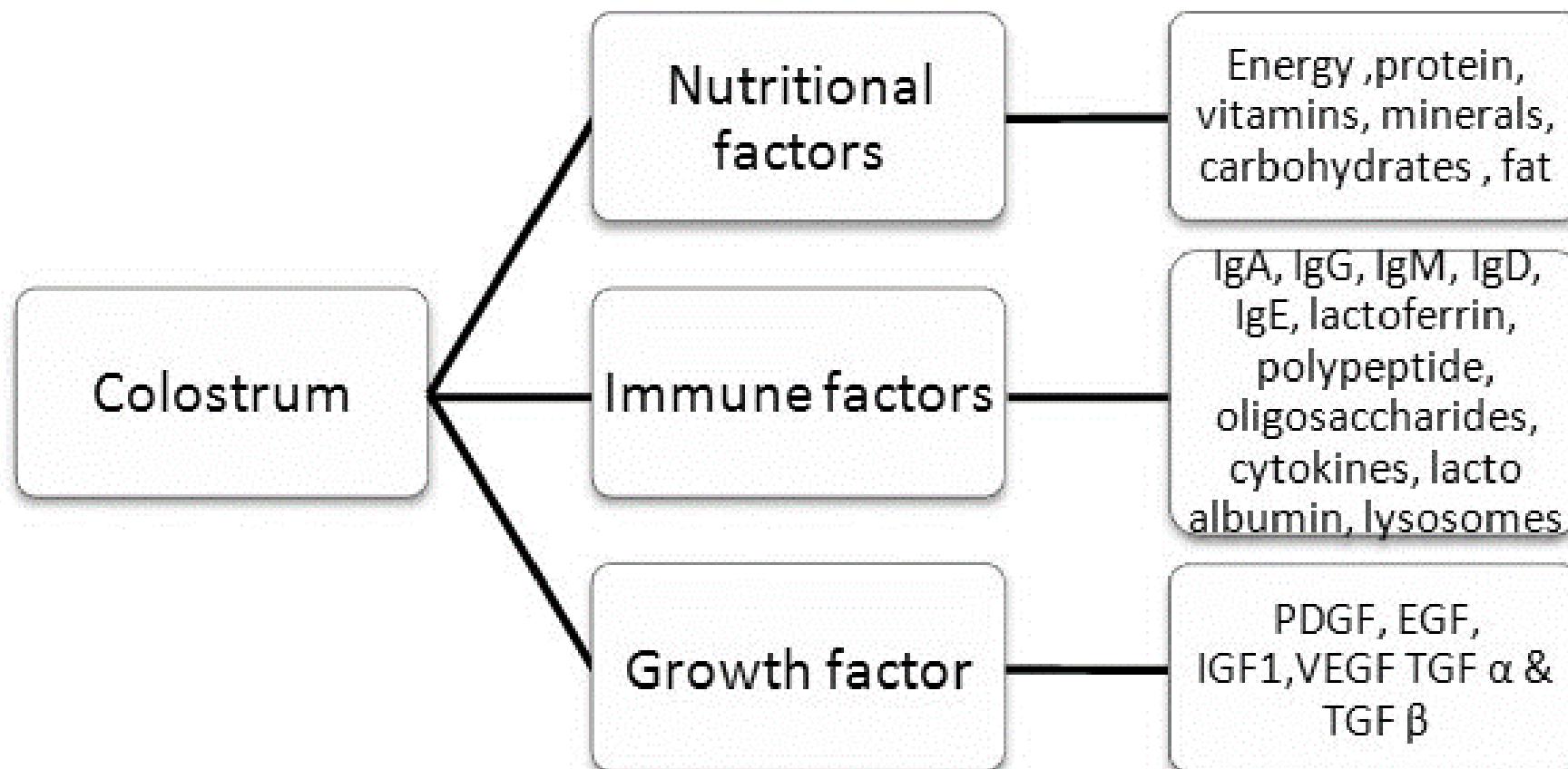
This source of antibody can only be absorbed intact across the intestine in significant amounts during the first 24-48 hours after birth.

Accordingly, it is important that lambs obtain colostrum in the first hours after birth or survival is severely endangered.

Hence the ewe, by producing antibodies, 'passively immunises her lamb(s) against infectious organisms.

Artificially reared and orphaned lambs during the first hours of their life need access to frozen ewe colostrum or need to be injected with plasma, serum or antibodies (gamma globulins) from mature sheep

# Composition of Colostrum



# Milk substitutes

The pre-ruminant lamb is unable to digest complex carbohydrates and requires a diet closely resembling ewe's milk available in a number of commercial milk replacers.

**Calf milk replacers** are **unsuitable** as the fat globules are not homogenised as in ewes milk and levels of lactose are higher often causing digestive upsets.



# Important factors of milk substitutes for feeding lambs

## Type of fat

Ewe's milk contains about 6% fat representing 35% of the dry matter. It is difficult to commercially prepare a milk substitute containing a high fat content.

Those containing 25-30% DM as fat result in satisfactory lamb growth.

Below this level, lambs consume more but have lower growth rates and increased incidence of digestive disorders.

Animal fats such as tallow and lard are commonly used in formulation of milk substitutes.

Small amounts of vegetable oils of equal digestibility may be added.

The fat should be stabilised with anti-oxidant. Addition of an emulsifying agent such as lecithin, mono- or triglyceride and homogenisation of the fat improves its utilisation.

# Important factors of milk substitutes for feeding lambs

## Type of protein

Ewe's milk contains about 5% protein representing 30% of the dry matter. Proteins are expensive but satisfactory growth rates are often achieved with 25% DM as total protein.

Skim milk powder, which contains casein as the predominant protein, is commonly used but is expensive. High temperatures during preparation denature the protein, rendering it less digestible for the lamb, so spray drying is preferred to the hotter roller drying.

It is now common to find that milk substitutes contain substantial amounts of vegetable and animal proteins.

# Important factors of milk substitutes for feeding lambs

## Type of carbohydrate

Pre-ruminant lambs can utilise glucose and galactose in addition to lactose, the carbohydrate in ewe's milk.

A milk substitute needs to contain these carbohydrates, otherwise it will not be digested in the small intestine and may undergo fermentation in the large intestine leading to digestive disorders.

## Vitamins and minerals

Skim milk contains sufficient water-soluble vitamins and minerals to support normal growth during the early weeks of life.

It may be necessary to add supplements of the fat-soluble vitamins.

Milk substitutes containing other proteins may need vitamins and minerals added to achieve satisfactory growth.

## Advantages, disadvantages and associated costs of various feeding systems for artificial feeding/rearing of lambs

Feeder type	Advantages	Disadvantages	Cost
Bottle & nipple	<ul style="list-style-type: none"> <li>❖ inexpensive</li> <li>❖ easy to clean</li> </ul>	<ul style="list-style-type: none"> <li>❖ only suitable for small numbers of lambs</li> </ul>	\$1.20 - \$1.75
Nipple pail	<ul style="list-style-type: none"> <li>❖ easy to clean</li> <li>❖ relatively low cost</li> <li>❖ readily available</li> <li>❖ low time per lamb</li> </ul>	<ul style="list-style-type: none"> <li>❖ chewed nipples can result in loss of entire pail of milk</li> <li>❖ pails can be tipped if not secured properly</li> </ul>	\$30 - \$70
Multiple nipple units	<ul style="list-style-type: none"> <li>❖ little or no milk loss</li> <li>❖ container is outside pen - avoids spilling and contamination</li> </ul>	<ul style="list-style-type: none"> <li>❖ can be difficult to teach lambs to drink</li> <li>❖ ensure there are check valves in tubes</li> </ul>	\$30 - \$70
Teat bar	<ul style="list-style-type: none"> <li>❖ closed system</li> <li>❖ home-made</li> </ul>	<ul style="list-style-type: none"> <li>❖ time for construction and maintenance of bar</li> </ul>	\$75 - \$150
Automatic feeding unit	<ul style="list-style-type: none"> <li>❖ low labour</li> <li>❖ 50 lambs per unit</li> </ul>	<ul style="list-style-type: none"> <li>❖ expense</li> <li>❖ milk storage temperature</li> </ul>	\$1000 - \$1500

## Various feeding systems for artificial feeding/rearing of lambs

Bottle & nipple



<http://www.bbc.com/news/uk-scotland-13092736>

Nipple pail



<http://www.premier1supplies.com/sheep-guide/wp-content/uploads/2012/10/orphansinuse.jpg>

Multiple nipple units



<http://calf-feeding.co.uk/testimonials.html>

Teat bar



<http://www.milkbar.co.nz/Products/LambKidTeatsFeeders.aspx>



<http://www.youtube.com/watch?v=ZRqwq1Tbkwk>



Teat bar



Automatic feeding unit

# Weaning of lambs

Weaning is when the milk is removed from the diet of a young mammal. Usually – but not always – it coincides with separation of the young from their dam.

Early weaning is usually defined as weaning prior to 90 days of age; 60 days is most common.

Late weaning is anything after that.



## A comparison of early vs. late weaning

<b>Early (less than 90 days)</b>	<b>Late (more than 120 days)</b>
<p>It is not necessary to castrate ram lambs.</p> <p>It is more efficient to feed grain to lambs than ewes.</p> <p>It eases lactation stress of prolific ewes</p> <p>It allows ewes to return to breeding condition earlier.</p> <p>Cull ewes can be sold earlier.</p> <p>Lambs can usually be marketed earlier.</p> <p>Pasture is saved for ewes.</p> <p>More ewes can be maintained on farm.</p>	<p>It is more natural.</p> <p>Lambs and ewes are less stressed.</p> <p>There is less risk of mastitis.</p> <p>It requires less pens and/or pasture fields.</p> <p>It takes advantage of available forage.</p> <p>Pasture gains may be more economical than feedlot gains.</p>
<p><b>However . . .</b></p> <p>It is more stressful to lambs and ewes.</p> <p>Ewes are more prone to mastitis.</p> <p>Extra pens and/or pasture fields are needed.</p>	<p><b>However . . .</b></p> <p>Lambs have to compete for the same pasture as ewes.</p> <p>Lambs are more likely to become infected with worm larvae.</p> <p>Lambs are exposed to more disease agents.</p> <p>Predator losses could be higher.</p> <p>Ram lambs need to be castrated.</p>

# Wean by weight

It is generally better to wean based on weight rather than age.

A general recommendation is that lambs and kids not be weaned until they have achieved 2.5 to 3 times their birth weight.

Artificially-reared lambs and kids should weigh at least 9-11 kg before being weaned.

Even more important than weight is dry feed consumption, as weaned lambs need to be consuming enough dry feed to support their maintenance and continued growth – in the absence of milk in their diet.

Their feed consumption should be at least 1 percent of their body weight at the time of weaning.

# Early weaning

Early weaning is most commonly associated with early, winter, and shed lambing.

After weaning, lambs are usually finished on hay and/or grain diets.

Early weaned lambs are usually creep fed.

Early weaning is probably best suited to prolific breeds and breeds that have high genetic potential for growth.

In a dairy sheep enterprise, it is common to wean lambs when they are 30 to 35 days of age.

Lambs that are artificially-reared are usually weaned by the time they are 6 to 8 weeks of age.

# Late weaning

The late weaning is more natural. It is less stressful to lambs.

The risk of mastitis is much less.

Late weaning is most commonly associated with late lambing, spring lambing, and pasture lambing. Lambs are typically finished on pasture diets. Late weaning is probably best suited to less prolific breeds and breeds with less potential for growth.

# Questions

- How do you feed a sheep during pregnancy?
- How do you feed a sheep during lactation?
- How do you feed a sheep during pregnancy?
- What is the difference between early and late weaning?

# Sources:

DJ. Cottle (2010): International Sheep and Wool hand book, Nottingham University Press

<http://www.sheepandgoat.com/articles/weaning.html>

<http://www.sheep101.info/201/weaning.html>



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# CHAPTER 15

## SHEEP REPRODUCTION

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The full reproductive cycle in female sheep spans 7-10 months. It comprises oestrus or receptivity to the ram, mating, fertilisation, implantation of the embryo, pregnancy, parturition or birth of the lamb, the bonding of dam and new born offspring and lactation up until the time of weaning.

High reproductive efficiency is a key determinant of the profitability of most sheep enterprises. In the case of prime lamb production, the benefit of increasing reproduction rate is directly visible in the greater number of lambs per ewe available for sale.

For self-replacing flocks, where wool production is paramount, greater reproductive efficiency not only increases the number of surplus animals available for sale but also allows for higher culling rates, more rapid genetic improvement, and a decrease in the number of ewes necessary to maintain the wether flock.



<http://www.sheep101.info/201/ewerepro.html>

# Reproductive Organs and Their Major Functions

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FEMALE

**Ovaries:** The ovaries contain the ova (eggs), and secrete female reproductive hormones (progesterone and estrogens).

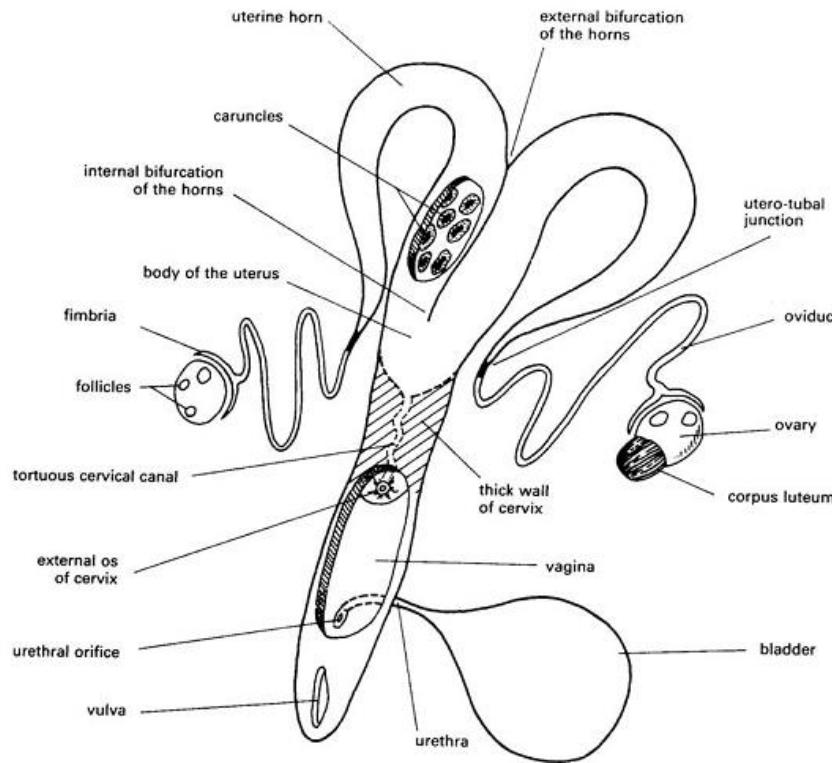
**Oviduct:** The oviduct opens like a funnel (the infundibulum) near the ovary. The infundibulum receives ova released from the ovary and transports them to the site of fertilization in the oviduct. The oviduct is involved in sperm transport to the site of fertilization, provides a proper environment for ova and sperm fertilization, and transports the subsequent embryo to the uterus.

**Uterus:** The uterus consists of two separate horns (coruna). In animals with multiple births, each horn can contain one or more fetuses. The uterus provides a proper environment for embryo development, supports development of the fetus (supplying nutrients, removing waste, and protecting the fetus), and transports the fetus out of the maternal body during birth.

**Cervix:** The cervix is the gateway to the uterus and is a muscular canal consisting of several folds of tissue referred to as “rings.” The cervix has relatively little smooth musculature. It participates in sperm transport, and during pregnancy, blocks bacterial invasion. The mucus produced during pregnancy (also during the luteal phase) forms a plug that makes the opening through the cervix impermeable for micro-organisms and spermatozoa.

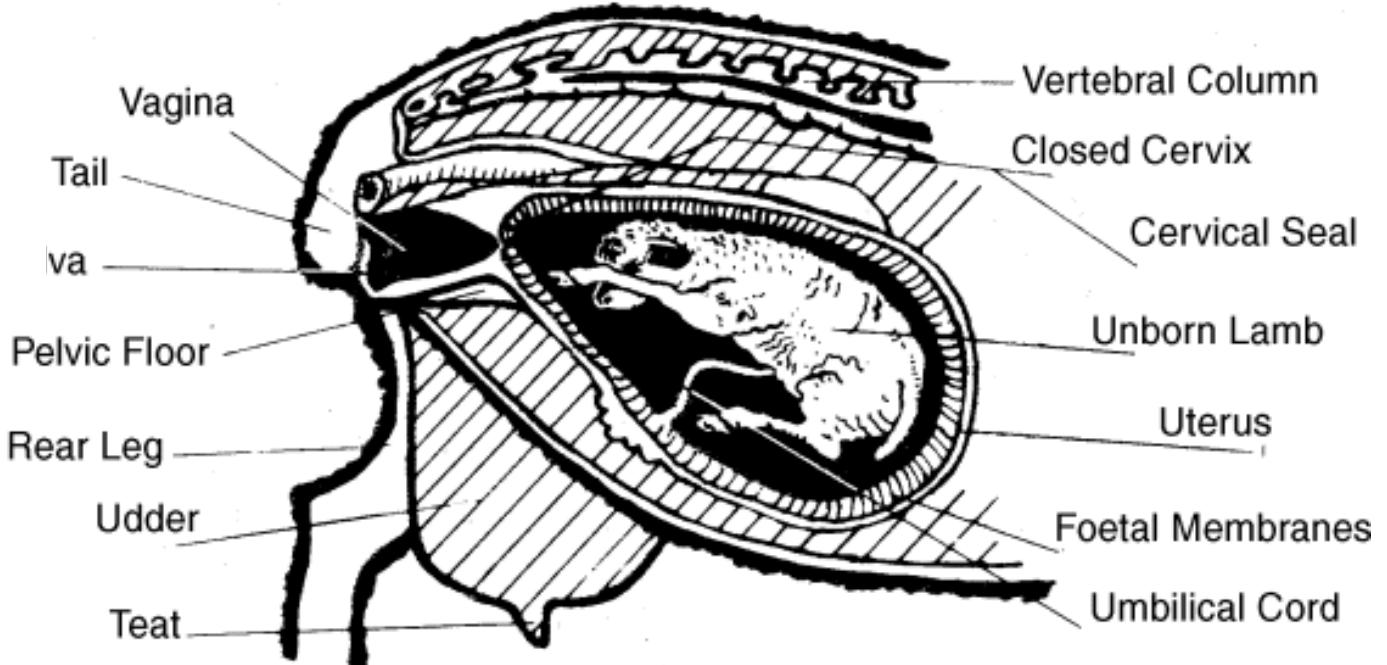
**Vagina:** This is the exterior portion of the female reproductive tract and is the site of semen deposition during natural mating.

**Vulva:** barrier for preventing external contamination of the female reproductive tract.



The reproductive organs of the ewe.

## Full Term Ewe with Lamb in Normal Presentation



<http://www.omafra.gov.on.ca/english/livestock/sheep/facts/98-091.htm>

# Oestrous cycle, oestrus and the breeding season

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The reproductive organs of the ewe function in repetitive cycles of 15-18 days duration, called oestrous cycles.

For a limited period of about 20-35 hours of each oestrous cycle the ewe will accept and may actively seek out the ram.

Because ewes are seasonally polyoestrous, a high proportion of them exhibit regular oestrous cycles only during particular months.

In the Southern Hemisphere, including Australia, this breeding season usually lasts from approximately February to June, but the actual duration of breeding activity is highly variable

and depends on several factors, to be discussed later. During the remainder of the year or non-breeding season, British-breed ewes are in anoestrus and their ovaries secrete relatively little hormone and do not ovulate.

# Oestrous cycle, oestrus and the breeding season

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Under natural conditions, mating in sheep usually precedes the spring by an interval of about 5 months, or the duration of pregnancy.

The sheep is called a short-day breeder, since the stimulus that controls the onset of breeding activity is the decrease in the ratio of light to dark hours.

It requires about 6-10 weeks of a decreasing light-dark ratio to stimulate breeding, and breeding activity often ceases within 1-3 months after the winter solstice.

Most breeding activity occurs during March-April.

Joinings at this time for as little as 4 weeks may result in 90% or more of ewes being in lamb.

# Hormonal control of the oestrus cycle

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- oestrus cycle is controlled by GnRH (Gonadotrophic Releasing Hormone) released by the hypothalamus.
- Just before the onset of oestrus, the pituitary gland, under the control of the hypothalamus in the brain, releases an increasing amount of Luteinizing Hormone (LH) and Follicular Stimulating Hormone (FSH).
- Growth of follicles is regulated by pituitary hormones – FSH, LH.
- LH stimulates the final maturation of the follicle containing the eggs (oocytes) and stimulates the follicle to produce the hormone estrogen.
- Estrogen brings the ewe into behavioral oestrus or 'heat.'
- The rising concentration of estrogen stimulates a surge in LH that stops further secretion of estrogen by the follicle.
- Once the egg has been released, LH transforms the follicle into a Corpus luteum (CL).
- CL produces progesterone, which in turn suppresses pituitary activity.
- If pregnancy does not occur, lysis (destruction) of the Corpus luteum occurs due to endogenous release of prostaglandin from the uterus, thus causing a fall in the progesterone level, and the cycle starts again.

# Behavioural signs of oestrus

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The signs of oestrus in the ewe are not obvious unless a ram is present. As in the doe, the vulva is swollen and redder than usual, and there is a discharge of mucus but is difficult to see in a ewe with a tail or fleece.

All of the symptoms mentioned may not be exhibited by a doe or ewe in oestrus. The best confirmation of

Oestrus is when the doe or ewe stands when being mounted. This is commonly called 'standing heat.' The duration of oestrus is variable in that it is shorter in younger ewes and does but longer in older animals.

Normal duration will be 24 to 36 hours.

# Estrus detection techniques

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- Using a teaser ram: teasers are males that have been either vasectomized or epididymized
- Tying an apron made of leather or canvas around the body of a ram to prevent the penis from entering the vagina of females
- Using a teaser with a marking harness: when a ram with a marking harness mounts a female in oestrus, some of the marking pigment will be transferred to the rump of the female
- Using oestrus detector

A photograph of three white sheep standing in a field of tall, golden-brown grass. The sun is low in the sky, creating a warm, golden glow and long shadows. The sheep are looking towards the camera. The background shows rolling hills under a clear sky.

# DRAMIŃSKI

# Estrous Detector for sheep

<http://www.youtube.com/watch?v=uusiGdQpoc0>

## Teaser Rams



<http://www.infovets.com/demo/demo/smrm/B538.HTM>



[http://premierfarmdiary.blogspot.hu/2011\\_11\\_01\\_archive.html](http://premierfarmdiary.blogspot.hu/2011_11_01_archive.html)

## Apron of ram



<http://www.ukal-elevage.com/en/product/apron-ram>



<https://www.flickr.com/photos/baalands/5009989450/>



# Reproductive Organs and Their Major Functions

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MALE

**Testes:** The testes are paired organs which descend from the abdominal cavity during fetal development to lie in the scrotum. They produce the male gametes (spermatozoa) and secrete the male sex hormone, testosterone. Testosterone is essential for the development of male characteristics, maintaining normal sexual behavior and sperm production.

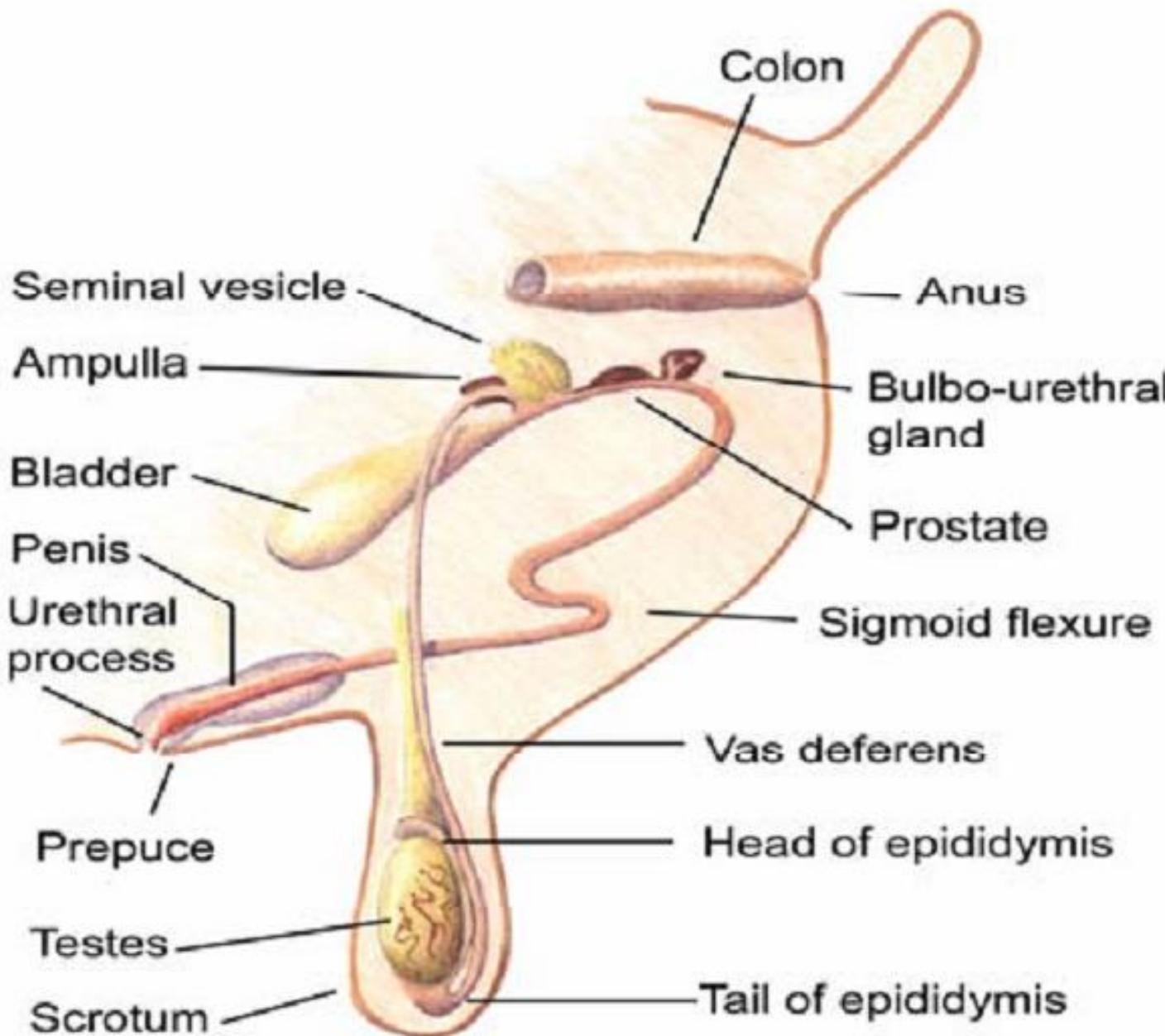
**Scrotum:** The scrotum is a muscular sac containing the testes. It supports and protects the testes and also plays a major role in temperature regulation. It maintains the temperature 3 to 5 °C below body temperature for optimal function.

**Epididymis:** The epididymis is located in the testes and is a long and convoluted tube in which sperm cells produced by the testicles are stored and mature to a stage capable of fertilization. This change occurs as sperm cells move from the head to the body of the epididymis with mature sperm being stored in the tail of the epididymis.

**Vas deferens:** The vas deferens is the duct that rises from the tail of the epididymis into the abdomen, where it joins the urethra at the neck of the bladder. It is often referred to as the 'spermatic cord.' Removal of a section of the vas deferens in each testis is known as a vasectomy, preventing passage of sperm from the epididymis.

**Accessory sex glands:** The accessory sex glands include the bulbo-urethral, prostate, and seminal vesicle glands and the ampulla. Accessory glands secrete additional fluids, which when combined with the sperm and other secretions from the epididymis, form the semen. Some of the secretions contain nutrients like fructose while others produce alkali secretion to raise the pH of the ejaculate. These secretions are added quickly and forcibly during the mating to propel sperm into the urethra.

**Penis:** This is the final part of the male reproductive tract and its function is to deposit semen into the vaginal tract of the female. At the end of the penis is a narrow tube called the urethral process (or 'worm') that sprays the semen in and around the cervix of the ewe/doe. The preputial sheath protects the penis, except during mating



The reproductive tract of the buck

# Mating Systems

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## Controlled natural mating

All rams should have the capacity to successfully cover a large number of ewes during the breeding season. Clearly this depends on the rams being in good health and having high libido and daily sperm production.

## Flock-mating

Fertile rams or bucks are allowed to remain continuously with a group of females. This mating system is commonly practiced by pastoralists. Under smallholder conditions, a flock may constitute all sheep or goats in a given village. This method avoids the need for heat detection but makes recording the mating date, the sire and calculation of the expected date of parturition difficult unless breeding males are fitted with a marking harness. Flock mating provides the best result in terms of fertility and lamb crop given an appropriate male-to-female ratio. However, inbreeding and subsequent declines in productivity could occur unless males are rotated or replaced on a predetermined period.

# Mating Systems

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## **Pen-mating**

This involves confining a sire with a group of females, in a paddock for example, for mating during the service period. A variation of this method may include housing groups of females with a selected breeding ram at night. Continuous supervision is important to make changes of sires if the assigned sire does not perform well. Sires may be fitted with a marking harness that enables calculation of the estimated date of lambing.

## **Hand-mating**

This involves detecting females in oestrus and bringing them to breeding males. In such a system, regular and efficient heat detection methods are essential. The PM-AM method of breeding is used, where females detected in oestrus in the afternoon are bred early the next morning and those detected in oestrus in the morning are bred in the afternoon of the same day. In terms of fertility, this method is the least efficient as the male is restricted in breeding the female. A variation of this system is observed where a producer may have few female sheep or goats but no breeding male. One sire kept by an individual will serve sheep or goats of many surrounding owners who bring ewes/does in oestrus to the male. In some instances ewes or does in oestrus are brought to the market, where male animals are available for breeding.



<http://www.youtube.com/watch?v=yJhRRGFri0g>

# Artificial insemination (AI)

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Artificial insemination is possible in sheep, but not common in the United States. This is because the ewe has a very complicated cervix which makes trans-cervical A.I. as is done with cattle, swine, and goats more difficult. As compared to other livestock, the ewe shows few visible signs of heat (estrus). Breed improvement in the sheep industry has been much slower to develop and the industry lacks a means to identify superior genetics.



<http://www.fwi.co.uk/articles/28/01/2014/143026/changes-to-beef-and-sheep-fat-depth-breeding-values.htm>



<http://familycow.proboards.com/thread/59660/artificial-insemination-sheep>

# Artificial insemination (AI)

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There are four methods of artificially inseminating a ewe: vaginal, cervical, trans-cervical, and intrauterine.

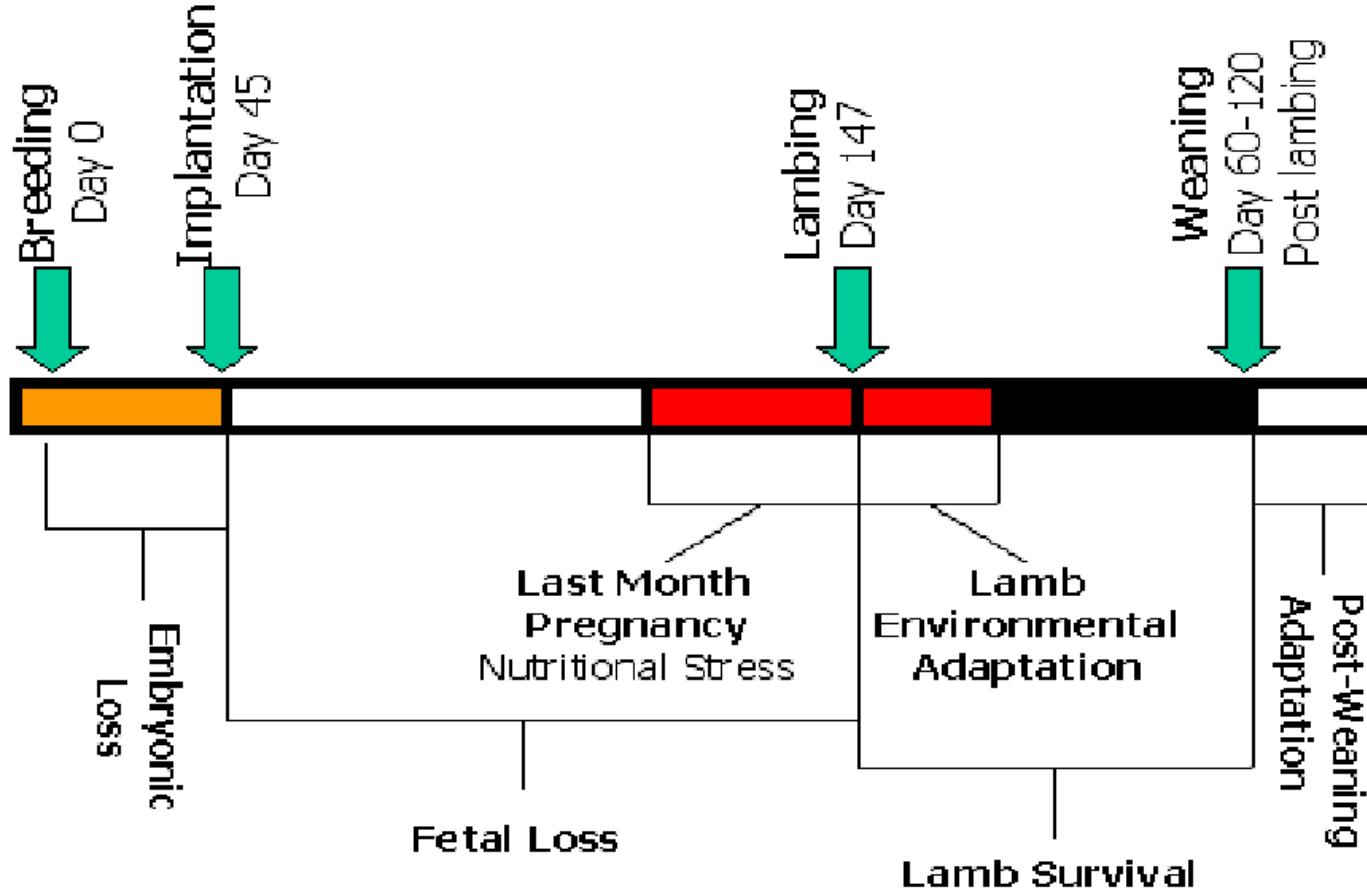
**Vaginal AI** is the simplest form of insemination and involves depositing fresh semen into the anterior vagina without any attempt to locate the cervix. Reported success rates are highly variable and this method is unsuitable for use with frozen semen.

**Cervical AI** is another cheap and relatively easy method of insemination. The cervix is located, via a speculum fitted with a light source, and the semen is deposited into the first fold of the cervix. Conception rates with fresh or chilled semen are good, but generally unacceptably low with frozen, thawed semen.

**Trans-cervical** method of insemination involves grasping the cervix and retracting it into the vagina with a pair of forceps to allow an inseminating instrument to be introduced into the cervical canal. The University of Guelph (Canada) has developed an instrument with a special bent tip that allows passage through the cervix.

**Laparoscopic AI** also known as intrauterine, by-passes the cervix and deposits semen directly into the uterine horns. In 1982, Australian researchers developed the laparoscopic insemination (LAI) procedure that revolutionized the sheep AI technique. LAI is a minimally invasive, minor surgical procedure that requires veterinary expertise.

# Reproductive Phases of the Ewe



# Questions

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- What does buck reproductive tract consist of?
- What does ewe reproductive tract consist of?
- What are the behavioural signs of oestrus?
- What are the oestrus detection techniques?

# Source:

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DJ. Cottle (2010): International Sheep and Wool hand book, Nottingham University Press

[http://www.esgpip.com/HandBook/Handbook\\_PDF/Chapter%205%20Reproduction%20in%20Sheep%20and%20Goats.pdf](http://www.esgpip.com/HandBook/Handbook_PDF/Chapter%205%20Reproduction%20in%20Sheep%20and%20Goats.pdf)

<http://www.sheep101.info/201/index.html>



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# CHAPTER 16

## WOOL PRODUCTION AND PROCESSING

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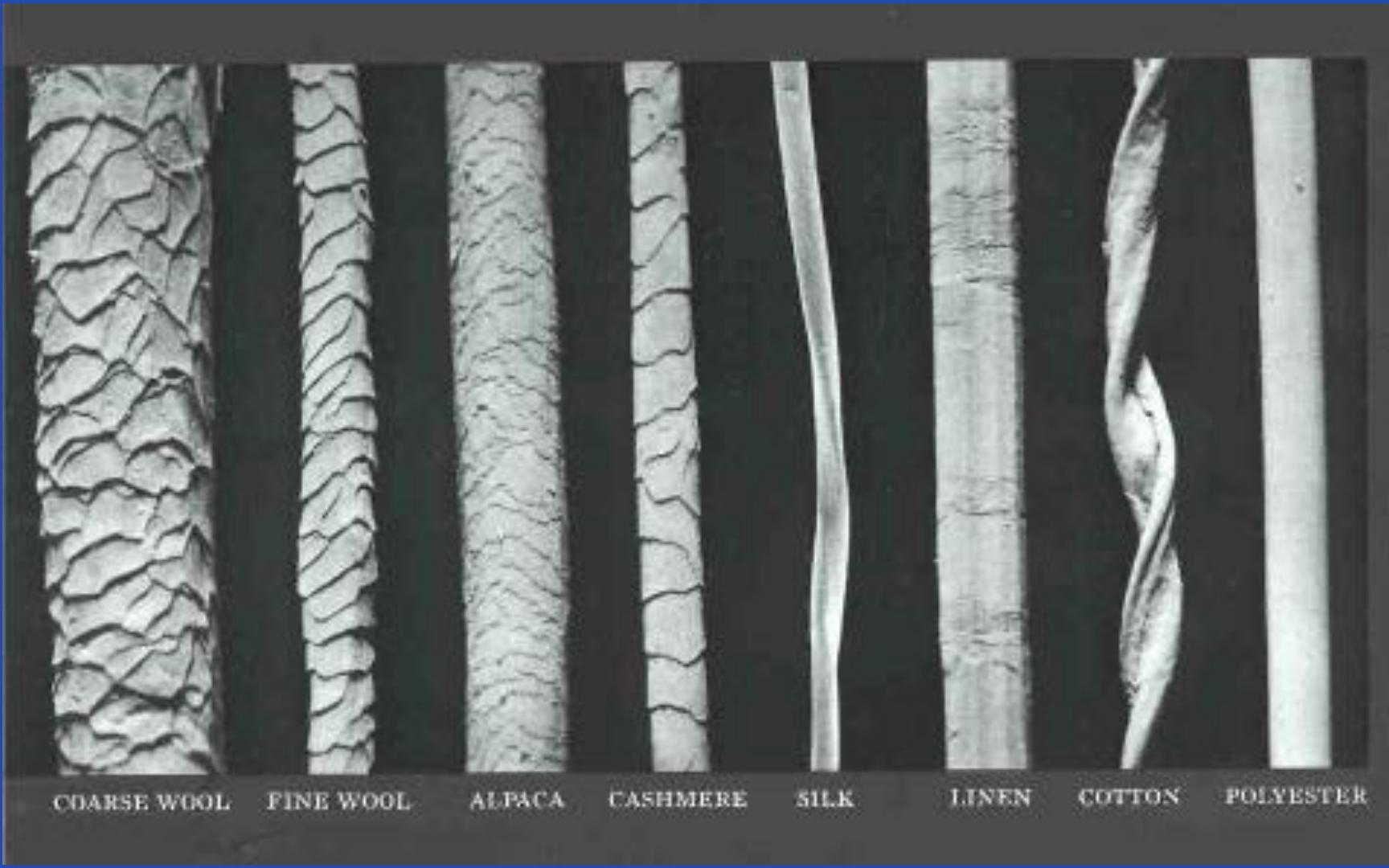
**BEFEKTETÉS A JÖVŐBE**



<http://www.omdfarm.co.uk/blog/2011/04/sheep-shearing/sheep-shearing-weekend-24-4-10-002/>

Coarse wool is no different from other wool types in that it is processor requirements that dictate the specifications the grower needs to meet to be able to sell his wool for as high a price as possible.

With the worsted system generally being too expensive to be efficiently used for lower value coarse wool, the principal spinning routes used for coarse wool are either semi-worsted to produce a cheap strong yarn or the woollen system to produce a bulky low strength yarn.



## WOOL CHARACTERISTICS



### Diameter

Mean fibre diameter is a measurement in micrometres (microns) of the average diameter of wool fibres in a sale lot. Fibre diameter is responsible for 70-80 per cent of the greasy wool price over the long term.

Fine and superfine wool production has increased as a percentage of the Australian wool clip. Australia dominates the supply of fine wool to the international trade, accounting for over 90 per cent of global production of Merino wool of 19.5 micron and finer.

Global demand for finer wool has increased. Manufacturers and processors must source more fine wool to satisfy the global consumers' demand for lightweight garments with next-to-skin comfort, particularly in women's wear.

## WOOL CHARACTERISTICS



### Length

Staple length generally determines the end use of wool, that is, whether it will be used in weaving or knitting.

Longer wools are processed in the worsted system (weaving). These combing types are generally around 50 millimetres (mm) and longer. The worsted system produces fine, even, smooth yarns mostly for apparel, but also for upholstery fabrics requiring a smooth finish.

The worsted system consists of two main processes, topmaking and spinning. Topmaking leaves the fibres lying in parallel after carding, gilling and combing. Wool tops are then spun into yarn.

In contrast, the woollen system converts scoured wool into yarn in two steps - woollen carding and woollen spinning.

Wool types used in the woollen system are called carding types, and usually have a much shorter fibre length (below 40 mm) than combing wools. These include types such as locks, crutchings, bellies and lambs wool.

## WOOL CHARACTERISTICS



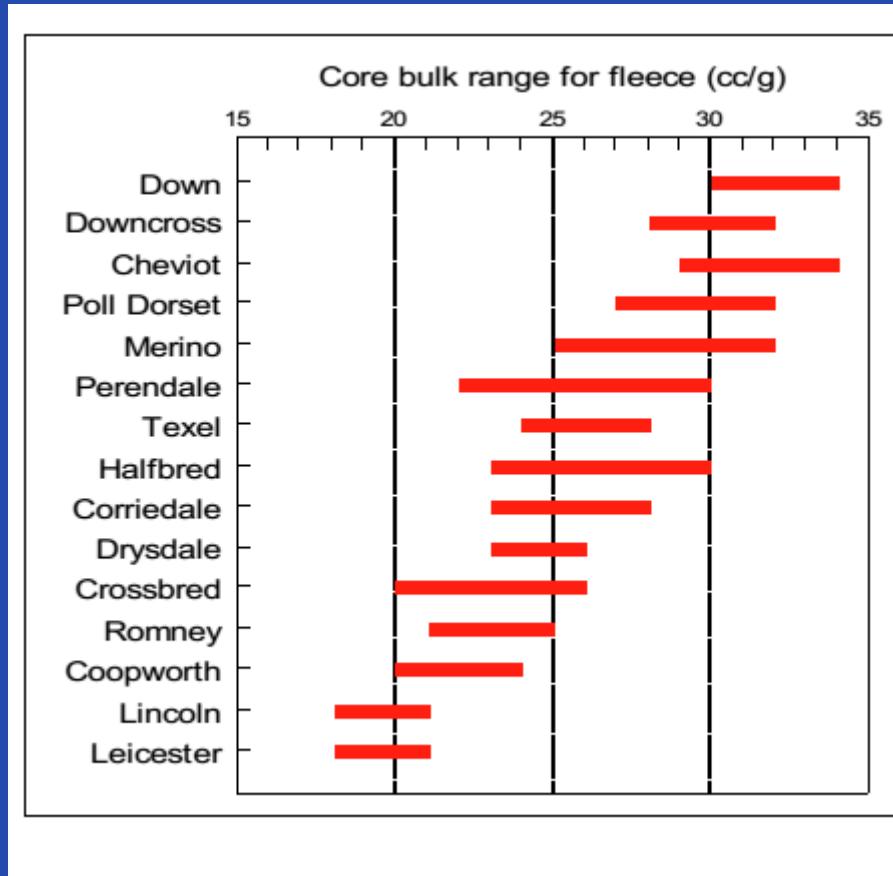
### Strength

Staple strength is a measure of the force required to break a wool staple of a given thickness (kilotex), recorded as Newtons per kilotex (Nkt).

Staple strength relates to the efficiency of wool processing, particularly the amount of fibre breakage and wastage during combing.

Recent changes in the textile market increased processor preference for longer tops (increased hauteur) of slightly reduced average fibre diameter, with low short fibre content. Spinners can spin fine yarns faster from these tops, with fewer yarn breakages and with increased evenness and bundle tenacity. Weavers using these finer yarns of increased tenacity and evenness can increase weaving speed and produce lighter cloth with fewer fabric faults.

# WOOL CHARACTERISTICS



## Bulk

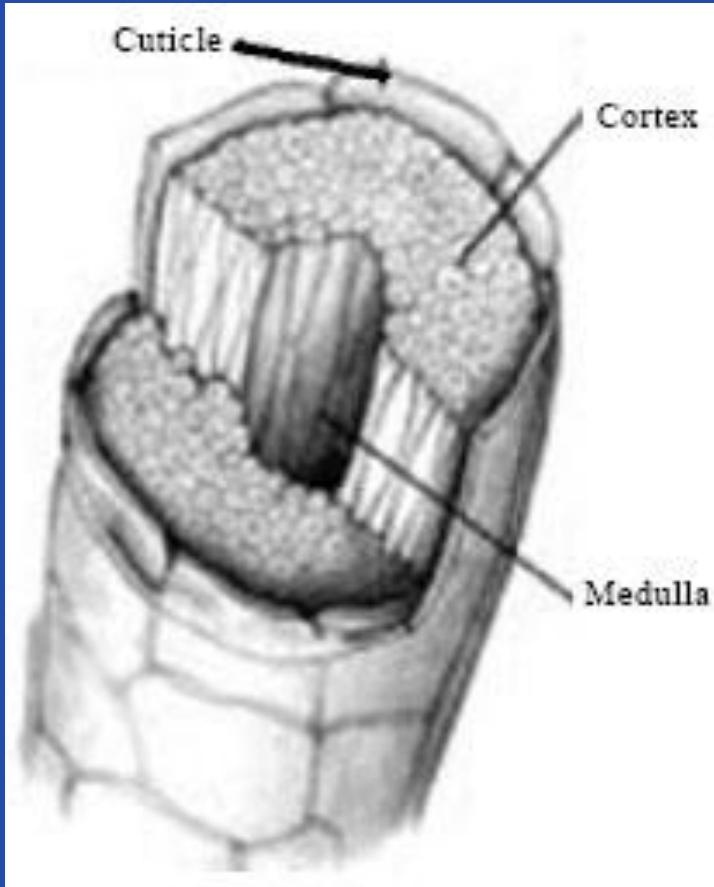
Bulk, a measure of the specific volume of a fibre mass, is closely related to fibre diameter and fibre curvature.

It contributes to good cover of the backing, enhanced tuft definition, a matt appearance and a resilient pile giving improved wearability and appearance retention.

Source:

<http://www.sgs.co.nz/~/media/Local/New%20Zealand/Documents/Technical%20Documents/Technical%20Bulletins/Wool%20Testing%20Info%20Bulletins/SGS-AGRI-5-1a-Wool-Bulk-A4-EN-11-11.pdf>

# WOOL CHARACTERISTICS



Source: <http://scialert.net/fulltext/?doi=ajt.2013.15.28&org=11>

## Medullation

Medullation is when an animal fibre has a hollow or partially-hollow core. In this state it has different physical properties in terms of bending resistance, and often takes up dye in a different manner, thereby accentuating it's presence.

## WOOL CHARACTERISTICS

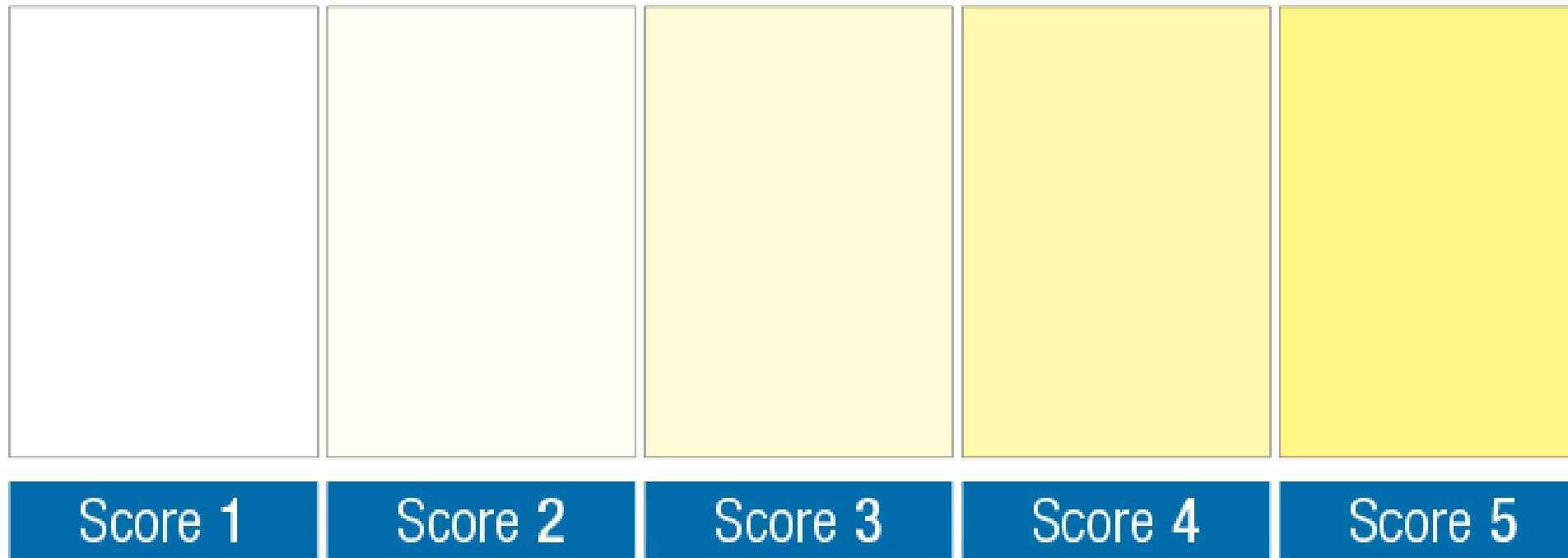


### Colour

While discoloured wool can only be satisfactorily dyed to dark colours, it is essential to have wools of good colour when dyeing pale bright colours.

Unscourable yellow discolourations and the stain absorbed into the wool fibre from faecal contamination (known as “pen stain”) are particularly serious as the associated pigments, are affected by light with the result that subsequently dyed wool may fade in areas where a carpet is exposed to direct sunlight .

**Wool colour**



## WOOL CHARACTERISTICS



### **Pigmented fibre**

Quite distinct from wool's overall yellow discolouration, the presence of dark fibres is an important aspect of wool quality.

A plain carpet of light colour can appear streaky if a few coloured hairs are distributed irregularly along the yarn.

# WOOL CHARACTERISTICS

VM is allocated into seven main types in the AWEX-ID typing system:

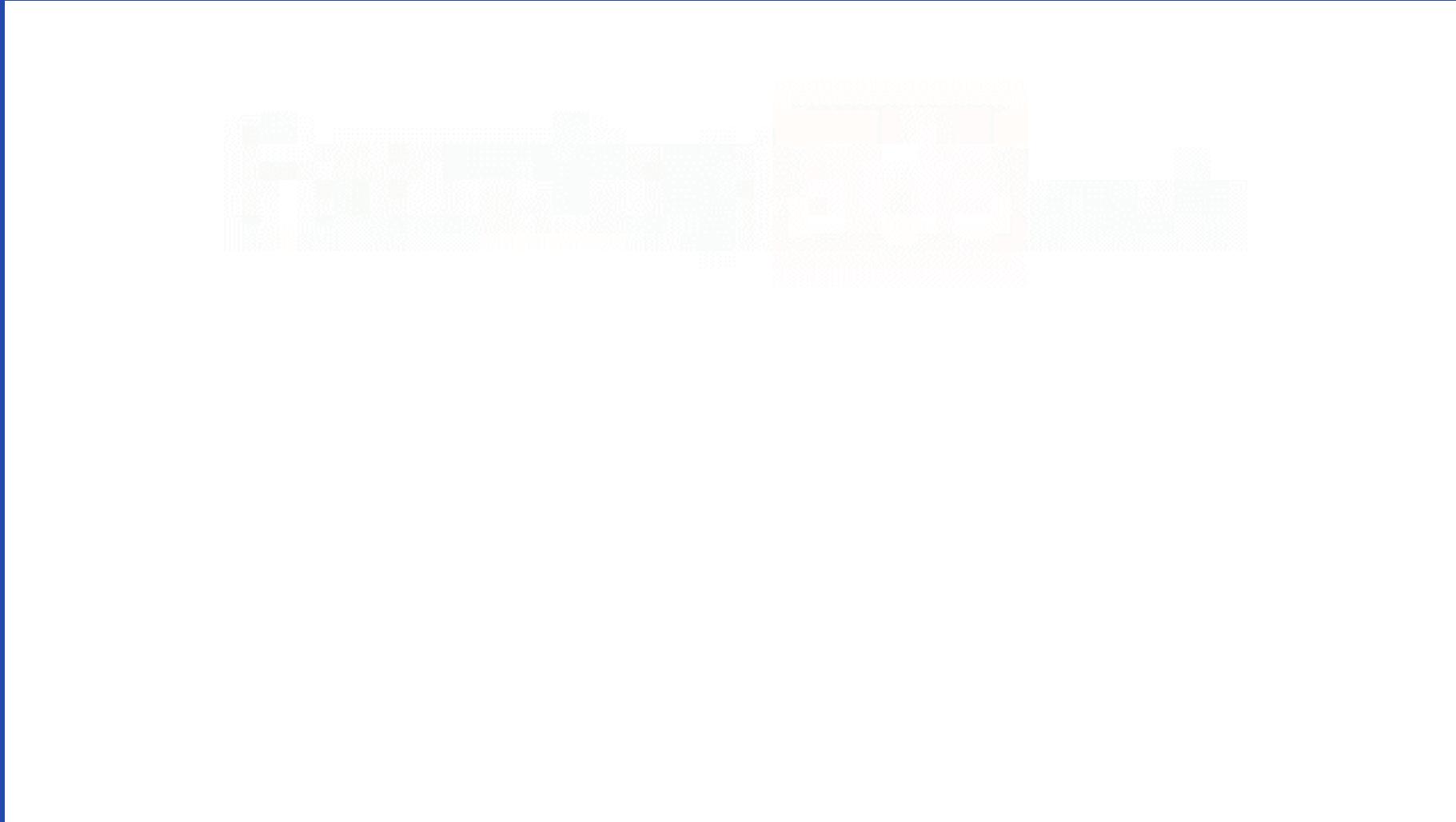
- B** Burr (barrel medic, burr medic).
- E** Seed (sub clover, carrot seed, scotch thistle).
- S** Shive (barley grass, wild oats).
- N** Noogoora burr.
- T** Bathurst burr.
- M** Moit.
- F** Bogan Flea.

## Vegetable matter

Vegetable matter (VM) in wool is a disadvantage as its removal during processing can be costly. Depending on the severity and type of VM, wool may need to undergo additional processing called carbonising.

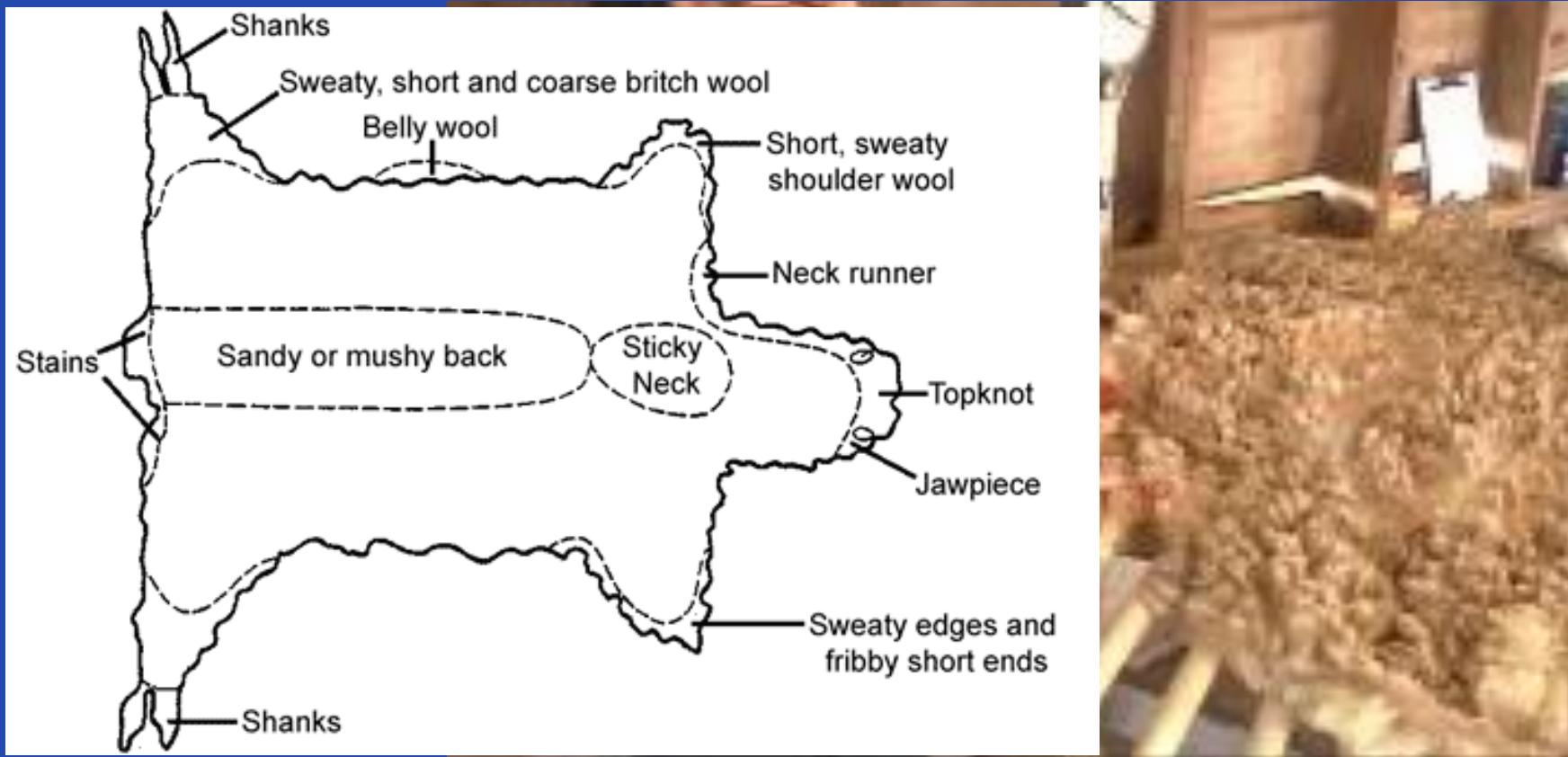
Carbonising is a relatively complicated and expensive process where wool passes through sulphuric acid bowls and ovens, before rollers crush the remaining brittle VM.

Carbonising is slow and usually involves higher fibre loss than other processing methods.



<http://www.youtube.com/watch?v=LZI11JSyE2I>

# FLEECE SKIRTING SECTIONS AND PROCEDURE



## The wool supply chain.



From fleece to fabric



85%  
15%

Broker

Private  
buyer

Auctions

Exporter

Exporting



Topmaker



Scouring



Carding



Combing

Spinning



Weaving



Garment maker

Weaver

Spinner

Source: International Sheep and Wool Handbook

# QUESTIONS

- What are the characteristics of wool?
- What is the diameter?
- What is the importance of the colour of wool?

# SOURCES:

DJ. Cottle (2010): International Sheep and Wool hand book, Nottingham University Press

<http://www.wool.com/fi/market-intelligence/woolcheque/wool-characteristics>

<http://www.sgs.com/~/media/Local/New%20Zealand/Documents/Technical%20Documents/Technical%20Bulletins/Wool%20Testing%20Info%20Bulletins/SGS-AGRI-Medullation-A4-EN-11-V2.pdf>



TÁMOP-4.1.1.C-12/1/KONV-2012-0004

# ANIMAL BREEDING

című digitális tananyag

Szegedi Tudományegyetem Mezőgazdasági Kar  
Állattudományi és Vadgazdálkodási Intézet

Mikó Józsefné Dr. Jónás Edit  
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MAGYARORSZÁG  
KORMÁNYA

**Európai Unió**  
Európai Szociális  
Alap



**BEFEKTETÉS A JÖVŐBE**



# CHAPTER 17

## SHEEP BREEDING AND SELECTION



**SZÉCHENYI** 2020



MAGYARORSZÁG  
KORMÁNYA

**Európai Unió**  
Európai Strukturális  
és Beruházási Alapok



**BEFEKTETÉS A JÖVŐBE**

Breeding of sheep makes use of the science of genetics - how different features of an animal are inherited by its offspring.

Robert Bakewell (1725-1795) was a pioneer in livestock improvement in spite of the fact that he did not understand genes or how they were passed on to the progeny.



His work was the stimulus for the development of a number of breeds as well as for the improvement of existing breeds where selection emphasis was placed on conformity to a visually desired type that was the hallmark of the breed and an indicator of its productivity.



However, since the advent of the science of genetics, visual observation of animals has been largely replaced by measurement, calculating breeding values and making predictions of the outcome of different mating systems.



This has resulted in the development of powerful selection tools that have changed the production capabilities of many animal populations quite dramatically.



The main aim of breeding is to improve the profitability, sustainability and ease of management of animals for the benefit of the producer.

Molecular genetic methods offer huge potential to change animal populations dramatically.

<http://www.le.ac.uk/el/newdishley/images/sheep1.jpg>



<http://www.le.ac.uk/el/newdishley/animals-speeton.html>



It is important to remember that food safety and ethical production methods have recently become more important in western societies, and therefore it is the consumer who will ultimately decide whether the product is desirable and whether the technology that was used to produce the product is ethically acceptable.



<http://www.le.ac.uk/el/newdishley/animals-speeton.html>



<http://www.le.ac.uk/el/newdishley/images/sheep1.jpg>

# BREEDING OBJECTIVES

- Defining the breeding objective is the first and most important step before implementing a breeding program. Breeding is a very powerful tool but it is generally a slow process.
- However the change is permanent and any change generated through selection accumulates over time.
- Therefore it is most effective when the breeding direction is clearly specified and when breeders persist in continuously breeding towards their ultimate goal.



# FUNDAMENTAL QUESTIONS OF BREEDING

Where do we want to go?

This is the breeding objective.

How can we get there?

This uses the science of genetics to help make the best decisions related to recording, selection and mate allocation.



Where to go is a major issue in animal breeding today. It focuses on which characteristics of a population need improvement. The direction and size of the desired changes will be determined by the breeder's assessment of their economic importance. For sheep it should include both measured and visually assessed traits that cannot be measured objectively. It is therefore critically important to define the breeding objective as clearly as possible early in developing the breeding program.

Breeding for:

- meat-production
- high fleece weight
- milk production
- disease resistance.



<http://www.bigpictureagriculture.com/2012/09/a-summary-of-sheep-breeds-popular-in-the-united-states.html>



Selection theory makes use of known relationships between traits.

For this reason it is not necessary to measure every trait in the breeding objective.

Hence a trait such as percentage of lean in the carcass can be represented in a breeding policy by an indirect criterion such as ultrasonic muscle and back-fat measured on the live animals.

However, for some traits, notably feed intake, the associations with other measurable traits are less well defined.

That indicates that an in-depth knowledge of the variation the traits display, inheritance of and the underlying genetic and phenotypic relationships between the different traits and the production system are all important in designing breeding programs.

Whatever the production system, we must attempt to develop breeding goals that will lead to an increase in overall profitability.



<http://www.fwi.co.uk/articles/18/09/2013/141132/live-export-checks-not-failing-says-nfu.htm>



The basic aim of all breeding plans is to increase profitability.

This can be achieved by

- increased economic returns from breeding higher quality meat and wool products,
- increasing the efficiency of biological processes and
- reducing the input costs.

It is therefore reasonable to express breeding objectives in terms of dollars.

The aim is then to maximize the breeding objective, by weighting each trait with an impact in dollar terms such that a one unit change in each of the traits in the breeding objective will contribute to the overall change in profitability as follows.



# BREEDING OBJECTIVE

$$\$_{trait\ 1} \hat{A}_{trait\ 1} + \$_{trait\ 2} \hat{A}_{trait\ 2} + \$_{trait\ I} \hat{A}_{trait\ 3} + \dots + \$_{trait\ I} \hat{A}_{trait\ m}$$

$\$_{trait}$  = economic value of the trait

$\hat{A}_{trait}$  = estimated breeding value (BV) of trait.



# INHERITANCE OF QUANTITATIVE TRAITS

Most production traits of economic importance show continuous variation due to the fact that they are under the control of a large number of genes, and affected by numerous environmental factors.

Their mode of inheritance cannot be readily observed and their inheritance can best be described and predicted in a statistical manner.

All genes are passed on to the next generation according to Mendelian principles.

This can be relatively easy to observe in genes that have a large effect, such as black colour, Booroola fertility and presence or absence of horns.



# INHERITANCE OF QUANTITATIVE TRAITS

Animals differ from each other in the genes that they have inherited from their parents and also from environmental effects.

Some may have inherited favourable genes for the trait of interest making them genetically more superior while others have inherited less favourable genes, whereas some may have received a more favourable environment and therefore perform better through chance.

However, breeders should not be interested in selecting animals that have received a better environment but in animals that carry favourable genes for the traits they are interested in.

Neither should breeders be interested in animals carrying a specific configuration of genes, as these configurations are broken up over generations.

Breeders should be interested in individuals that carry the most beneficial set of genes for a specific breeding objective that will be passed on to their progeny.



# INHERITANCE OF QUANTITATIVE TRAITS

The effects of individual genes are not usually seen because their effect is too small and furthermore environmental factors camouflage their effect.

Therefore the environmental effects need to be separated from the genetic effects to get a true indication of an animal's breeding value:

The phenotype ( $P_i$ ) of an animal  $i$  is the product of its genotype ( $G_i$ ) and environment ( $E_i$ ).

$$P_i = G_i + E_i$$



$$P_i = G_i + E_i$$

This equation can be further subdivided as

$$P_i = A_i + D_i + I_i + E_{pi} + E_{ti}$$

$A_i$  = the breeding value

(sum effect all the genes affecting the trait)

$D_i$  = dominance effect

$I_i$  = interaction or epistatic effect

$E_{pi}$  = permanent environmental effect

$E_{ti}$  = temporary environmental effect



$$P_i = A_i + D_i + I_i + E_{pi} + E_{ti}$$

- The dominance effect **D** originates from the interaction between genes at the same locus while the epistatic effect originates from the interaction between genes at different loci. These effects are very difficult to predict and are generally treated as 'noise' in within-breed genetic improvement programs. They are, however, important in crossbreeding systems. The permanent environmental effect **E<sub>p</sub>** is due to an environmental effect such as when an animal is born as a single or twin, or born from a maiden dam, which can have a permanent impact on an animal's performance.
- By knowing the relative size of each permanent environmental effect, one can adjust the measurements to obtain a better indication of the genetic value of an individual. In the case of temporary environment effects, where **E<sub>t</sub>** can simply be a gut fill effect affecting body weight at the time when the animal was weighed, the best solution is to give all animals as similar as possible an environment by running them as one group.



The proportion of variation that the sum effect of all the genes affecting the trait ( $V_A$ ) explains relative to the total phenotypic variation ( $V_P$ ) is called the heritability ( $h^2$ ) of the trait and is given by

$$h^2 = V_A / V_P$$

This is the key principle in understanding genetic improvement programs as the heritability indicates how fast a population can be shifted by selection.



# SELECTION

- Selection is one of the main tools breeders have to make genetic changes.
- The science of selection is built around the well-established observation that 'like begets like' in a pure breeding population of animals.
- Over the last 30-40 years the science of selection has had a major impact on genetic improvement of farmed animals.



# RESPONSE TO SELECTION

Response (R) to selection depends on the amount of genetic variation as indicated by the heritability that the trait displays and the difference in performance between the selected group ( $P_s$ ) and the average of the population (P).

$$R = h^2 (P_s - P) \text{ or } R = h^2 S$$

$$\text{where } S = (P_s - P)$$

This is generally known as the breeder's equation because it predicts the genetic change that can be expected per generation.

This simple relationship helps us to predict the effect of a single round of selection if the heritability of the trait of interest is known.



# FACTORS AFFECTING RESPONSE TO SELECTION

There are several factors that influence the annual rate of genetic change.

These factors can be manipulated to find the best structure that will increase the accuracy of selection and maximize the genetic response.

Variation of the trait Genetic change depends on the amount of genetic variation a trait exhibits. If there is no genetic variation then one cannot differentiate between individuals and the higher the variation, the greater is the potential to make genetic progress.



# CORRECTION FOR ENVIRONMENTAL FACTORS

When choosing individuals of high genetic merit unwanted environmental effects may lower the accuracy of selection.

Through chance, a genetically exceptional animal might have been poorly positioned in the uterus, born from a maiden, stood on by its mother, reared as a twin, stuck in a fence for 2 days or been missing at drenching.

The more significant such environmental effects are, the lower the heritability appears, because they inflate the phenotypic variation ( $V_p$ ) that is used in the calculation of the heritability.

Where these effects can be identified, they can be accounted for to give a more accurate prediction of the genetic merit of candidates for selection.



Environmental factors that can influence the ranking of animals are management group, birth type, age of the dam and age at measurement.

It is critically important to ensure that animals that are being compared must receive the same treatment and managed in one contemporary group.

Age of the ewe has a particularly large effect on fertility and litter size as maiden Merino ewes are on average 7% less fertile, and have a litter size that is on average 15 % smaller than that of mature ewes.

The size of these effects can be used to adjust the raw measurement data and effectively increasing heritability resulting in more accurate selection and therefore greater response.

This adjustment allows twin-reared rams to compete fairly in the selection process.

Their weaning-weight records can be corrected or adjusted by adding the difference between the average weaning weight of all single-reared rams and the average weaning weight of all twin-reared rams to the weaning weight of each twin-reared ram.

Similar corrections can be made for sex, age of mother, age at measurement/ date of birth, and management group.

This is normally calculated automatically during the statistical analysis of the performance data to estimate breeding values. However, it is critically important that the important environmental effects are recorded for each animal.



# REPEATED MEASUREMENTS

The accuracy of ranking young animals for selection can be improved by these environmental corrections.

However, a number of factors will contribute to variation in most production characters throughout the life of an animal.

Factors such as *age, season, pregnancy and lactation* can all affect measurements and can result in, say, the fleece weight of an animal changing markedly from year to year.

Young animals are chosen on the basis of their superiority early in life because we are hoping that they will retain that superiority and maintain a high level of production throughout their lifetime.

**A repeatability of 1.0 indicates perfect agreement between the rankings of young animals and the rankings of those same animals in later life.**

**A repeatability of 0 indicates no relationship.**



# REPEATABILITY OF SOME PRODUCTION TRAITS IN MERINO SHEEP

---

<i>Characteristic</i>	<i>Age of first assessment</i>	
	<i>Weaning</i>	<i>Later ages</i>
Greasy fleece weight (CFW)	0.4 - 0.5	0.5 – 0.8
Clean yield	0.4 – 0.5	0.5 – 0.8
Live weight LW	0.3 – 0.8	0.5 – 0.8
Fibre diameter (FD)	0.2 - 0.5	0.5 – 0.8
Staple strength (SS)		0.3 - 0.7
Coefficient of variation of fibre diameter		0.4 - 0.8
Reproduction rate (LW/EJ)		0.04 – 0.2
Faecal worm egg counts(WEC)	0.2 - 0.3	0.2 - 0.3



# HERITABILITY

Heritability estimates and variation of various traits in Merino sheep.

<i>Trait</i>	<i>Heritability</i>	<i>Coefficient of Variation (%)</i>
Greasy fleece weight (GFW)	0.30 – 0.45	19 - 25
Clean fleece weight (CFW)	0.28 – 0.45	18 - 31
Clean wool yield (Yield)	0.50 - 0.65	6 - 9
Staple strength (SS)	0.40 - 0.50	30 - 37
Fibre diameter (FD)	0.37 – 0.57	8 – 11
Coefficient of variation of fibre diameter (CVFD)	0.40 - 0.50	14 - 16
Birth weight (BWT)	0.05 - 0.23	20 - 23
Weaning weight (WWT)	0.20 – 0.25	20 - 26
Yearling weight (YWT)	0.30 - 0.60	14 - 20
Hogget weight (HWT)	0.35 - 0.60	14 - 20
Fertility	0.06 - 0.08	47
Litter size (LS)	0.10 - 0.13	36
Survival rate of lambs to weaning as a trait of the lamb	0.01 - 0.28	24 - 46
Survival rate of lambs to weaning as a trait of the dam	0.03 - 0.14	24 - 46
Lambs born/ewe joined (LB/EJ)	0.03 – 0.20	55 - 72
Lambs weaned / ewe joined (LW/EJ)	0.03 – 0.15	66 - 93
Milk production (Milk breeds and Merino crossbred ewes)	0.10 – 0.54	34 - 50
Subcutaneous fat depth (ultrasound) (SFD)	0.20 – 0.30	35 - 38
Eye muscle depth (ultrasound) (EMD)	0.25 – 0.30	9 - 16
Faecal worm egg count (WEC)	0.20 - 0.40	> 100
Susceptibility to fly strike	0.35 - 0.40	> 100

**The higher the heritability the easier it is to change a trait through selection.**

Sources: Matebesi et. al., 2009



# SELECTION INTENSITY

Different traits show different distributions of observations and therefore have different variances.

In order to have a standardized system on which animals are selected, the selection intensity ( $i$ ), which is the selection differential ( $S$ ) divided by its standard deviation, is used.

$$S = i \times \text{sd}$$

Where  $\text{sd}$ = phenotypic standard deviation of the trait



# SELECTION INTENSITY

The proportion of animals that need to be replaced in a flock determines  $i$ . Since more females are normally replaced than males in the flock, we need to determine  $i$  separately for males ( $i_m$ ) and females ( $i_f$ ).

Their average values times the standard deviation of the trait (sd) is then used to replace  $S$  in the breeders' equation as follows.

$$R = (i_m + i_f)/2 \times h^2 \times sd$$

The selection intensity can be increased by joining fewer males or replacing males more often. It is strongly linked to the generation interval because both are determined by the age structure of the flock.



# GENERATION INTERVAL

A breeding program is a continuous event and genetic gains per generation accumulate by an amount (R) as predicted above.

The annual rate of genetic change is affected by the number of years ewes and rams are kept in the flock.

To express the gain on an annual basis, the generation interval (L), or average age of parents when the progeny are born, must be calculated.

Generally the length of the generation interval is the time taken to complete a round of selection ~ and so the longer the generation interval, the slower is the response to selection.

Rams and ewes must be considered separately when calculating the generation interval, as their genes make equal contributions to the progeny despite the lower number of rams.

$$R = \frac{(i_m + i_f)/2 \times h^2 \times sd}{(L_m + L_f)/2}$$



# INBREEDING

Inbreeding arises from the mating of related animals.

When two individuals have a common ancestor, they may both carry copies of the same gene that was present in the ancestor.

If these two individuals mate, their progeny may inherit the same gene from the male and the female and therefore may have identical genes by descent at the same place on the chromosome.

The level of inbreeding in subsequent generations will increase with negative consequences on production.

Breeders should therefore not simply use the best ranking animals as future parents because there is a high likelihood that a large proportion of individuals from a few families will be selected which will inevitably results in an increase in the level of inbreeding, and a parallel decrease in genetic variation.

Hence breeders should use their discretion to maintain genetic diversity and to restrict the rate of inbreeding in their flock.



# ALLOCATION OF MATES

Females should be allocated to males in such a way that they are not closely related to each other, to help avoid inbreeding in the resulting progeny.

One strategy is to not select too many male progeny from just one or a few sires.

However, this is another issue that can be handled by a tactical mate selection tool.



# CORRECTIVE MATING

The aim of animal breeding programs is to improve the productivity of commercial flocks.

However, traditional breeders tend to breed towards a desirable “type” by using corrective mating, also known as negative assortative mating.

It is widely practiced in the sheep industry where there is a desire to breed towards an intermediate optimum, or to reduce between animal variation in a trait, and/or where the available selection pressure may not allow culling all animals below acceptable standards, and these are then mated to above average animals.

However, the response to such a selection and mating strategy will only result in a temporary 6 to 10% change when selection has reach an equilibrium.

When selection is relaxed the trait will revert back to its natural state and with the concomitant reduction of 10 to 20% in the heritability of the trait, this strategy does not warrant any significant cost or effort.



# RELATIONSHIPS BETWEEN TRAITS

Two or more traits such as height and body weight are often correlated.

This correlation is known as a phenotypic correlation because the association is between two phenotypes of the same animal.

Phenotypic correlations may be due to environmental or genetic correlations.

Environmental correlations refer to two or more traits that are influenced by the same environmental factor such as the availability of feed.

Sheep growing in an area with abundant feed will grow faster and be bigger than sheep growing in an area where a shortage of feed exists thereby generating a correlation between growth and feed availability.

The phenotypic correlation may also result from a genetic correlation which means that the genes affecting two traits are associated.

The primary genetic cause of a phenotypic correlation is pleiotropy, which is due to the effect one gene can have on two or more characteristics.



# RELATIONSHIPS BETWEEN TRAITS

Genetic correlations are important in animal breeding because they produce a correlated response to selection.

This is particularly useful if trait A is easier and cheaper to measure and has a higher heritability than trait B.

The correlated response (CR) per generation in trait A to selection on trait B is given by the following equation (Falconer and Mackay, 1996, in:Cottle,2010).

$$CR_A = r_{gAB} \times h_A \times h_B \times sd_A$$

$r_{gAB}$  = genetic correlation between trait A and B

$h_A$  = square root of the heritability of trait

$A h_B$  = square root of the heritability of trait B

$sd_A$  = phenotypic standard deviation of trait A



# GENOTYPE X ENVIRONMENTAL INTERACTION

- Genotype x environmental interaction (G x E) occurs where two genotypes A and B are tested in two environments 1 and 2, with the result that  $A_1 - B_1 \neq A_2 - B_2$
- These interactions may be associated with a change in rankings of genotypes or just a change in the difference between two genotypes. Genotypes could be different breeds, strains or individual sheep, while environments could be different locations, years or nutrition.
- If the correlation is equal to one then we can assume that the same genes influence the trait in different environments, and any interactions are just a reflection of scale effects (e.g. all animals would weigh twice as much if raised in the other environment). However, when the correlation deviates from unity, then it indicates that different genes are influencing the same trait in different environments.
- Not all the genetic gains generated from selection in a favourable environment will be transferred to a harsher, commercial production environment, because of a change in rankings of sires.



**Table 1** Genetic correlations ( $\pm$  s.e.) between subjectively and objectively measured wool and conformation traits in Tygerhoek Merino flock

Subjective traits	Live weight and objective wool traits								
	LW	GFW	CFW	CY	FD	SL	SS	CVFD	SDFD
<b>Subjective wool traits</b>									
QUAL	-0.01 $\pm$ 0.07	0.10 $\pm$ 0.06	0.18* $\pm$ 0.06	0.30* $\pm$ 0.05	-0.32* $\pm$ 0.05	-0.01 $\pm$ 0.08	0.17 $\pm$ 0.12	-0.50* $\pm$ 0.06	-0.62* $\pm$ 0.05
ROC	0.20* $\pm$ 0.08	0.02 $\pm$ 0.08	0.01 $\pm$ 0.07	0.06 $\pm$ 0.07	-0.28* $\pm$ 0.08	0.09 $\pm$ 0.08	0.33* $\pm$ 0.14	-0.73* $\pm$ 0.06	-0.81* $\pm$ 0.05
COL	-0.03 $\pm$ 0.07	-0.19* $\pm$ 0.07	-0.02 $\pm$ 0.07	0.45* $\pm$ 0.05	-0.09 $\pm$ 0.06	0.16* $\pm$ 0.07	0.17 $\pm$ 0.12	-0.08 $\pm$ 0.07	-0.14* $\pm$ 0.07
OIL	-0.15 $\pm$ 0.08	0.48* $\pm$ 0.08	0.28* $\pm$ 0.08	-0.44* $\pm$ 0.06	-0.02 $\pm$ 0.07	-0.33* $\pm$ 0.08	0.10 $\pm$ 0.13	0.05 $\pm$ 0.08	0.03 $\pm$ 0.07
STAPL	-0.01 $\pm$ 0.09	0.35* $\pm$ 0.08	0.39* $\pm$ 0.08	0.21* $\pm$ 0.07	0.59* $\pm$ 0.06	0.12 $\pm$ 0.08	-0.05 $\pm$ 0.14	0.49* $\pm$ 0.07	0.71* $\pm$ 0.05
BANDP	0.01 $\pm$ 0.08	0.42* $\pm$ 0.08	0.48* $\pm$ 0.07	0.24* $\pm$ 0.06	0.37* $\pm$ 0.06	0.40* $\pm$ 0.07	0.08 $\pm$ 0.13	0.04 $\pm$ 0.08	0.20* $\pm$ 0.07
WFS	0.21* $\pm$ 0.07	-0.00 $\pm$ 0.07	0.00 $\pm$ 0.07	0.03 $\pm$ 0.05	0.03 $\pm$ 0.06	0.16* $\pm$ 0.06	-0.10 $\pm$ 0.11	-0.05 $\pm$ 0.06	-0.02 $\pm$ 0.06
FCS	0.01 $\pm$ 0.10	0.04 $\pm$ 0.11	0.12 $\pm$ 0.10	0.18* $\pm$ 0.08	-0.30* $\pm$ 0.08	-0.02 $\pm$ 0.10	0.06 $\pm$ 0.16	-0.05 $\pm$ 0.09	-0.18* $\pm$ 0.09
PIGM	-0.00 $\pm$ 0.07	0.09 $\pm$ 0.07	0.06 $\pm$ 0.07	-0.00 $\pm$ 0.05	0.09 $\pm$ 0.05	0.00 $\pm$ 0.06	0.08 $\pm$ 0.11	-0.06 $\pm$ 0.06	-0.01 $\pm$ 0.06
<b>Subjective conformation traits</b>									
PS	0.18 $\pm$ 0.10	-0.13 $\pm$ 0.10	0.09 $\pm$ 0.09	0.12* $\pm$ 0.09	-0.16* $\pm$ 0.08	-0.20 $\pm$ 0.11	0.13 $\pm$ 0.19	-0.01 $\pm$ 0.11	-0.12 $\pm$ 0.11
GEN	0.67* $\pm$ 0.05	0.11 $\pm$ 0.08	0.23* $\pm$ 0.07	0.25* $\pm$ 0.05	-0.06 $\pm$ 0.06	0.31* $\pm$ 0.06	0.05 $\pm$ 0.13	-0.06 $\pm$ 0.07	-0.06 $\pm$ 0.06
HOCKS	0.36* $\pm$ 0.07	-0.01 $\pm$ 0.09	0.03 $\pm$ 0.08	0.19* $\pm$ 0.06	0.13* $\pm$ 0.06	0.09 $\pm$ 0.08	0.20 $\pm$ 0.13	-0.17* $\pm$ 0.07	-0.07 $\pm$ 0.07
FQ	0.42* $\pm$ 0.09	0.07 $\pm$ 0.11	0.16 $\pm$ 0.11	0.18* $\pm$ 0.08	0.08 $\pm$ 0.08	0.07 $\pm$ 0.10	0.39* $\pm$ 0.17	-0.33* $\pm$ 0.09	-0.20* $\pm$ 0.09
TOPL	0.25* $\pm$ 0.10	-0.34* $\pm$ 0.11	-0.29* $\pm$ 0.11	0.03 $\pm$ 0.09	-0.18* $\pm$ 0.09	0.14 $\pm$ 0.10	0.04 $\pm$ 0.18	-0.25* $\pm$ 0.10	-0.27* $\pm$ 0.09
TOT	-0.23* $\pm$ 0.07	0.48* $\pm$ 0.06	0.28* $\pm$ 0.07	-0.26* $\pm$ 0.05	0.13* $\pm$ 0.06	-0.43* $\pm$ 0.06	0.25* $\pm$ 0.12	0.03 $\pm$ 0.07	0.06 $\pm$ 0.06

QUAL = wool quality, ROC = regularity of crimp, COL = wool colour, OIL = wool oil, STAPL = staple formation, BANDP = belly and points, WFS = woolly face score, FCS = face cover score, PIGM = pigmentation, GEN = general head conformation, HOCKS = hocks, FQ = front quarters, TOPL = topline, TOT = total fold score, LW = live weight, GFW = greasy fleece weight, CFW = clean fleece weight, CY = clean yield, SL = staple length, SS = staple strength, FD = fibre diameter, CVFD = coefficient of variation of fibre diameter, SDFD = standard deviation of fibre diameter.

\* = significant correlation.

# GENETIC EVALUATION ESTIMATING BREEDING VALUES (EBV)

The success of breeding programs relies on estimation of accurate breeding values for the traits of interest.

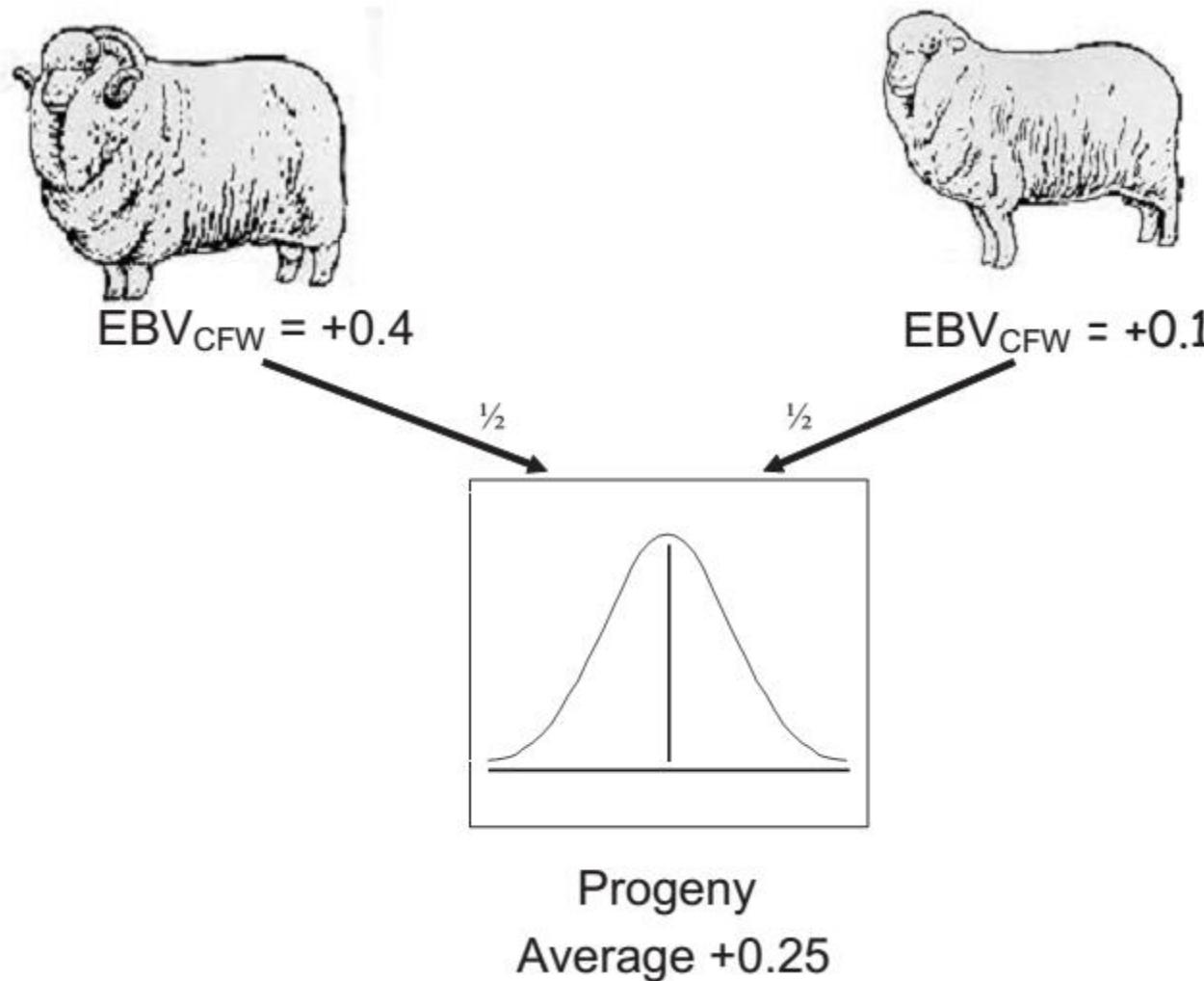
Estimating breeding values form the basis of modern animal breeding techniques as they predict how a selected animal's progeny will perform relative to the rest of the flock.

The simplest type of EBV is given by an individual's measurement as a deviation from the phenotypic mean of the group in which it has been raised. This deviation allows animals to be ranked from the best to the poorest and thus to identify the best performers. However, not all of their superiority will be passed on to their progeny.

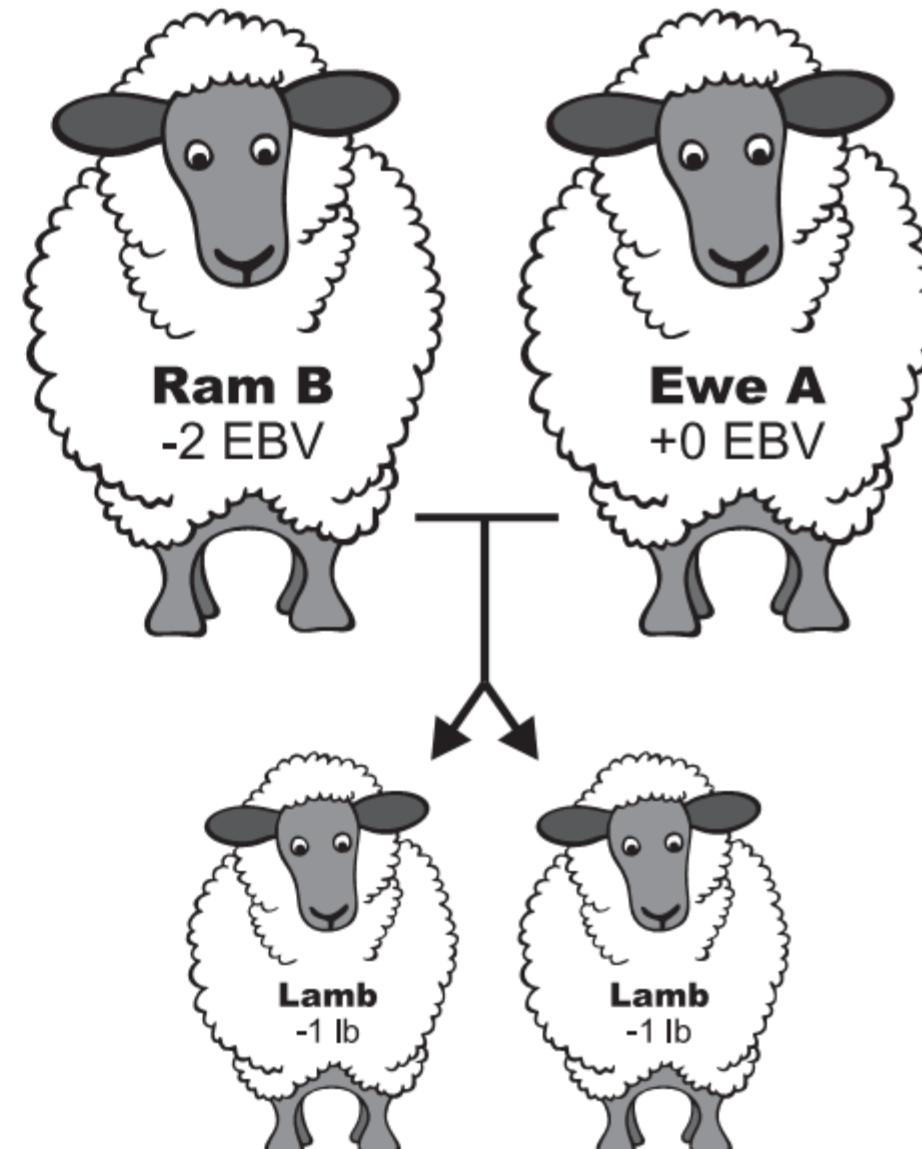
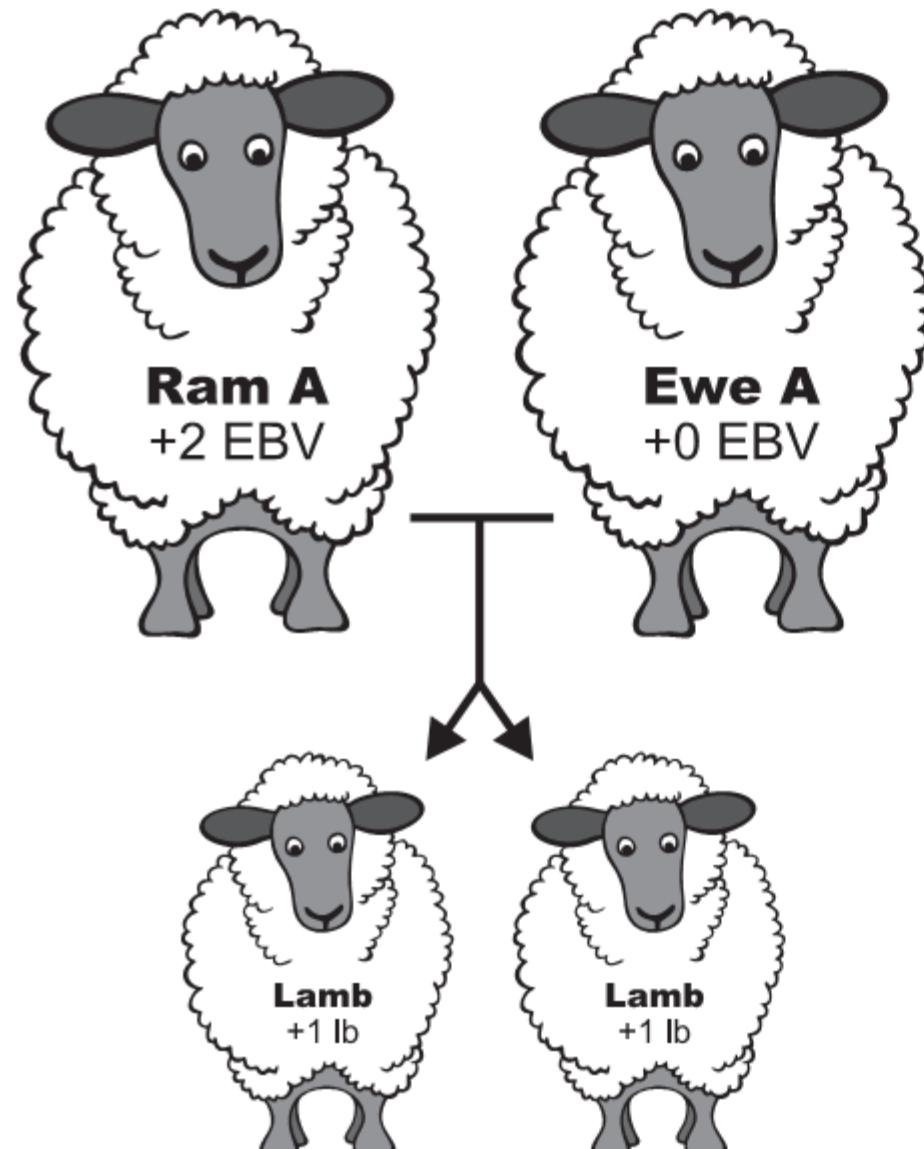
The accuracy and reliability of breeding values can be improved by using information from other sources. Data must be corrected for the important environmental factors as they will increase the accuracy of selection.



## Predicting progeny's EBV from parents' EBV.



## Example of differences in lamb weaning weight from Ram A and Ram B.



# BLUP BREEDING METHODS

The most accurate method to estimate breeding values from phenotypes is with BLUP.

It is a statistical technique and uses all the available information from genetically related relatives and also from correlated traits to estimate a BLUP breeding value.

It corrects for environmental factors such as flock and year of production, and other factors such as birth status, sex and age of the dam that can affect an animal's breeding values.

One of the main advantages of BLUP is that it can also use information from different flocks. Thus where a ram has progeny in two or more flocks, BLUP can use the pedigree information and adjust the performance measurements of the progeny for the flock effect (both environmental and genetic). Information from all relatives in all flocks (sire, progeny and half sibs in this case) is used to increase the accuracy of the EBVs.



## **The following factors affect the accuracy and reliability of BLUP breeding values:**

1. Heritability of the trait. A higher heritability increases the accuracy.
2. Knowledge of the environmental factors to correct the data
3. Amount of information available on relatives. Closer relatives, such as the progeny, contribute more information than relatives further removed, because they have more genes in common.
4. The larger the number of relatives measured, the higher the accuracy.
5. In multiple trait evaluations, where the trait of interest is correlated to another trait, measuring and including the second trait will add information to the trait of interest thereby increasing the accuracy

As males are normally measured more intensively than females this results in an improved ability to differentiate more between males than females, thereby increasing the accuracy of identifying genetically superior animals with a consequent increase in the financial genetic response .



# GENETICS OF PRODUCTION TRAITS

## WOOL PRODUCTION

Fleece weight and fibre diameter are the two main traits affecting income from wool. Both are heritable but are negatively correlated.

However, selection experiments have clearly shown that genetic progress can be achieved in both traits simultaneously.

EBVs are now readily available for most wool traits from many ram breeding flocks.

The effect of using EBV for fibre diameter has resulted in a substantial improvement in wool fineness of industry flocks during the past decade.

Wool Traits				
Fleece Weight	FW	Predicts offspring differences for wool production (greasy).		Western Range, Maternal Wool
Fiber Diameter	FD	Predicts offspring differences for fleece quality.		Western Range, Maternal Wool
Staple Length	SL	Predicts offspring differences for length of the wool fiber.		Western Range, Maternal Wool
Fiber Diameter Coefficient of Variation	FDCV	Predicts offspring differences for fleece uniformity, expressed as the coefficient of variation (%) among individual wool fibers		Western Range, Maternal Wool
Fiber Curvature	CURV	Predicts offspring differences in crimp frequency. This EBV is based on an OFDA optical measurement of fiber curvature.		Western Range

# **GENETICS OF PRODUCTION TRAITS**

## **DISEASE AND PARASITE RESISTANCE**

Sheep diseases have traditionally been controlled by management procedures which concentrated largely on preventative chemical treatments such as drenching, jetting, dipping and vaccinations.

However, parasites have become increasingly more resistant to chemicals.

Breeding strike is also partially controlled by surgical mulesing but this procedure is now being phased out due to animal welfare concerns.

These management procedures are not sustainable and breeding offers a long term solution to intestinal worms and blowfly strike.

### **Parasite Resistance**

Worm Egg Count

WEC

Predicts offspring differences for parasite resistance based on worm egg counts recorded at weaning or postweaning ages.

Hair



# GENETICS OF PRODUCTION TRAITS

## GROWTH AND CARCASS QUALITY

Major genes have also been found for carcass traits such as the callipyge and carwell genes that increases muscle mass. However, the callipyge gene also displays extreme meat toughness.

Therefore selection still appears to be the most successful method to increase meat yield.

There is considerable genetic variation for growth, fat and muscle traits between sheep.

The heritability of growth increases with age because the dam has a considerable effect on the growth performance of her progeny up to weaning, largely because of her milk production.

It is now common practice in specialized lamb breeding programs to measure subcutaneous fat thickness and eye muscle depth with ultrasound techniques on the live animal. Using the EBVs to select for these traits has been very successful.

### Carcass Traits

Fat Depth	FAT	Predicts offspring differences in carcass backfat depth between the 12th and 13th rib. It is derived from ultrasonic measurements of fat depth in live animals and adjusted to standard postweaning weight of 120 pounds for Terminal and Maternal Wool breeds and a standard yearling weight of 190 pounds for Western Range breeds.	Terminal, Maternal Wool, Western Range
Loin Muscle Depth	EMD	Predicts differences in offspring performance in carcass eye muscle depth between the 12th and 13th rib. It is derived from ultrasonic measurements of loin muscle depth in live animals and adjusted to standard postweaning weight of 120 pounds for Terminal and Maternal Wool breeds and a standard yearling weight of 190 pounds for Western Range breeds.	Terminal, Maternal Wool, Western Range



# GENETICS OF PRODUCTION TRAITS

## GROWTH AND CARCASS QUALITY

<b>Growth Traits</b>			
Birth Weight	BWT	Predicts differences in offspring weight at birth. Birth weight is measured within 24 hours of birth.	All breeds
Maternal Birth Weight	MBWT	Predicts differences due to genetic effects of the ewe on the birth weight of her lambs.	All breeds
Weaning Weight	WWT	Predicts differences in offspring live weight at 60 days of age. Weaning weight is recorded between 45 and 90 days of age.	All breeds
Maternal Weaning Weight	MWWT	Predicts differences in offspring from daughters based upon the maternal ability of the daughters. They are expressed as kilograms of live weight at weaning.	All breeds
Postweaning Weight	PWWT	Predicts offspring differences for postweaning weight at 120 days. Up to two postweaning weights can be recorded from 91 to 305 days of age. In extensively managed operations that wean from 90 to 150 days of age, this measurement predicts genetic differences in body weight at weaning.	All breeds
Yearling Weight	YWT	Predicts offspring differences in live weight at 360 days of age. Yearling weight is recorded between 290 and 430 days of age.	Western Range, Maternal Wool
Hogget Weight	HWT	Predicts differences in offspring weight at 450 days of age. Hogget weight is recorded between 410 and 550 days of age.	Western Range, Maternal Wool
Adult Weight	AWT	Predicts differences in offspring for live weight at 540 days of age. Four repeat measurements of adult weight (kg) may be submitted; however, this option is not active for the NSIP.	



## Selection Indexes

Western Range Index	WRI	Developed to select for multiple traits that impact extensively managed range flocks. WRI = PWWT + 0.26*MWWT - 0.26*YWT + 1.92*GFW - 0.47*FD + 0.36*NLB	Western Range
Katahdin Ewe Productivity	KT EP	Developed to select for multiple traits that impact hair sheep production systems. KT EP = 0.245*WWT + 2.26*MWWT + 0.406*NLW - 0.035*NLB	Hair
Polypay Ewe Productivity	PP EP	Developed to select for multiple traits that impact Polypay sheep production systems. PP EP = 0.265*WWT + 1.2*MWWT + 0.406*NLW - 0.035*NLW	Maternal Wool
Carcass Plus		Developed to improve carcass value in Australian markets CP = 5.06*PWWT - 13.36*FAT + 7.83*EMD	All breeds; most applicable to Terminal Sire
LAMB 2020		Developed in Australia as an alternative to Carcass Plus and designed to reflect projected demand for lamb in 2020. LB = 0.32*WWT + 0.47*PWWT - 0.21*BWT - 0.55*FAT + 1.54*EMD - 0.04*WEC	All breeds; most applicable to Terminal Sire



# QUESTIONS

- What are the objectives of breeding?
- What parameters have higher heritability?
- What is the selection intensity?



# SOURCES

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- P.A. Matebesi , J.B. van Wyk, S.W.P. Cloete (2009): Relationships of subjectively assessed wool and conformation traits with objectively measured wool and live weight traits in the Tygerhoek Merino flock. South African Journal of Animal Science 2009, 39 (3)

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2014.

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# CHAPTER 18

## MARKETING OF SHEEP AND SHEEP MEAT

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# MARKETING OF SHEEP AND SHEEP MEAT

that is safe, healthy and consistent in supply and quality. Competition from other protein products is fierce. Lamb has now positioned itself as a versatile, tender and flavoursome product that is well recognised on restaurant menus around the world.

Live sheep export is focused on the Middle Eastern markets with an increasing emphasis on animal welfare, product quality, younger sheep and market specifications.

A small number of live sheep are exported for breeding to other sheep producing nations.



<http://www.smh.com.au/federal-politics/political-opinion/the-carnage-begins-on-the-boat-20110603-1fkvc.html>



	NATIONAL	VICTORIA	OVERALL VALUE
2009	3.5 million	703,000	\$322.9 million
2010	2.9 million	438,000	\$322.5 million
2011	2.4 million	481,000	\$328.2 million
2012 (to July)	1.4 million	67,000	\$189.2 million

<http://www.theage.com.au/national/turmoil-all-round-brings-a-drop-in-live-sheep-exports-20121005-274w3.html>

World per capita lamb, mutton, and goat consumption increased from 3.95 pounds in 1965 to 4.17 in 2007. Asia and Mexico experienced increases in per capita consumption primarily because of increasing personal incomes and urbanization. Total consumption in these regions was also influenced by population growth. South America, the United States, Oceania, and Europe experienced declines in per capita lamb consumption of 50% or more since 1965.

Lamb and mutton represent primary animal-sourced protein for regions of North Africa, the Middle East, India, and parts of Europe.

# EXPORTS

Australia and New Zealand are the world's principal lamb and mutton exporters. Australia exports 44% of its lamb production and 80% of its mutton crop. In 2011, Australia exported 648 million pounds of lamb and mutton valued at AU\$1.1 billion. New Zealand exports 80% of its lamb production annually and 84% of its mutton. In 2011, New Zealand exported 750 million pounds of lamb and mutton valued at NZ\$2.9 billion.

The United States is the largest export market for Australian lamb and accounted for 32% of total Australian lamb export value in 2011 followed by the Middle East, European Union, and China. In terms of volume, exports to the United States, the Middle East, and China were similar in 2011. Australia exported 3.1 million live sheep in 2010 valued at AU\$298 million. Key markets for live sheep exports include Jordan, Qatar, and Kuwait.

# EXPORTS

The European Union accounts for 57% of New Zealand's lamb export value. Principal New Zealand export markets in terms of volume were the United Kingdom (19%), China (12%), and the United States (7%). In terms of value, the United Kingdom was New Zealand's largest market followed by the United States and Germany. New Zealand's primary export market for live sheep is Saudi Arabia.

The United States exports only minimal amounts of lamb (about 2% of domestic supplies). The U.S. sheep industry exports cull ewes and rams to Mexico where they are slaughtered to produce mutton. Total live sheep exports were 80,000 head in 2010 but only 13,000 head in 2011. The reduction in live animal exports was primarily the result of lower U.S. culling rates given current record domestic lamb prices.

# IMPORTS

The European Union is the world's largest lamb and mutton importer (490 million pounds annually). The United States and China each import about 140 million pounds. Income growth in many developing countries has increased lamb meat imports. For example, China's per capita lamb consumption has increased about 4% since 1980. But, with a population that exceeds 1 billion, even small percentage increases in per capita consumption have required China to increase imports by 500% over the past 20 years.

U.S. lamb imports have increased over the past decade, while European Union imports have been relatively flat. Lamb imports account for nearly one-half of U.S. lamb consumption. About 65% of U.S. lamb imports originate in Australia and 35% in New Zealand.

## Sheep and lamb categories

Category	Description
Young lamb	Male and female lambs with no 'ram like' characteristics. Generally suckers, unshorn with no permanent teeth, normally up to 5 months of age.
Lamb	Male and female lambs with no 'ram like' characteristics. Generally weaned, shorn with no permanent teeth and normally older than 5 months of age.
Hogget	Castrated male or female sheep with no 'ram like' characteristics and up to 2 permanent teeth.
Ewe	Female with more than 2 permanent teeth.
Wether	Castrated male sheep with no 'ram like' characteristics and with more than 2 permanent teeth.
Ram	Ram and castrated male sheep with 'ram like' characteristics.

# LIVE ASSESSMENT

## *Assessment of lambs and sheep for sale*

Accurate appraisal of the live animal assists the producer and agent to target specific markets.

The traditional approach of visually assessing sheep as a mob or while they are running through the drafting race often results in drafts of lambs or sheep with a 5-8 kg carcass weight range and a wide variation in fat scores.

To successfully market even lots of sheep the assessor needs to be able to accurately estimate the carcass weight, fat score and skin quality.

These skills can be improved by experience and regular abattoir feedback.

To achieve this, it is necessary to weigh and fat score the live animal.

# LIVE ASSESSMENT

## *Estimating carcass weight*

Carcase weight can be estimated by using the following formula: Estimated carcass weight = live weight x dressing percentage. When calculating carcass weight it is important to have an understanding of the factors affecting dressing percentages. You also need a set of lamb scales for accurately determining the live weights of the lambs for sale.

### Factors affecting dressing percentage:

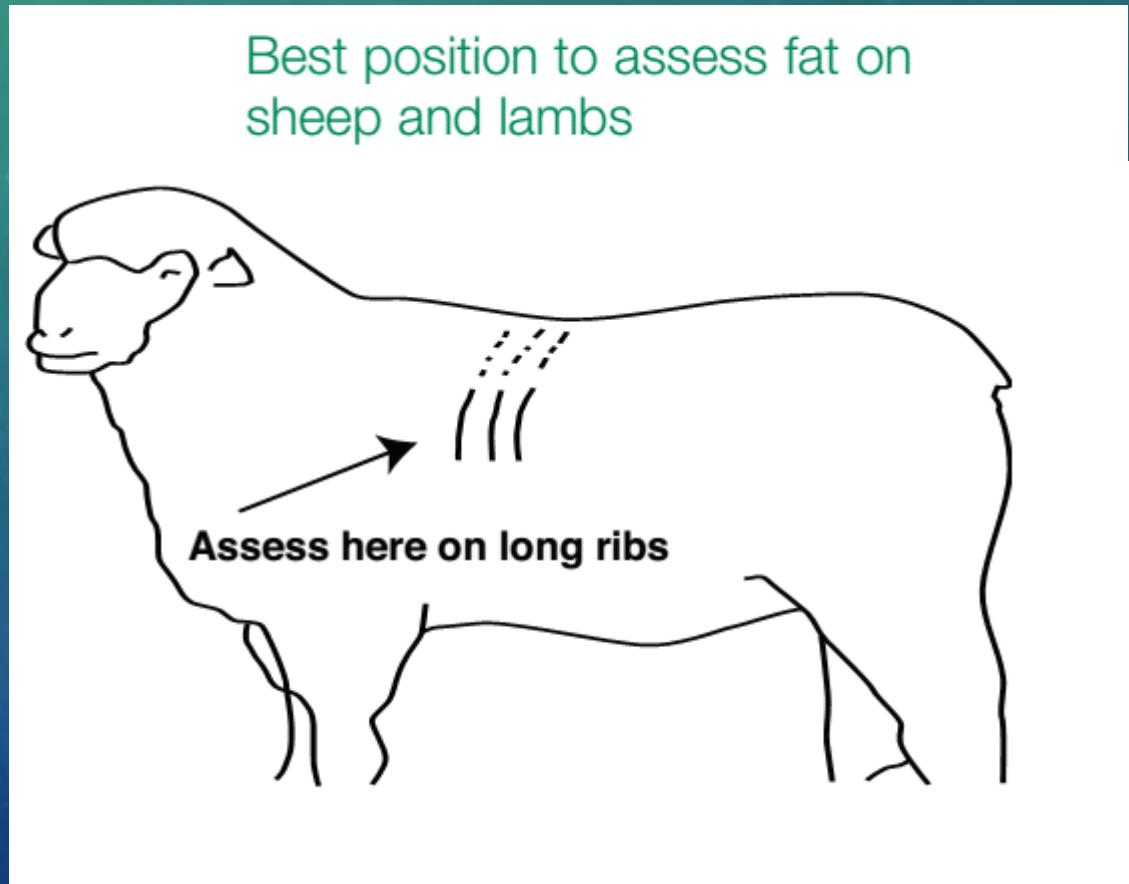
- Fatness
- Time Off Feed And Water Before Live
- Assessment
- Skin Weight
- Sex
- Breed
- Weaned / Unweaned
- Carcass Trim
- Seasonal and feed conditions

# LIVE ASSESSMENT

## *Fat scoring sheep and lambs*

Fat score is the fat measurement on the carcase based on the actual soft tissue depth at the GR site. The GR site is 110mm from the midline over the 12th rib. Fat scores range from 1 (leanest) to 5 (fattest). Each fat score represents a 5mm band width.

As a general rule, at the same weight, ewe lambs will be fatter than wether lambs which will in turn be fatter than ram or cryptorchid lambs.



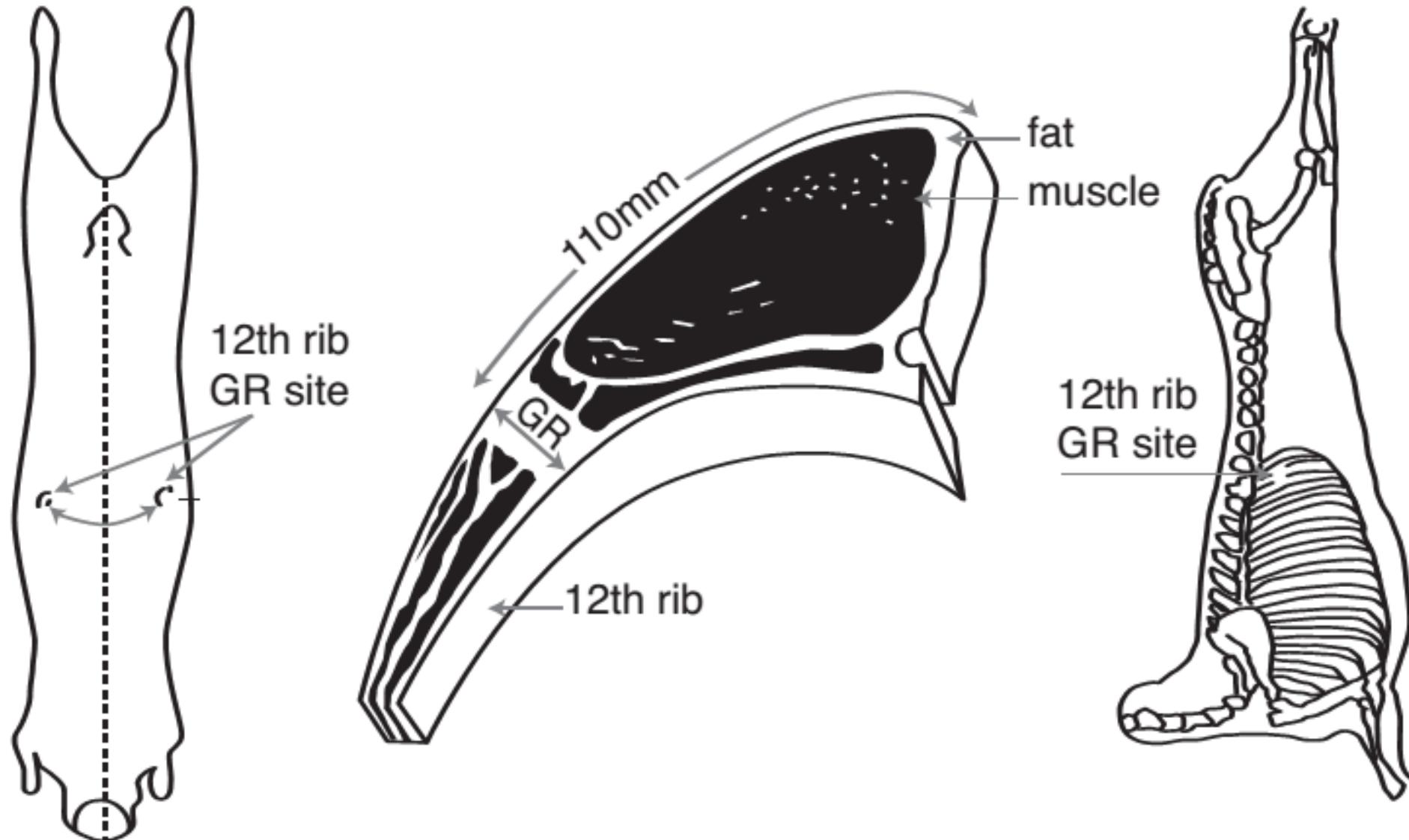
## Fat scores

Score	1	2	3	4	5
GR tissue depth (mm)	0–5	6–10	11–15	16–20	21+
<b>Assessment over the long ribs</b>	Individual ribs felt very easily. Can not feel any tissue over the ribs.	Individual ribs easily felt, however some tissue is present.	Individual ribs can still be felt. Can feel more tissue over the ribs.	Can only just feel ribs. There is fluid movement of tissue.	Ribs can not be felt. Tissue movement is very fluid.
<b>Dressing percentage</b>	41%	43%	45%	47%	49%

*Dressing percentages are for second cross lambs. Data supplied by NSW Agriculture.*

Source:[http://www.mla.com.au/files/ab17a0fe-474b-46a3-a764-9d6600880417/assessing-sheep-and-lambs-livestock-descriptions\[1\].pdf](http://www.mla.com.au/files/ab17a0fe-474b-46a3-a764-9d6600880417/assessing-sheep-and-lambs-livestock-descriptions[1].pdf)

## Location of the GR site



# FATNESS

Factors affecting dressing percentage include fatness, time off feed and water prior to live assessment, skin weight, sex, breed, weaned or unweaned, carcass trim and feed conditions.

Fat score	Lambs		Sheep	
	Unweaned	Weaned	Wethers	Ewes
1	43%	41%	39%	38%
2	45%	43%	41%	40%
3	47%	45%	43%	42%
4	49%	47%	45%	44%
5	51%	49%	47%	46%

Time off feed and water before live assessment

Time off feed and water	Increase in dressing percentage
0-3 hrs	0
4-5 hrs	+ 1%
6-8 hrs	+ 2%
9-12 hrs	+ 2.5-3%
13-24 hrs	+ 3.5-4.5%

## SKIN WEIGHT

The skin weight of lambs varies according to the wool length, the amount of water held by the wool, and the tissue weight.

The dressing percentage allowance for wool length is approximately 1 per cent per 25 mm of woollength change from the standard 50 mm length used as a 45 per cent dressing percentage guide.

**For example**, if the wool length is 100 mm, then deduct 2 per cent from the dressing percentage, or if it is 25 mm add 1 per cent to your estimated dressing percentage.

A 75-mm skin, when thoroughly saturated, can hold 1.5 to 2.0 kg of water.

## SEX

Wether lambs can dress up to 2 per cent less than ewe lambs, because ewe lambs at high weights tend to have higher fat measurements.

## BREED

The breed can affect fat cover and muscling and hence, dressing percentage. Merino cross and Merino lambs tend to have lower dressing percentages than second cross lambs by about 1.5 -2.5 %

## WEANED / UNWEANED

Unweaned lambs (still sucking) may dress 1.5 to 2 per cent higher than weaned lambs of the same weight and fatness.

# CARCASS TRIM

The level of carcass trim in abattoirs is influenced by the dressing procedure. Depending on the type of trim, dressing percentages vary significantly.

The standard AUS-MEAT carcass trim requires the removal of kidneys, channel fat, cod fats and thick skirts (diaphragm), and is most commonly used by export abattoirs.

The non-standard trim retains kidneys, channel fats, cod fats and thick skirts (diaphragm) in the carcass and therefore increases dressing percentage by up to 4%.

This latter type of trim is performed in some domestic plants.

## HOT AND COLD WEIGHT

Some abattoirs prefer to use cold weights so when meeting specifications it is important to remember that cold weight (after chilling ) is 2-3% less than hot weight (immediately post slaughter and dressing).

## SEASONAL VARIATION

Fluctuation of up to +3% can occur because of the seasonal effects on feed quality. When lambs are grazed on low quality roughage diets the dressing percentage will be lower due to slower rates of passage through the gut. On these diets, lambs and sheep will take longer to empty out, influencing the carcass weight relative to the live weight.



<http://www.youtube.com/watch?v=s8zNAWRx25s>

# QUESTIONS

- What are sheep and lamb categories?
- How can we assess the live animals?
- What are the fat scores and what are their characteristics?
- What parameters affect the quality of lamb?

## SOURCES:

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- [http://www.dpi.nsw.gov.au/\\_data/assets/pdf\\_file/0005/177602/comparing-lamb-marketing-methods.pdf](http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0005/177602/comparing-lamb-marketing-methods.pdf)
- [http://www.mla.com.au/files/ab17a0fe-474b-46a3-a764-9d6600880417/assessing-sheep-and-lambs-livestock-descriptions\[1\].pdf](http://www.mla.com.au/files/ab17a0fe-474b-46a3-a764-9d6600880417/assessing-sheep-and-lambs-livestock-descriptions[1].pdf)



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# CHAPTER 19

## SHEEP HEALTH



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The maintenance of sound sheep health is essential for profitable and efficient sheep production and acceptable levels of animal welfare.

It requires active disease surveillance measures and effective prevention or management programs.

Usually the loss due to disease results from incremental and often unapparent effects of endemic disease on animal thrift or reproduction, rather than the potentially devastating effects of epidemic diseases.

The occurrence of various diseases varies between regions, seasons and sheep classes, and in some cases is more common in specific enterprise types.

Disease control should generally be based on management of the environment (pasture types, paddock changes, seasonal effects), and where feasible, immunological approaches (vaccines and genetics), rather than using chemical intervention as the first approach.

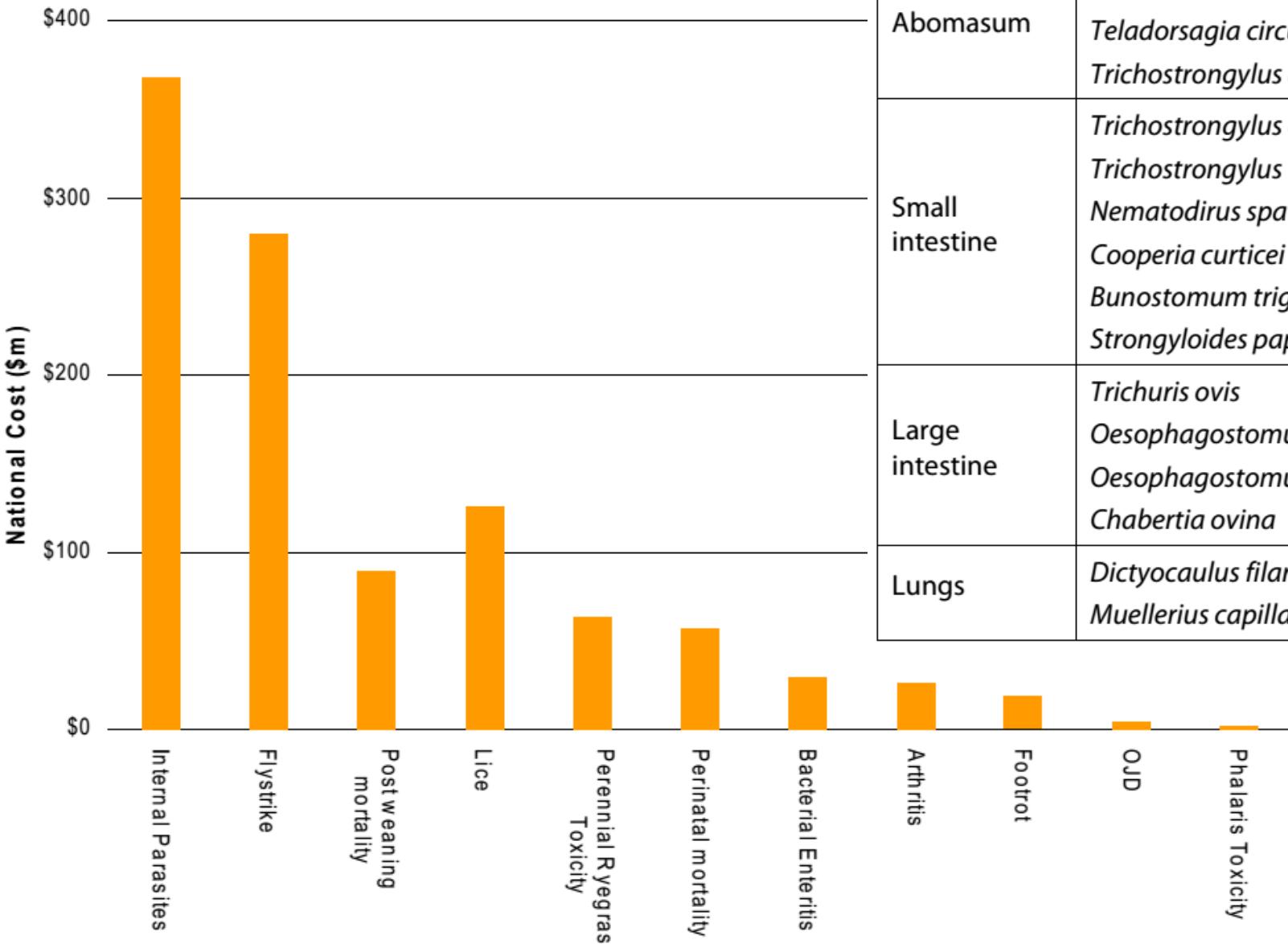
This invariably requires forward planning and pasture rotation schedules to be developed, but recognises that prevention is better than cure.

# Categories of disorders

- Internal parasites (roundworms, tapeworms, flukes and coccidia)
- External parasites (blowfly strike, lice, mites)
- Non-parasitic causes of diarrhoea (including grain poisoning)
- Common bacterial, viral and fungal infections (Clostridial diseases, Johnes disease, footrot, scabby mouth, arthritis cheesy gland, pneumonia)
- Metabolic diseases (pregnancy toxæmia, hypocalcaemia, grass tetany) and hypothermia Mineral deficiencies and toxicities (especially copper, cobalt and selenium)
- Fleece diseases (dermatophilosis, fleece rot)
- Reproductive diseases

Examples of round worms and where they are located in ruminants.

National cost (\$million) of major sheep health issues in Australia.



Site	Round worm scientific name	Round worm common name
Abomasum	<i>Haemonchus contortus</i> <i>Teladorsagia circumcincta</i> <i>Trichostrongylus axei</i>	Barbers Pole Brown Stomach Stomach Hair
Small intestine	<i>Trichostrongylus colubriformis</i> <i>Trichostrongylus vitrinus</i> <i>Nematodirus spathiger</i> <i>Cooperia curticei</i> <i>Bunostomum trigonocephalum</i> <i>Strongyloides papilliferus</i>	Black Scour Black Scour Thin Necked Intestinal Small Intestinal Hook Worm Strongyloides
Large intestine	<i>Trichuris ovis</i> <i>Oesophagostomum columbianum</i> <i>Oesophagostomum venulosum</i> <i>Chabertia ovina</i>	Whip Worm Nodule Worm Large Bowel Large Mouthed Bowel
Lungs	<i>Dictyocaulus filaria</i> <i>Muellerius capillaries</i>	Large Lung Small Lung

Source:  
[http://www.woolwise.com/Parasite\\_Control/Internal%20Parasite%20Control%20of%20Sheep%20-%20Reference%20Manual.pdf](http://www.woolwise.com/Parasite_Control/Internal%20Parasite%20Control%20of%20Sheep%20-%20Reference%20Manual.pdf)

# Internal parasites

Helminth parasites (round worms, tapeworms and flukes) are generally regarded as the most economically important sheep health problem (excluding nutrition) on a global basis, causing reduced productivity, diarrhoea (scouring) and sheep deaths.

Most worms are “host-specific”, in that they will only develop in one species. However, some worms, such as the liver fluke and the intermediate stage of hydatids, occur in a number of host species.

In the major sheep zones, most sheep are continually infected, except where treatments are given during periods when re-infection is minimal, and sheep usually carry mixed burdens of species simultaneously.

# Round worms (nematodes)

## The Barbers Pole Worm (*Haemonchus contortus*)

The Barbers Pole Worm(*Haemonchus contortus*) is a bloodsucking worm found in the fourth stomach (abomasum), and its presence can be a major disincentive to sheep raising in environments where it is prevalent.

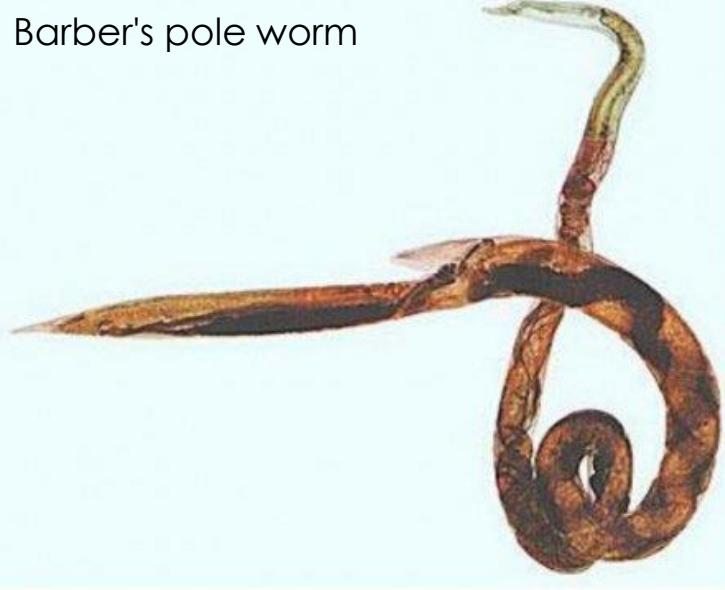
As a prolific egg-layer, large numbers of infective larvae can rapidly develop and accumulate on pasture, and sheep deaths from blood loss commonly occur with little warning.

Signs prior to death relate to blood loss, i.e.anaemia, seen as pale membranes of the eyes and mouth, weakness when driven and recumbency. Diarrhoea is not a feature of *Haemonchus* infection.

Due to the requirement for abundant moisture and warm weather conditions, this species is most significant in summer rainfall regions such as northern NSW and Queensland in Australia, South Africa, southern USA and all tropical countries. In temperate regions, *Haemonchus* is often present but usually causes only sporadic problems, but there are increasing reports of clinical haemonchosis from cooler environments such as New Zealand, the UK and Europe.

# Round worms (nematodes)

## The Barbers Pole Worm (*Haemonchus contortus*)



Barber's pole worm



Lancet on barber's pole worm head



Signs of the disease

# Black scour worms (*Trichostrongylus colubriformis* and *Trichostrongylus vitrinus*)

The “scour worms”, which cause the characteristic sign of diarrhoea (scouring) when large burdens are present, comprise many species occurring in the fourth stomach and intestines, most barely visible to the naked eye. The most important types include *Teladorsagia* (*Ostertagia*) *circumcincta* (Brown Stomach worm), *Trichostrongylus* species (Black Scour worm) and *Nematodiruss* species (Thinnecked Intestinal worm).

Less important types include the large bowel worms *Chabertia ovina* and *Oesophagostomum*. As these species occur in all environments, due to the wide tolerance of their larvae to environment conditions, the scour worms are the major target for sheep worm control, except where *Haemonchus* predominate. Adult female black scour worms lay 100–200 eggs per day. Black scour worms live in the first three metres of the small intestine of the sheep and cause damage to the lining of the gut.

The adult female in the small intestine lays eggs, which are passed out in the dung.

# Black scour worms (*Trichostrongylus colubriformis* and *Trichostrongylus vitrinus*)

Black scour worm



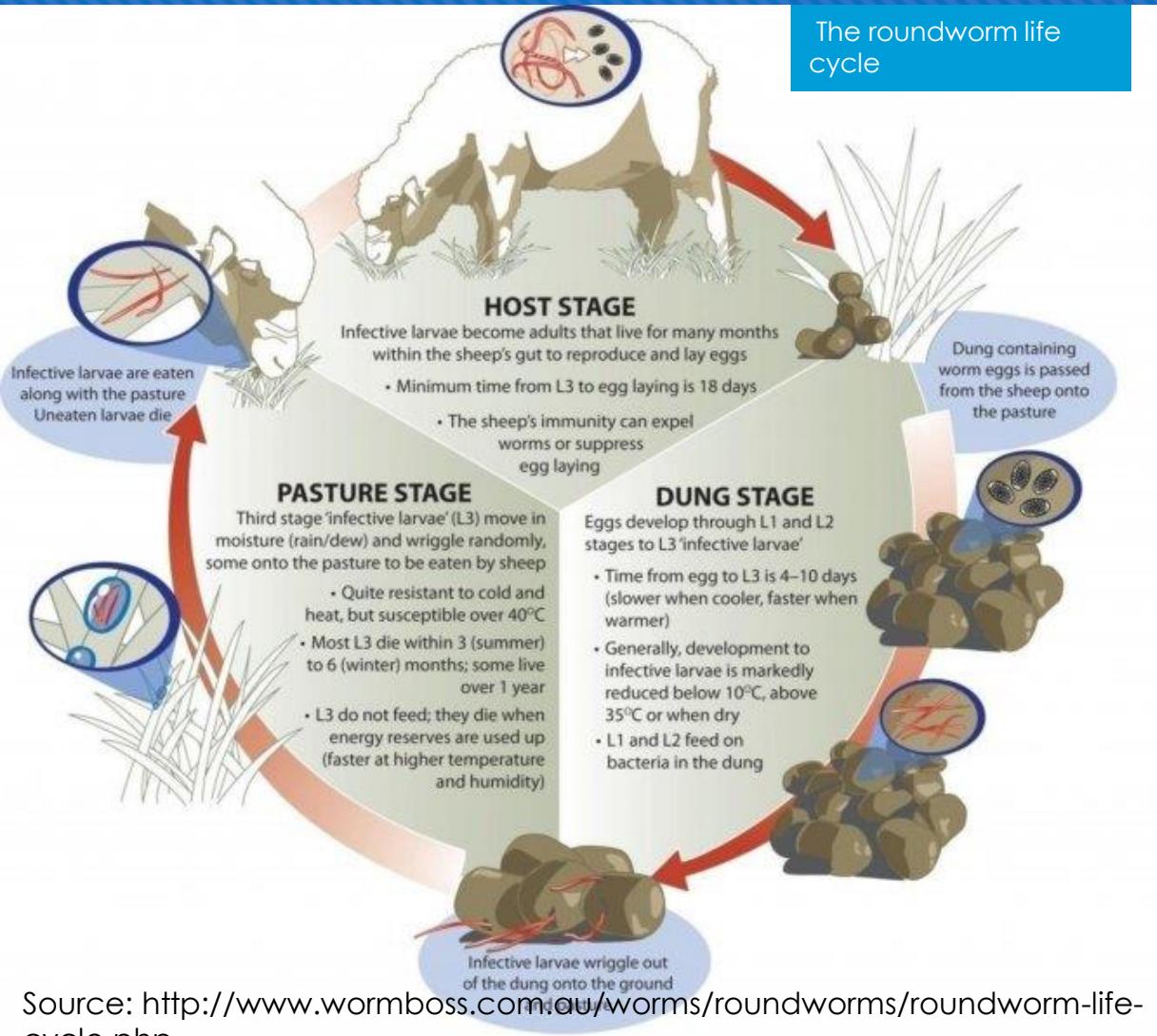
Normal surface of the small intestine



The wall of the small intestine damaged by black scour worm



# The sheep nematode life cycle



The life cycle of both *Haemonchus* and the scour worm species is relatively simple. Adult worms in the gut produce eggs that are shed in the sheep's faeces onto the pasture, where they hatch and develop through various larval stages. The third stage ("infective") larvae remain in the faecal pellet until there is sufficient moisture to allow migration onto the herbage, where they are either ingested by grazing sheep or die after a variable period. Inside the sheep, the larvae develop into adult worms in about 3 weeks, although under some circumstances they may remain in a dormant state for some months before eventually resuming development.

# Flukes (*trematodes*)

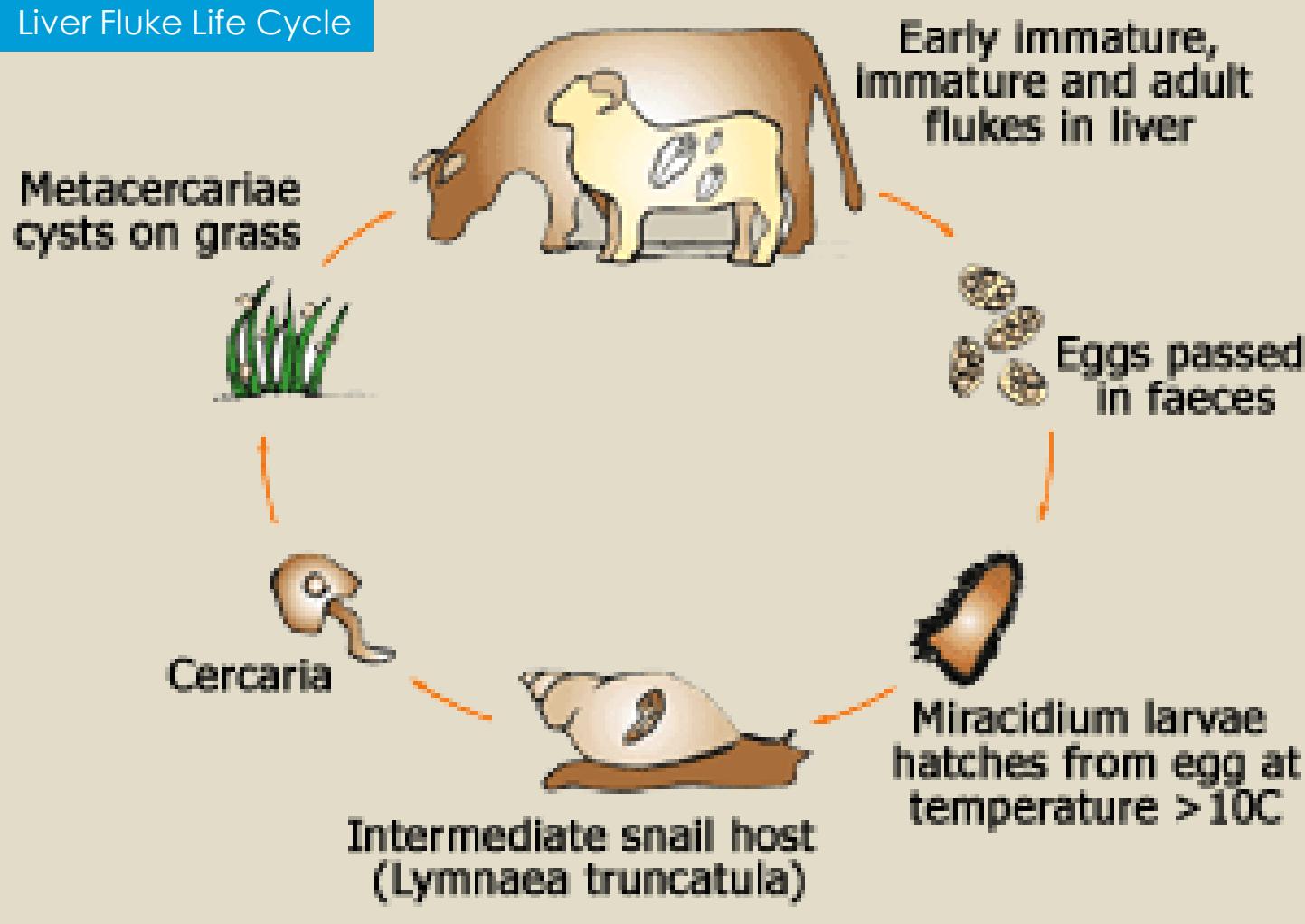
## Liver fluke (*Fasciola hepatica*)

Liver fluke (*Fasciola hepatica*) is by far the most important fluke of livestock globally. Adult flukes live in the bile ducts in the liver, and have a complex life cycle that requires the larval stages to enter an aquatic snail and multiply, before emerging to develop to infective forms that encyst on vegetation, where they are available for ingestion by grazing animals.

Several forms of disease occur, including deaths from an acute form associated with haemorrhage due to large numbers of migrating immature flukes. Less acute disease is seen as anaemia, jaundice and deaths, but chronic fascioliasis is most common, and is mostly seen as illthrift and anaemia.

However, the fluke's distribution is limited to moist situations and seasons suitable for the survival of snails, and fencing off snail-infested areas assists its control on individual properties. Liver fluke infects all ruminants, and less routinely, other grazing livestock such as horses.

## Liver Fluke Life Cycle



## Flukes (trematodes) Liver fluke (*Fasciola hepatica*)



Liver fluke (*Fasciola hepatica*)

Source: <http://www.wild-facts.com/2010/wild-fact-751-party-crasher-liver-fluke/>

Source: <http://www.britannica.com/EBchecked/media/5519/Liver-fluke>

# Tapeworms (cestodes)

Tapeworms are obligate parasites, which means that the adult stage cannot survive away from the host. They are zoologically classified in the Phylum Platyhelminthes (literally "flat worms") and Subphylum Cestoda. All tapeworms have indirect life cycles, which means that they utilise more than one host. The final host harbours the adult or sexually mature stage of the worm, whereas the immature stages occur in one or more intermediate hosts.

These immature stages occur in a variety of forms and sizes, but can all broadly be described as "bladder worms" or "cysts". Adult tapeworms are hermaphroditic. Tapeworms of veterinary importance are either adult, in which case they colonise the gut or bile ducts, or immature. Adult tapeworms do relatively little direct damage to the host, in comparison with the immature stages, which can cause major tissue destruction, depending on the tissue they parasitise. The immature forms parasitise skeletal muscle (called "measles" due to their appearance) or other organs such as the central nervous and respiratory systems and the liver. These immature forms are of interest not only for their pathogenic potential to the host, but also from a public health point of view where food animals are concerned, because many of them are potentially zoonotic.

# Tapeworms (cestodes)

Tapeworms of sheep can be divided into 2 broad groups:

Adult tapeworms that live in the small intestine of sheep:

- *Moniezia expansa*, the most common tapeworm lives in the sheep's small intestine and is often detected when mature segments (proglottids) from the worm are passed in the sheep's dung. These look like white grains of rice.



<http://www.sheepandgoat.com/articles/tapeworms.html>

Immature or larval (cystic) stages of tapeworms that occur within organs of sheep with adult tapeworms in the dog:

- Hydatid tapeworm (*Echinococcus granulosus*)
- Sheep measles (*Taenia ovis*)
- Bladder worm (*Taenia hydatigena*)

# Tapeworms (cestodes)

The most common tapeworm of sheep is *Moniezia expansa*. These worms consist of a flat ribbon-like tube of segments called proglottids and a neck and head (the size of a pin head) at one end of the worm.

Adult tapeworms, which can be up to a metre long, are found in the sheep's small intestine, where they attach to the inner surface using strong, muscular suckers on the head of the worm (the scolex). Each proglottid (segment) is a complete functional unit, including sets of male and female reproductive organs, and thus can fertilise itself or other nearby proglottids as necessary.

Mature proglottids, full of tapeworm eggs, break free from the body of the worm and pass out of the sheep's gut via the dung. They look like grains of rice in the dung. Eggs are released from the proglottids into the environment and can remain potentially infective for several months.

# Hydatid tapeworm (*Echinococcus granulosus*)

The hydatid tapeworm (*Echinococcus granulosus*) is very important as humans can become infected, with serious illness possible.

However, humans do not become infected from contact with sheep or by eating sheep meat or offal. Humans are generally infected from domestic dogs.

The dog carries the adult tapeworm, with eggs being passed in its dung. The sheep or human swallows the eggs and cysts form in tissues such as the liver or lungs. Sheep tend to suffer no ill-effects and after initial exposure their resistance generally prevents new cysts from forming. In humans, however, the cysts can cause serious illness or even death. Surgery is required to remove cysts.

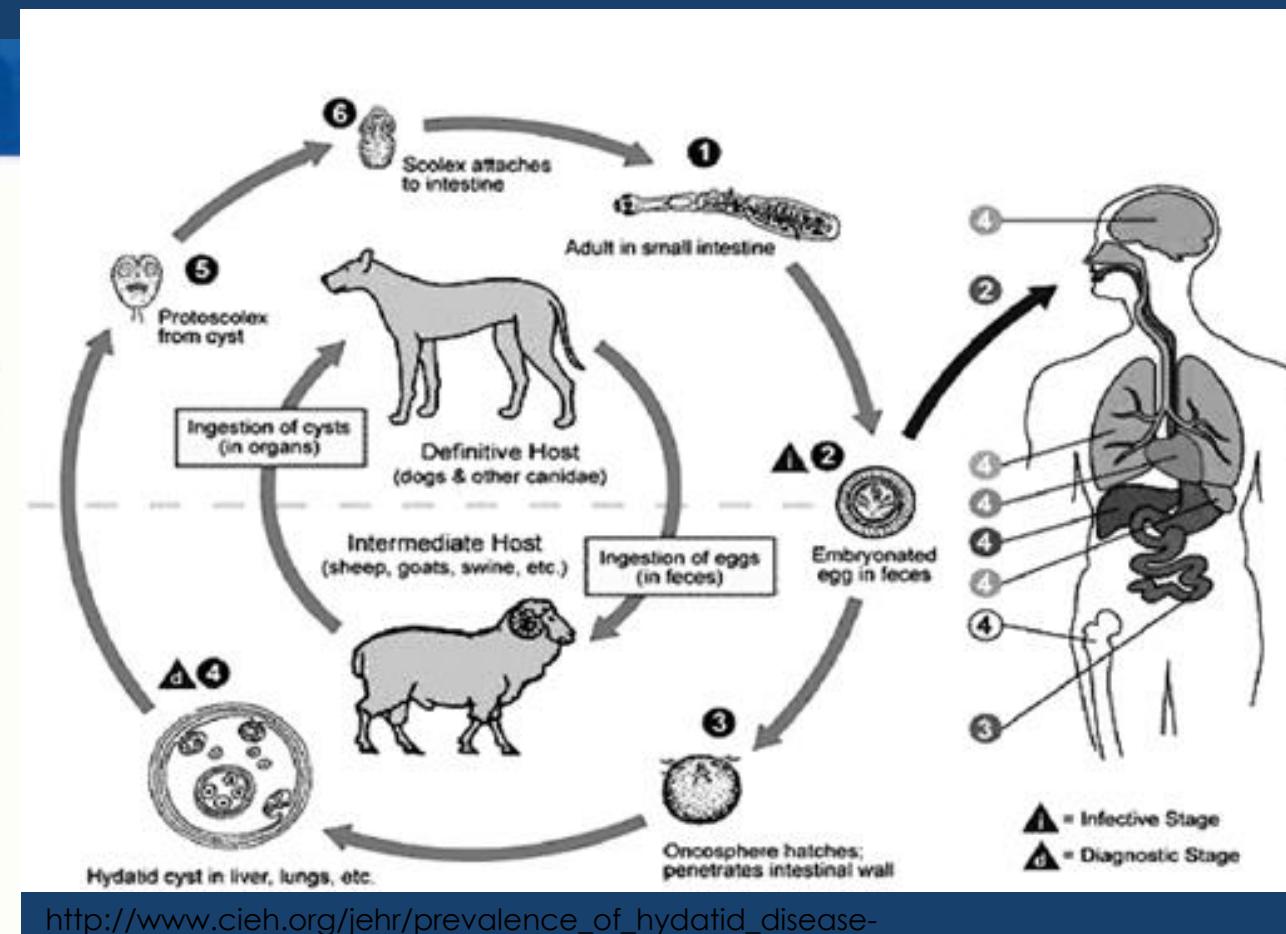
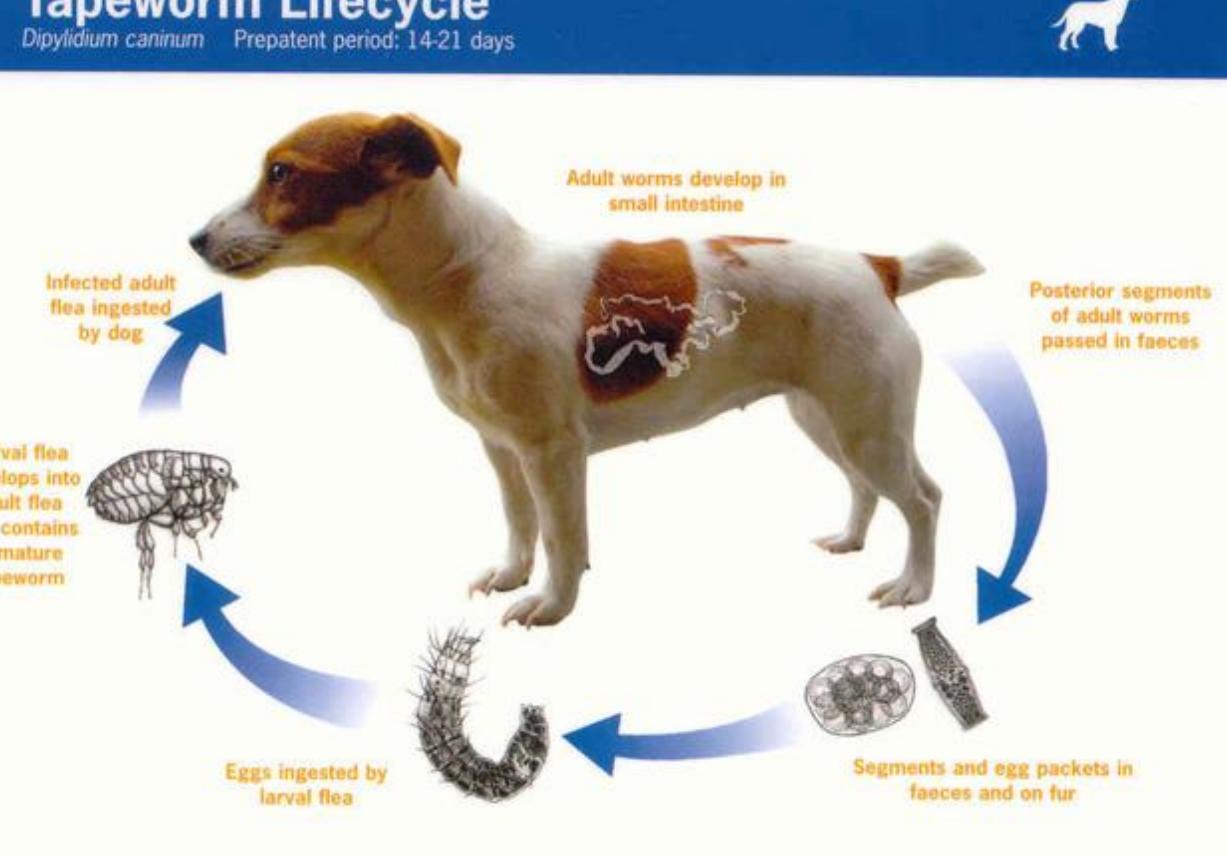
This disease can largely be prevented by: preventing dogs from eating sheep offal regular treatment of working dogs and pets in sheep areas with praziquantel. Treatment of sheep for tapeworm will have no effect on the cysts in the sheep.

The large tapeworm segments visible in the dung of sheep are not hydatid tapeworm but segments of the intestinal tapeworm of sheep (*Moniezia expansa*).

# Hydatid tapeworm (*Echinococcus granulosus*)

## Tapeworm Lifecycle

*Dipylidium caninum* Prepatent period: 14-21 days

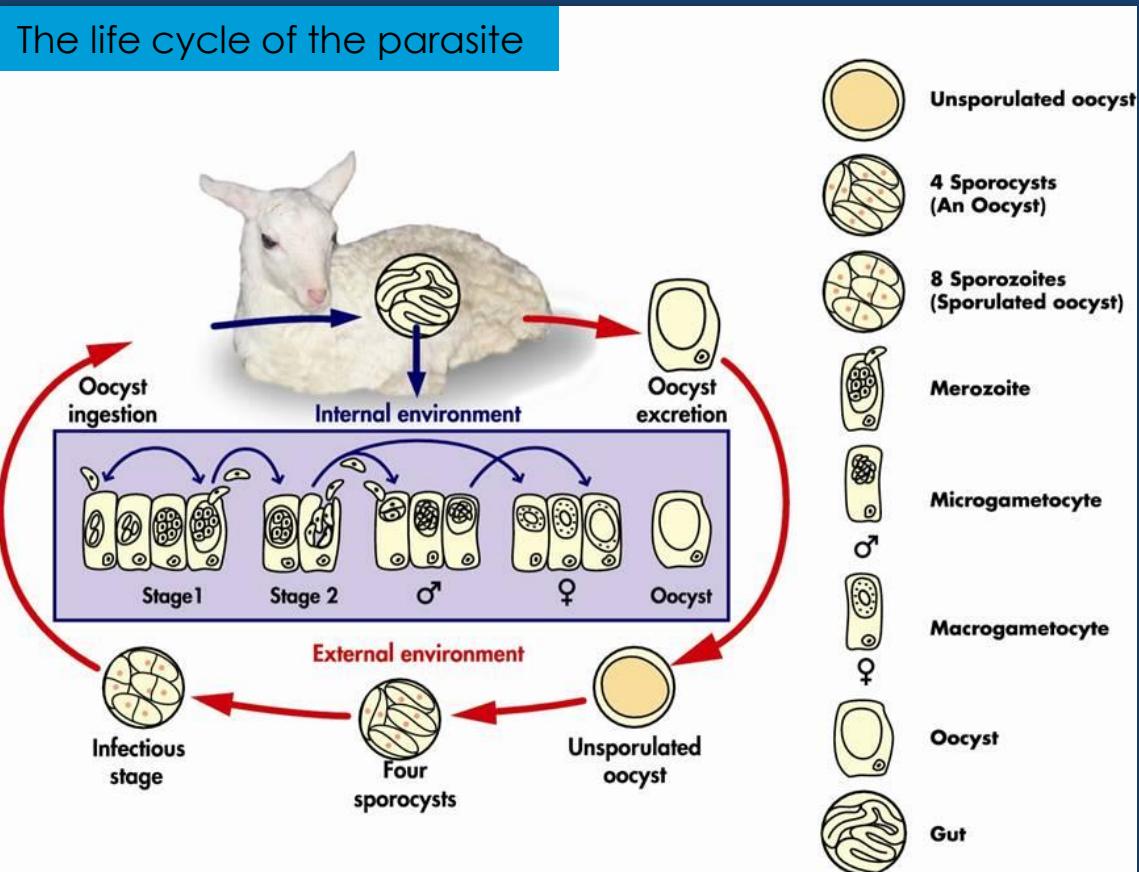


# Coccidiosis

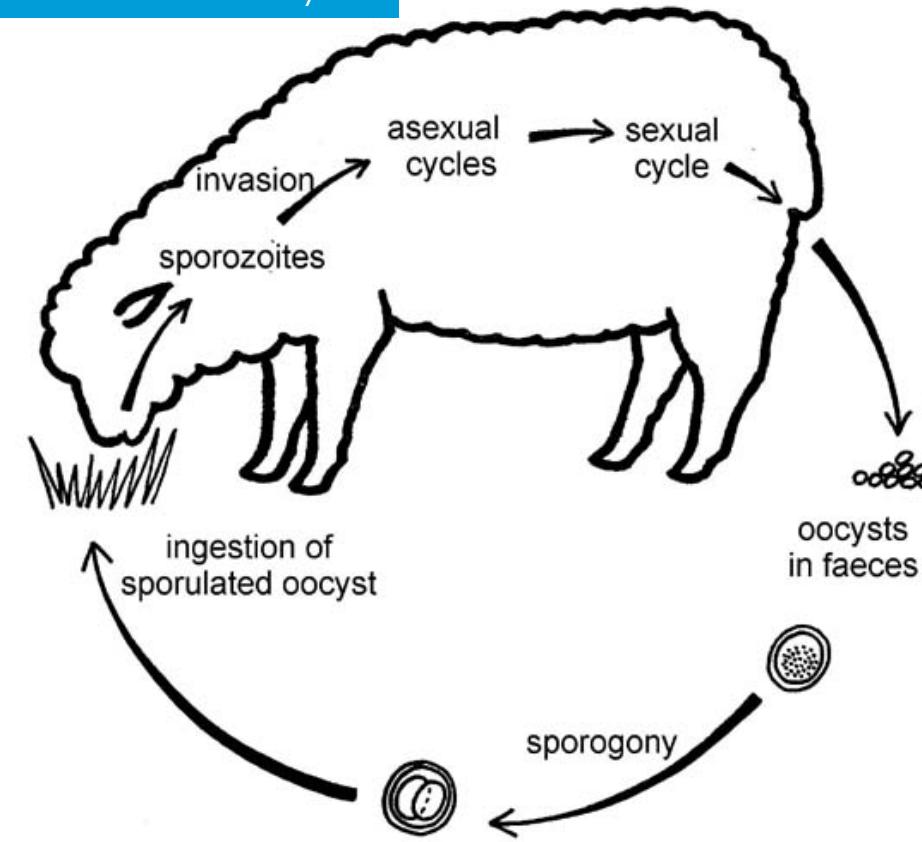
Coccidia are microscopic protozoan (single-celled) parasites of the gut, which are commonly present in healthy animals but can cause severe disease in animals where an immunity has yet to develop or is compromised (Taylor, 1995). The infective forms are passed in faeces and transmitted to other sheep as they graze, with damage to the gut occurring as the organisms multiply and break out of gut-lining cells. Disease is seen as profuse diarrhoea, reduced weight gains, and at times deaths if severe occurrences are left untreated. Almost all lambs are infected with coccidia within the first few weeks of life, but immunity usually develops quickly, although some lambs may develop a mild transient diarrhoea.

# Coccidiosis

The life cycle of the parasite



Coccidia Life Cycle



# Immunity to worms

The main factor governing the size and impact of worm burdens in animals is the level of the natural immunity that develops with continued exposure to infection.

Lambs are highly susceptible to worm infection in their first year of life, and full adult immunity may not develop until over 18 months, depending on the level and time course of larval intake.

In contrast, adult sheep typically reject worm larvae and maintain very low burdens, except in a small proportion of individuals genetically incapable of mounting an effective immune response.

However, continued contact with worms is necessary to maintain immunity, and even adult sheep may suffer parasitism if exposed to heavy larval intake after a prolonged absence of worm contact.

# Worm control programs

Efficient worm control requires planning an annual program based on pre-emptive treatment and management routines to minimise worm challenge to susceptible sheep, and measures to maximise natural worm immunity.

- Routine treatments at times animals are likely to carry significant (but usually sub-clinical) burdens
- Treatments to pre-emptively prevent pasture contamination with worm eggs at critical times
- Pasture management to minimise heavy larval challenge to worm-susceptible sheep
- Ensuring that sheep remain in good nutritional condition, to assist in resisting the acquisition of heavy worm burdens and tolerating their effects
- Monitoring worm egg counts at intervals during periods when worm larval intake is likely
- Introducing rams genetically selected to have a superior level of worm resistance
- Measures to minimise the development of drench resistance

# External parasites

- Several external parasites are significant problems for sheep industries globally, although the relative importance of different types and species varies markedly between countries. The potential for significant production loss and sheep mortalities due to blowfly strike and infestation with the sheep scab mite, and significant wool loss due to body lice, necessitate a good understanding of appropriate sheep management routines and chemical applications for treatment and prevention.

# Blowfly Strike (Cutaneous Myiasis)

Blowfly is the main external parasite affecting sheep in the summer months. More likely to occur in warmer, humid weather, the blowfly season is starting earlier and lasting longer than before. If left untreated, fly strike can be fatal.

## Symptoms

*Agitation and dejection* - foot stamping, vigorous shaking, gnawing or rubbing of the tail and breech.

*Odour* - as infestation develops a distinctive smell is noticeable. Wool becomes matted and discoloured.

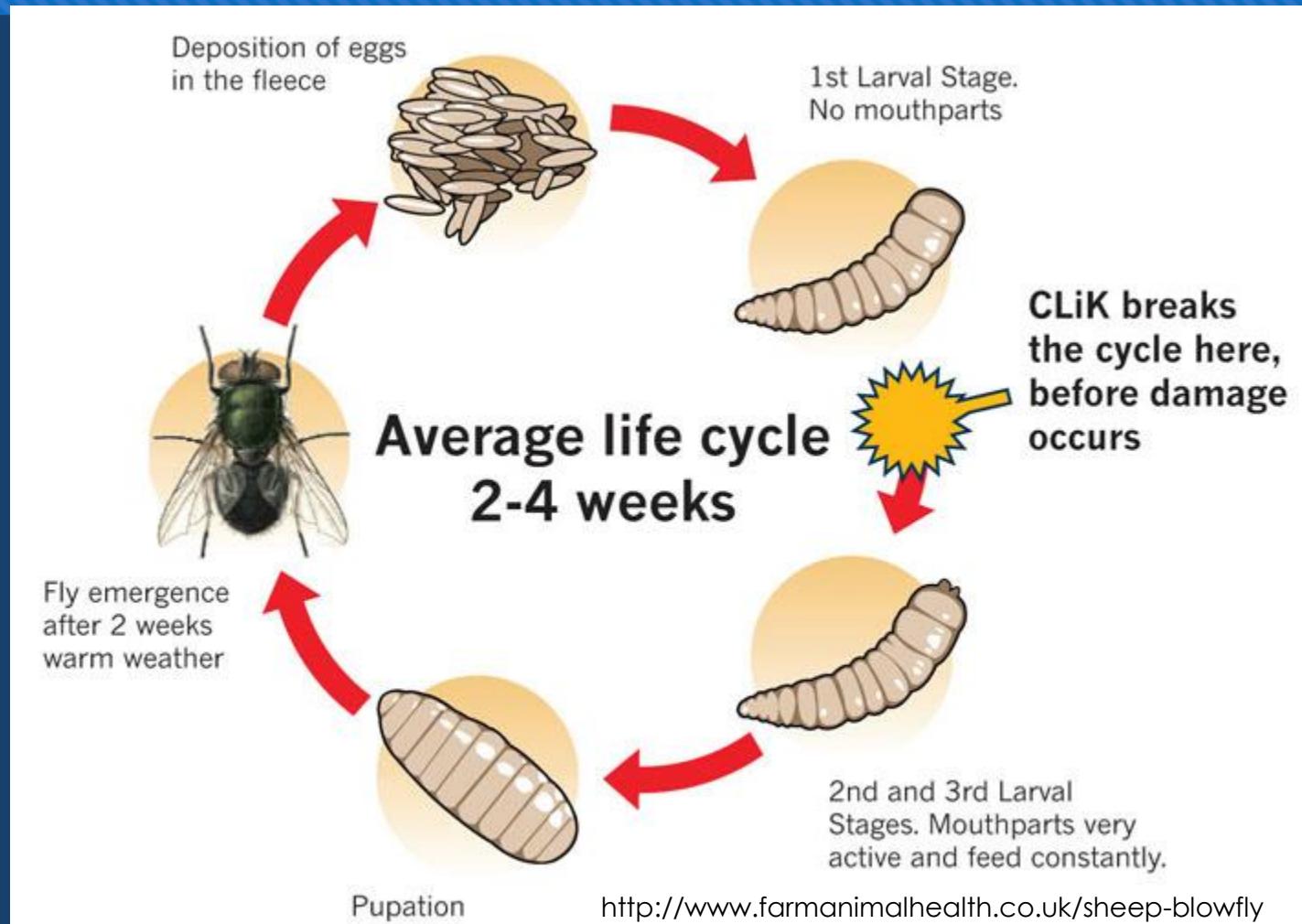
*Wool is shed* - if infestations remain untreated, the affected area increases from the centre, accompanied by constant discomfort.

*The smell of infestation attracts more flies* – if unchecked, further infestations of flies can result in a quick and agonising death.



# Blowfly Strike (Cutaneous Myiasis)

- Blowfly larvae need soil temperatures above 9oC to develop.
- The first 'wave' of flies – from overwintered larvae - causes spring strike.
- Flies continue to deposit many hundreds of eggs onto affected sheep, which hatch into larvae.
- Larvae develop through 3 stages between egg and adult.
- Stages 2 and 3 damage the sheep's skin as they feed causing 'strike' which leads to production losses and welfare problems.

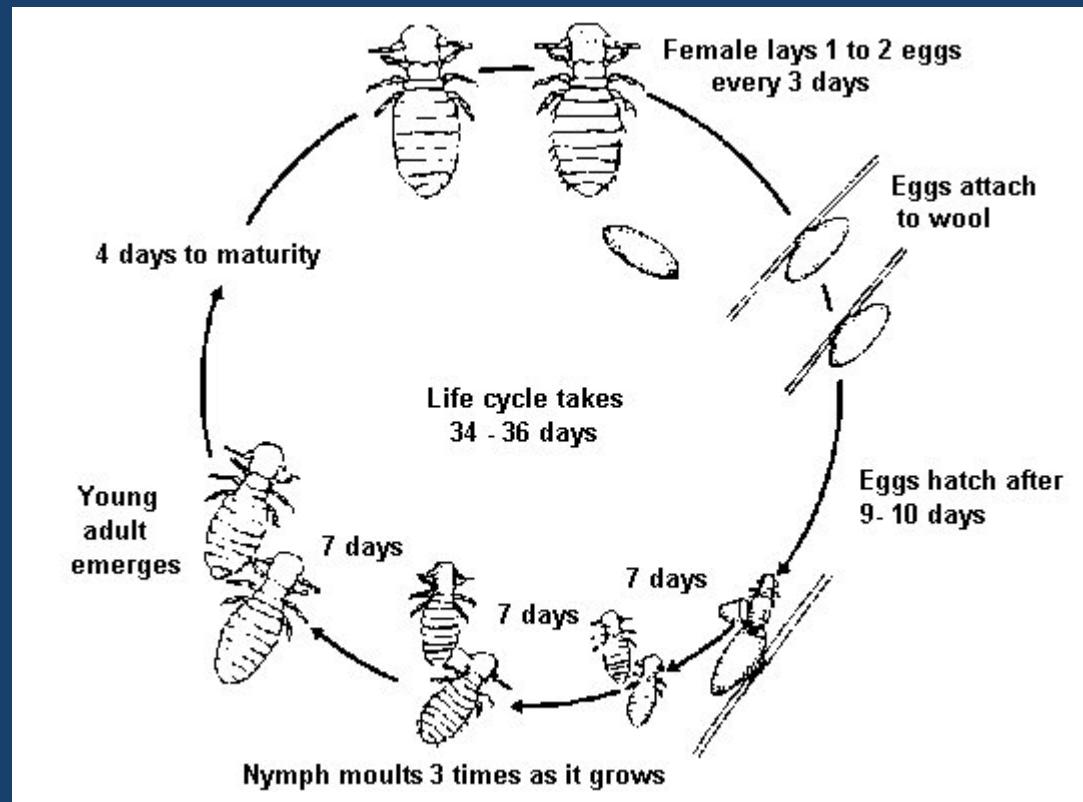


# Sheep body lice (*Bovicola ovis*)

Sheep lice are one of the three main parasite diseases of sheep.

They have a significant economic impact on the sheep industry, both in lost production and costs of control. The impact of lice is determined by how long the sheep have been infested and the number of lice that are present.

Often there is little economic impact in the first year of an infestation, but if left untreated lice numbers can build to levels where significant losses may be experienced.



# Economic effects of lice on production

In summary, the effects that have been measured are:

• Fleece value	reduced by \$3-\$10
• Greasy fleece weight	reduced by 0.2–1.1 kg
• Clean fleece weight	reduced by 0.2–0.9 kg
• Fibre diameter	no effect
• Yield	reduced by 2.6–6%
• Colour	more yellow and less bright
• Fibre or staple length	slight reduction
• Staple strength	possible reduction
• Processing performance	reduced top yield and fibre length, increased carding loss and noil
• Body weight and reproduction	no effect
• Skin value	possible reduction

# Mites of sheep

## Sheep scab

The highly debilitating external parasite of sheep, *Psoroptes ovis*, occurs in most sheep-raising countries (but is exotic to Australia and New Zealand).

The mites cause an intense irritation, with constant scratching and biting that leads to severe dermatitis, scab formation, wool damage and shedding, reduced weight gains and in some cases death.

Scab mites may also occur in the ears causing chronic irritation and damage there.

As with most parasites it is more severe in young lambs and sheep in poor nutritional condition. It is responsive to several insecticide groups, and fortunately, also to macrocyclic lactone anthelmintics, provided these are given by programs that ensure developing immature mites are killed.



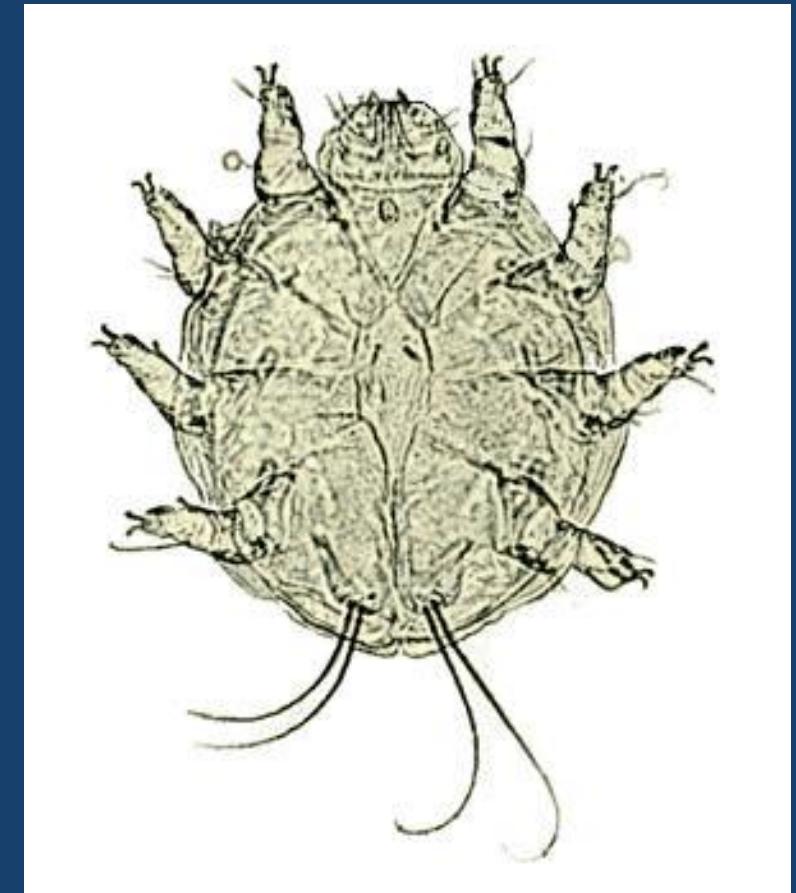
<http://www.county-vets.co.uk/veterinary-services/farm-animals/sheep/sheep-scab/>

# Itch mite

*Psorergates ovis*, which is common in most areas other than Europe, is a microscopic parasite invisible to the naked eye, and also causes skin irritation and rubbing by sheep.

The signs are similar to those of lice, but typically only a small portion of a flock shows severe wool damage.

Confirmation is by mite detection in skin scrapings from affected sheep, though a negative result is meaningless, as the signs in severely affected sheep are often due to hypersensitivity, requiring very few mites. Itchmite are now rare where there has been widespread use of macrocyclic lactone anthelmintics for sheep nematode control, as this group is also highly effective against itch mite.



# Diarrhoea due to non-parasitic causes

## Infectious causes of scouring

There are several bacterial causes of gastroenteritis and scouring in sheep and although the causal organisms are commonly present in healthy sheep, outbreaks of clinical disease usually only occur when sheep are debilitated or stressed from other causes (including nutritional stress, transport, overcrowding or management practices such as shearing).

Causal organisms include *Salmonella*, *Campylobacter* and *Yersinia* species.

# Other bacterial, viral and fungal diseases

## Clostridial diseases

Diseases caused by toxins produced by Clostridia bacteria are a common cause of sheep losses, but inexpensive vaccines have long been available, and are highly effective where used routinely.

An important decision is whether a product protecting against only the major diseases (enterotoxaemia and tetanus) is sufficient, or protection against a wider range of bacteria is justified.

Vaccination of ewes 4-6 weeks before lambing affords some protection to young lambs through colostral antibodies.

The recommended protocol for lambs and unvaccinated adult sheep is generally two doses of vaccine given at least 4 weeks apart.

An annual booster maintains immunity. It is convenient to give the first dose at lamb marking and the second at weaning.

# Clostridial diseases

## Enterotoxaemia (Pulpy kidney)

The causal organism, *Cl. perfringens* type D, is a normal inhabitant of the gastrointestinal tract of healthy sheep.

Outbreaks of clinical disease are most commonly associated with rapid changes in diet, particularly to a higher plane of nutrition with large amounts of rapidly fermentable carbohydrate, such as grain, lush pastures or young cereal crops.

Unforeseen outbreaks of the disease may occur where pasture characteristics change quickly whilst being continuously grazed; however, enterotoxaemia also occurs without obvious causal factors.

Sheep are often found dead, often before the clinical signs of scouring, depression or nervous signs are noted, but death generally ensues once these signs occur.

# Clostridial diseases

## Tetanus

Tetanus Spores of *Cl. Tetani* are resident in soil, and infect sheep by contaminating a skin wound, typically from shearing or marking, dog bites or grass seed penetration.

The spores germinate in dead or damaged tissue where the bacteria produce the potent toxin, which causes muscle spasms, paralysis and death.



<http://www.pipevet.com/content/Tetanus.asp>

All animal species, including man, can be infected, with death in the majority of cases, and treatment is rarely possible (although anti-toxin may be effective if given prior to the appearance of clinical signs).

# Footrot



<http://adlib.eversite.co.uk/adlib/defra/content.aspx?id=000IL3890W.18B4R37JRPS8XP>

Footrot is an infectious disease of the feet leading to various degrees of lameness, and is endemic in most sheep-raising countries.

The disease involves infection of the interdigital skin with a complex mixture of bacteria (of which *Dichelobacter nodosus* is essential), and depending on the virulence of the strain, progresses from inflammation of the skin-horn junction to underrunning of sole and wall of the hoof.

More than one foot is usually involved, and with severe lameness, sheep are reluctant to move and kneel to graze.

Vaccines are available to reduce the severity, and as the propensity for infection has a genetic basis, breeding approaches are possible.

# Scabby Mouth (contagious ecthyma)



<https://www.zoetis.com.au/diseases/221/scabby-mouth-disease.aspx>

Scabby mouth or contagious ecthyma ("orf") is a viral disease of sheep and goats that is transmissible to humans (in which the disease may cause mild to severe dermatitis), and has been reported in sheep-raising countries throughout the world. The infection rate within affected flocks varies greatly, but can reach 100%. Infection enters through skin abrasions, causing lesions mostly around the mouth, nose and on the feet.

These are initially seen as vesicles, which rupture and lead to raw, sometimes bleeding, scabs which eventually harden and drop off.

Apart from a transient acute lameness and reduced ability to feed, the disease is of no lasting significance in sheep, although it may be a blowfly strike risk.

# Metabolic diseases

## Pregnancy toxæmia

Pregnancy toxæmia ("twin lamb disease") is caused by an imbalance between energy demands and energy supplied in the diet. The demands of the foetus for energy (in the form of glucose) increases in the last third of pregnancy relative to the glucose production capacity of the ewe and this causes a fall in the blood glucose levels in the ewe.

If dietary energy is not sufficient to maintain blood glucose within a normal range, the ewe's fat reserves are mobilised and the level of circulating fatty acids increases.

The liver converts these fatty acids to ketones; both fatty acids and ketones are toxic at high levels.

If the production of toxic compounds increases beyond the level at which the tissues can take them up, disease may result. The disease affects only pregnant ewes.

Ewes pregnant with twin lambs are at an increased risk, as are ewes that are older, very thin or very fat.

# Metabolic diseases

## Hypocalcaemia

Hypocalcaemia refers to a depressed level of calcium in the blood, which results in lower levels in tissues.

As late pregnancy and lactation increase the body's total demand for calcium (Chrisp et al., 1989), ewes in the last trimester of pregnancy and lactating ewes are most susceptible.

However, any sheep class can be affected and calcium depletion can also be triggered by stresses such as mustering over long distances, transport and prolonged yarding.

Calcium deficiencies may also be observed in sheep fed diets with low calcium content or low calcium bioavailability.

# Metabolic diseases

## Hypocalcaemia

Cereal crops and grains often have low amounts of calcium and the availability of calcium is reduced in diets containing oxalates or phytate.

Hypocalcaemia typically has a rapid onset and sheep often deteriorate over about 24 hours. Sheep may have muscle tremors (most obvious over the shoulder area) that progress to hindlimb weakness and tetany (stiffness) of limbs, and eventually seizures .

If detected before advanced neurological signs occur, injections of calcium solutions are often effective, but this is obviously difficult on a large scale and sheep must be monitored for relapses

# Questions

- What are the categories of disorders and what are their characteristics?
- What are the major internal parasites and what are their characteristics?
- What are the major external parasites and what are their characteristics?
- What are the major metabolic diseases and what are their characteristics?

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- <http://www.wormboss.com.au/worms/tapeworms.php>



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# ANIMAL BREEDING

című digitális tananyag

Szegedi Tudományegyetem Mezőgazdasági Kar  
Állattudományi és Vadgazdálkodási Intézet

Mikó Józsefné Dr. Jónás Edit  
Főiskolai docens

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**SZÉCHENYI** 2020



MAGYARORSZÁG  
KORMÁNYA

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# CHAPTER 20

## SHEEP DAIRYING

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# Sheep dairying

# World Milk Production

Cow milk dominates global milk production, but milk from other animals is important in specific regions, countries and local contexts.

Globally cow milk represents 85 percent of global production and at least 80 percent of total production in all regions except South Asia, where its share is less than half (44 percent).

In addition to cow milk, only buffalo milk makes a substantial contribution at the global level accounting for 11 percent of global production and 23 percent of developing country production.

The contribution of milk from goats (3.4 percent), sheep (1.4 percent) and camels (0.2 percent) is limited at the global level and only slightly higher among the developing countries as a group.

# World milk production

	Sheep milk		Goat milk		Cow milk		Camel milk		Buffalo milk		Milk, total	
	Volume	Share	Volume	Share	Volume	Share	Volume	Share	Volume	Share	Volume	Share
	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%
<b>Developed</b>	327	0.9	2516	0.8	320886	98.1	0	0.0	228	0.1	327000	100
Formerly centrally planned economies	101	1.1	858	0.8	99367	98.4	0	0.0	13	0.0	101000	100
Industrialized	243	0.9	1782	0.7	238381	98.1	0	0.0	221	0.1	243000	100
<b>Developing</b>	309	1.8	10623	3.4	221174	71.6	1292	0.4	69983	22.6	309000	100
East and Southeast Asia	45	2.8	587	1.3	39479	88.7	19	0.0	3124	7.0	44500	100
China	39	2.8	265	0.7	34950	88.9	15	0.0	2925	7.4	39300	100
Rest of East and Southeast Asia	5	2.9	322	6.2	4529	87.0	4	0.1	199	3.8	5207	100
Latin America and the Caribbean	62	0.0	449	0.7	61811	99.2	0	0.0	0	0.0	62300	100
Brazil	20	0.0	136	0.7	19976	99.4	0	0.0	0	0.0	20100	100
Rest of Latin America and the Caribbean	42	0.1	312	0.7	41836	99.1	0	0.0	0	0.0	42200	100
South Asia	126	0.1	5751	4.6	55972	44.4	0	0.0	64520	51.2	126000	100
India	89	0.0	2927	3.3	43466	48.7	0	0.0	42799	48.0	89200	100
Rest of South Asia	37	0.2	2824	7.6	12506	33.7	0	0.0	21721	58.5	37100	100
Near East and North Africa	35	8.4	1231	3.6	27924	80.9	142	0.4	2333	6.8	34500	100
Sub-Saharan Africa	23	4.8	2391	10.3	18691	80.2	1127	4.8	0	0.0	23300	100
<b>World</b>	8641	1.4	13144	2.1	542069	85.4	1292	0.2	70211	11.1	635000	100

Source: FAOSTAT (2011)

- ▶ More than half of the world's sheep population is in developing countries; sheep are more prevalent than goats in cooler climates.
- ▶ Sheep production has many potential outputs - milk, meat, skin, fibre and manure - but most small-scale producers in developing countries raise sheep for meat or sale as livestock at local markets.

- ▶ Most sheep milk is produced in the Mediterranean region, and most dairy sheep breeds are found in this region and the Near East.
- ▶ The milk yield and lactation length of dairy sheep are not comparable to those of dairy cattle or dairy goats, but sheep milk production can be improved by milking stimulation (e.g., milking several times a day).
- ▶ Genetic selection of dairy sheep has not resulted in significant improvements in milk yield and lactation length. Dairy sheep breeds include Awassi, East Friesian and Lacaune.

# Dairy sheep and goat facts

- ▶ The Near East region has the highest sheep and goat milk production per inhabitant.
- ▶ About 95 percent of the world's goat population is in Asia, Africa and Latin America. Asia accounts for the largest share, with approximately 60 percent of the total.
- ▶ Most dairy goat raising is in the Mediterranean region, South Asia and parts of Latin America and Africa.
- ▶ Major goat milk producers are India, Bangladesh and Pakistan.
- ▶ In India, more than 90 percent of small ruminants are owned by landless and marginal farmers.
- ▶ The average milk yields of goats vary significantly among major milk producing countries. In Bangladesh, the average goat milk yield is about 80 kg/year, while in India and Pakistan it is more than 140 kg/year.

# Dairy sheep and goat facts

- ▶ Major sheep milk producers are China, Turkey and Greece.
- ▶ Milk from goats contributes significant shares of total milk production in sub-Saharan Africa (13 percent) and parts of South, East and Southeast Asia (excluding China).
- ▶ Milk from sheep is important in the Near East and North Africa (7.5 percent of total milk production) and sub-Saharan Africa (7 percent).
- ▶ The countries with the most dairy goats are Bangladesh, India and Mali.
- ▶ The countries with the most dairy sheep are China, the Syrian Arab Republic, the Islamic Republic of Iran, Turkey and Algeria.

# Sheep Milk

Ovine milk, compared to bovine and caprine milk, is characterized by: higher protein and fat content, which makes ovine milk more suitable for cheese-making.

Average chemical and physical composition of ovine milk, compared with milk composition of the other three main ruminant species and with human milk

	Sheep	Goat	Cow	Buffalo	Woman
Water (%)	82.5	87.0	87.5	80.7	87.5
Total solids (%)	17.5	13.0	12.5	19.2	12.5
Fat (%)	6.5	3.5	3.5	8.8	4.4
Ø fat globule (µm)	4.0	3.9	4.4	—	—
TN* (%)	5.5	3.5	3.2	4.4	1.1
Casein (%)	4.5	2.8	2.6	3.8	0.4
Serum protein (%)	1.0	0.7	0.6	1.1	0.7
Lactose (%)	4.8	4.8	4.7	4.4	6.9
Minerals (%)	0.92	0.80	0.72	0.8	0.30
Ca (mg/l)	193	134	119	190	32
Energy (kcal/l)	1050	650	700	1100	690
Density	1.037	1.032	1.032	1.030	1.015
Acidity (°SH)	8.5	8.0	7.1	10.0	—
pH	6.65	6.60	6.50	6.67	6.85
Freezing point (°C)	-0.580	-0.570	-0.524	-0.580	—

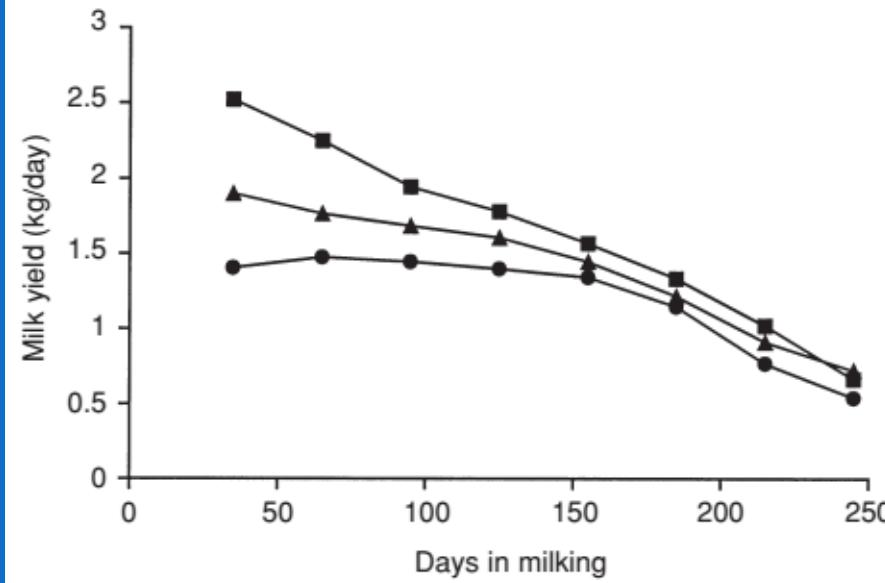
\*TN: total nitrogen ( $N \times 6.38$ ).

Source: CAB International 2004. Dairy Sheep Nutrition(ed. G. Pulina)

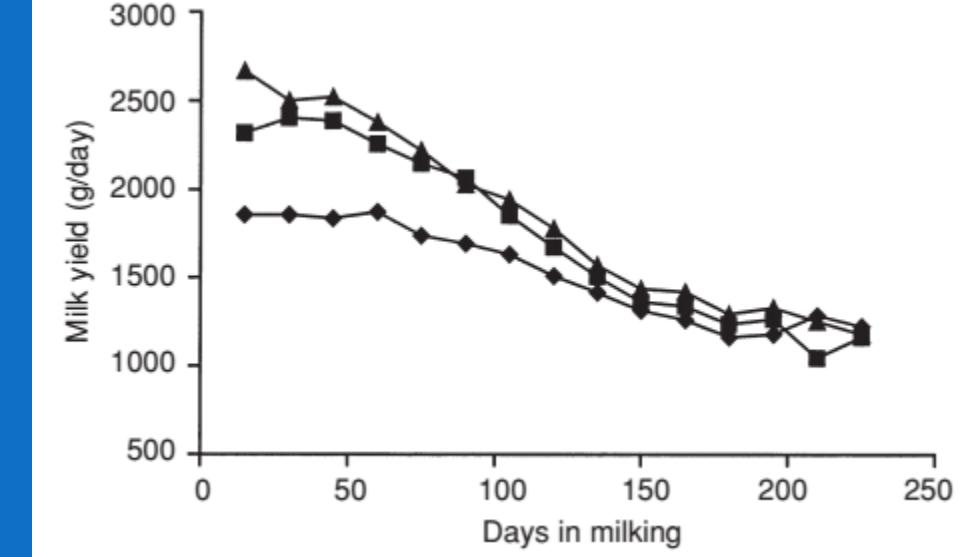
## Fat and protein content of ovine milk in certain dairy breeds

Breed	Fat (%)	TN* (%)
Aragat	5.70	5.49
Awassi	6.70	6.05
Chios	6.60	6.00
Comisana	7.5–10.6	5.9–10.4
Delle Langhe	6.75	5.95
Frisona dell'est	6.64	6.21
Karagouniki	8.70	6.60
Lacaune	7.14	5.81
Leccese	7.93–8.38	5.81–6.30
Manchega	9.07	5.43
Massese	6.79–7.44	5.48–5.96
Merino	8.48	4.85
Sarda	6.69	5.82
Tsigai	7.41	5.45

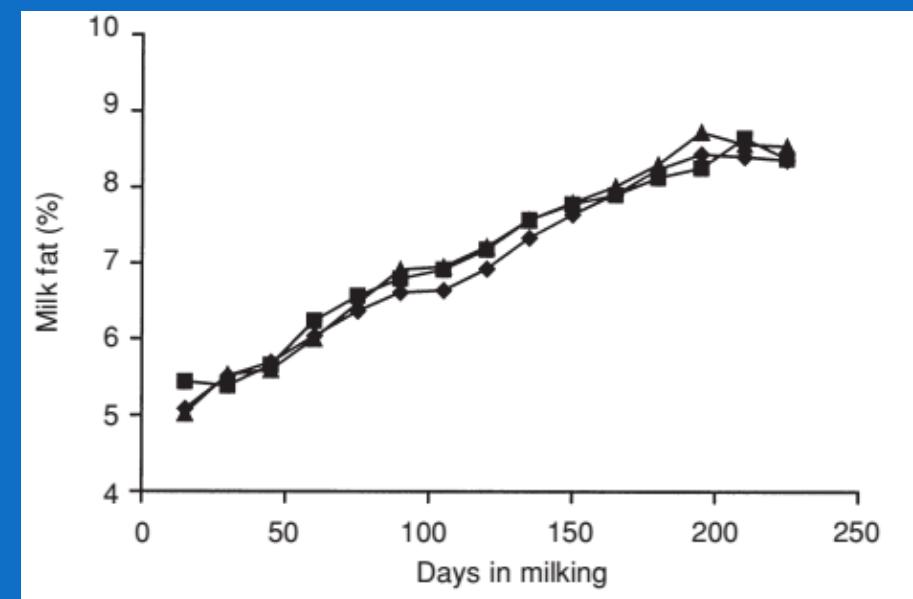
\*TN = total nitrogen ( $N \times 6.38$ ).



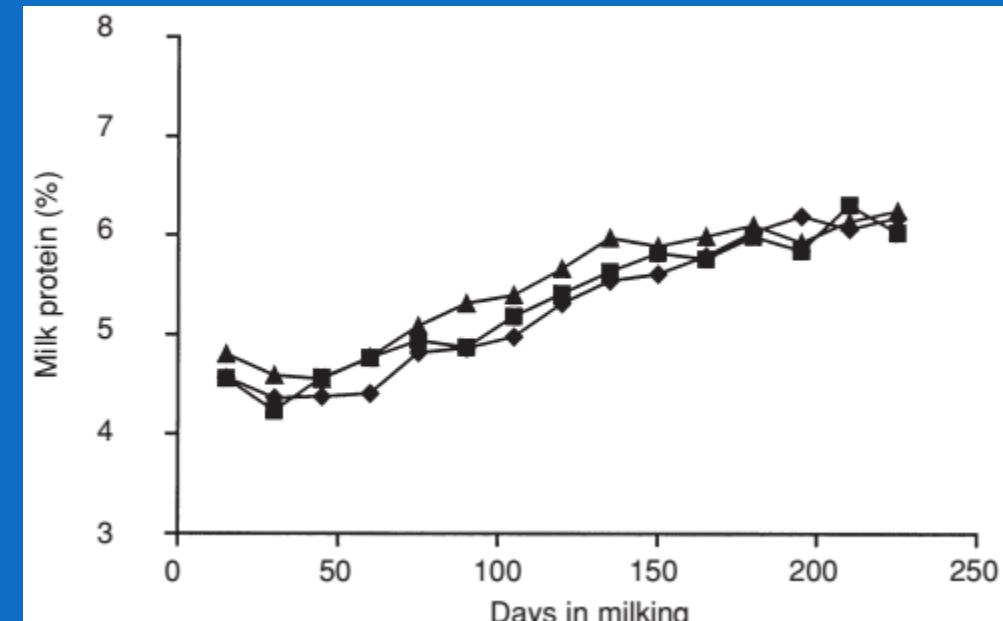
Sarda sheep lactation curves for milk yield separated by altitude of location of the flocks estimated with a Test Day model. ■, plain; ▲, hill; ●, mountain



Lactation curves of milk yield for three different parity classes of Valle del Belice sheep estimated with a Test Day model. ◆, 1; ■, 2; ▲, 3



Lactation curves of fat percentage for three different parity classes of Valle del Belice sheep estimated with a Test Day model. ◆, 1; ■, 2; ▲, 3



Lactation curves of protein percentage for three different parity classes of Valle del Belice sheep estimated with a Test Day model. ◆, 1; ■, 2; ▲, 3

# Feeding of Lactating Ewes

Milk production with dairy ewes requires more intensive systems and more nutrients per animal than are usually necessary for meat or wool production systems.

During lactation, nutrient requirements may be very high. Inadequate feeding may reduce both the daily milk production and the length of the lactation.

**Proper feeding strategies for the lactating ewe cannot be based simply on what is known about dairy cows.**

## Apparent digestibility and retention times for ruminants fed the same medium-quality timothy hay ad libitum

Item	Caprine	Ovine	Bovine
Body weight (kg)	29	30	555
Intake of dry matter			
g/day	700	650	7830
g/kg BW	24.3	21.7	14
g/kg BW <sup>0.75</sup>	56	51	68
Digestibility (%)			
Dry matter	47	47	54
NDF	44	44	52
Retention time of forage particles			
Rumen (h)	28	35	47
Whole GI tract (h)	52	70	79
Ratio: rumen/entire GI tract	54	50	59

BW: body weight; NDF: neutral detergent fibre; GI: gastrointestinal.

**Intake and chewing activity of cows and sheep fed the same pelleted total mixed ration as sole feed source**

Variable		Dairy cows	Dairy ewes
Intake	(kg of DM/day)	8.4	1.2
Eating time	(min/day)	110.7	56.0
Rumination time	(min/day)	19.4	78.5
Total chewing time	(min/day)	130.1	134.5
Eating efficiency	(min/kg of DM)	13.1	46.3
Rumination efficiency	(min/kg of DM)	2.3	64.9
Total chewing efficiency	(min/kg of DM)	15.4	111.2

Source: CAB International 2004. *Dairy Sheep Nutrition*(ed. G. Pulina)

# Diet Formulation for Dairy Sheep

One of the main objectives of diet formulation is to estimate the optimal dietary concentration of nutrients. This is obtained by dividing nutrient requirements by predicted DM intake.

The diet is then balanced by combining available feeds so that the dietary concentration of nutrients matches the concentration of nutrients required by the animal.

# Energy concentration

The optimal energy concentration (UFL or NEL/kg of DM) can be estimated by using energy requirements and feed intake as predicted by any of the published feeding systems.

Optimal energy concentration of the diet (UFL/kg of DM) for lactating ewes estimated assuming zero energy balance

FCM <sup>a</sup> (kg/day)	Bodyweight (kg)								
	30	35	40	45	50	55	60	65	70
0.5	0.65	0.66	0.67	0.67	0.67	0.68	0.68	0.69	0.69
1.0	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
1.5	0.85	0.84	0.84	0.83	0.83	0.83	0.83	0.82	0.82
2.0	0.92	0.91	0.90	0.90	0.89	0.89	0.88	0.88	0.87
2.5			0.96	0.95	0.94	0.94	0.93	0.93	0.92
3.0					0.99	0.98	0.98	0.97	0.96
3.5							1.01	1.01	1.00
4.0									1.03

<sup>a</sup> 6.5% fat-corrected milk yield

Source: CAB International 2004. *Dairy Sheep Nutrition*(ed. G. Pulina)

# Protein concentration

Optimal dietary protein concentration (g/kg of DM) should be calculated by dividing the required metabolizable protein (PDI or MP depending on the system used) by the predicted DM intake. However, when this approach is used the diets balanced for PDI or MP are often quite low in CP concentration, with values ranging between 11% and 15% CP (DM basis).

5% true protein milk (kg/day)	Bodyweight (kg)								
	30	35	40	45	50	55	60	65	70
0.5	16.6	15.8	15.1	14.8	14.5	14.0	13.7	13.3	12.9
1.0	17.7	16.9	16.5	15.9	15.6	15.0	14.5	14.3	13.9
1.5	18.5	17.7	17.4	16.7	16.4	15.9	15.7	15.2	14.8
2.0	19.1	18.7	18.1	17.7	17.2	16.6	16.4	15.9	15.7
2.5			18.9	18.3	17.8	17.5	17.0	16.6	16.4
3.0					18.6	18.0	17.6	17.3	16.9
3.5							18.3	17.8	17.6
4.0									18.0

# Fibre

The quantity of fibre in the diet influences both feed intake and ruminal fermentation.

**Optimal concentrations of NDF, CP and NFC depending on the productive levels of the sheep.**

	Production categories of 6.5% fat-corrected milk yield (g/day)					
	<500	500–799	800–1099	1100–1399	1400–1699	1700–2100
NDF (% DM)	45.0	45.0	44.5	41.2	38.9	33.2
CP (% DM)	14.5	15.0	15.5	16.3	16.7	17.3
NFC (% DM)	28.0	28.0	28.0	31.0	33.0	38.0

NDF:neutral detergent fibre;

CP: Dietary crude protein

NFC: Non-fibre carbohydrates

# Fibre particle size

The minimum feed particle size that stimulates rumination plays a very important role in the ovine diet. Diets that contain too much long fibre limit intake due to their filling effect. In addition, there is a limit to the number of hours per day for which a ruminant can ruminate. This means that diets that are too rich in fibre are eaten only in limited quantities because rumination takes too long.

## The effect of ryegrass silage particle size and timing of cutting on intake and milk production in lactating ewes between the 1st and 4th weeks of lactation

Type of silage		Silage				Milk yield	Lamb growth
Length	Timing of cutting <sup>a</sup>	CP (%)	pH	PS <sup>b</sup> (%)	Intake (kg DM/day)	(kg/day)	(g/day)
Short	Early	16.6	3.75	74	1.45	2.67	254
	Late	11.8	3.96	82	1.03	2.17	199
Long	Early	16.6	3.75	28	0.93	2.17	200
	Late	11.7	4.22	10	0.76	1.72	156

<sup>a</sup> Early cut: 16.6% CP; late cut: 11.8% CP; the diet was supplemented with 800 g/day of concentrates with 15.5% CP.

<sup>b</sup> PS, particle size (% < 50 mm).

## Fibre particle size distribution of a complete pelleted diet containing 37.4% NDF (of DM)

Sieve diameter (mm)	NDF retained (%)	NDF not retained (%)
4.74	0.0	100.0
2.36	5.7	94.3
1.18	14.8	79.5
0.60	20.8	58.7
0.30	21.5	37.2
0.15	24.0	13.2
< 0.15	13.2	0.0
Total	100.0	



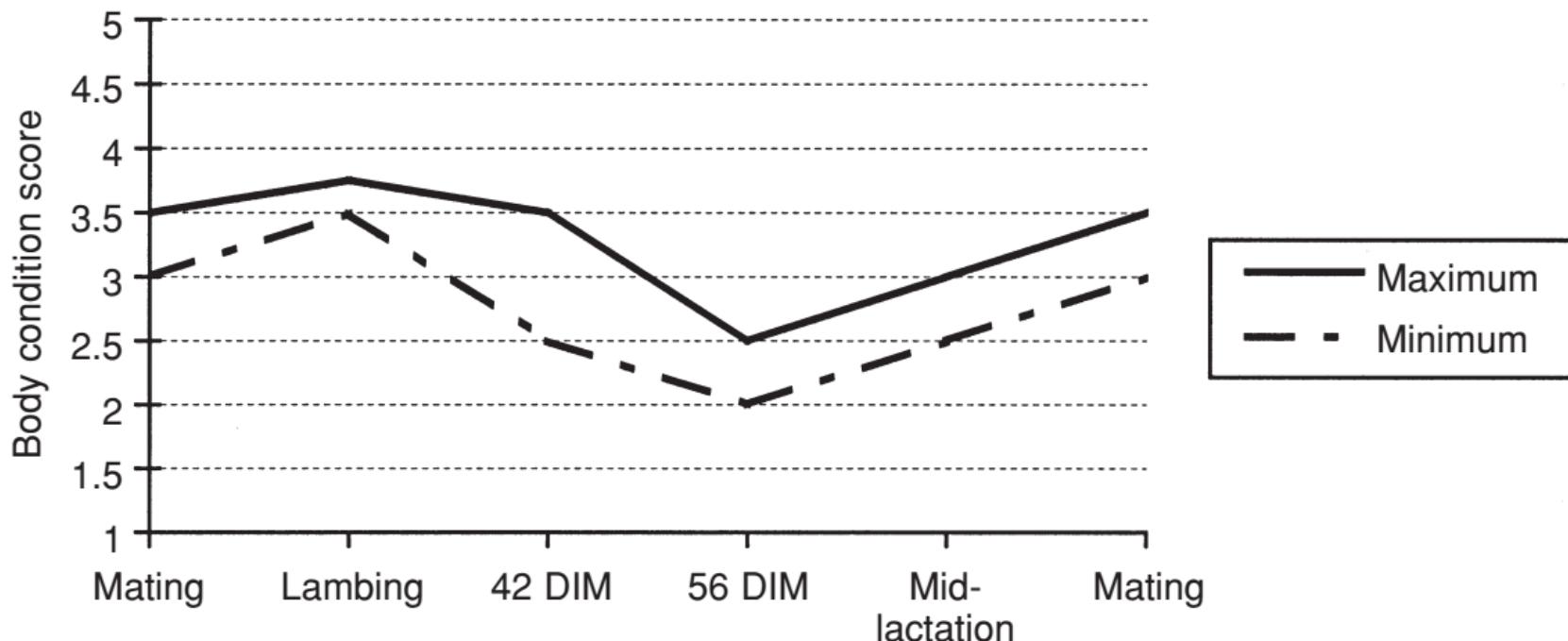
<sup>a</sup> Pellets treated with 8 M urea before ND treatment to avoid possible starch residues.

<http://www.sheep101.info/201/feedinglambs.html>

# Body condition

The body condition of the ewes at lambing is one of the factors that clearly influences their milk production in the first months of lactation, because part of the milk produced at this stage depends on body fat mobilization. Even when sheep are fed high-quality diets, a negative energy balance is none the less inevitable in the first months of lactation.

**Target body condition score during the production cycle of dairy ewes**  
DIM, days in milk.



# Milking



<http://www.youtube.com/watch?v=pNcHu602EV8>

## Questions

- What are the nutritional components of sheep milk?
- What percentage of sheep milk is water?
- How are lactating sheep fed?
- What does the food of sheep consist of?

# Sources:

- ▶ DJ. Cottle (2010): International Sheep and Wool hand book, Nottingham University Press
- ▶ Giuseppe Pulina (2004): Dairy Sheep Nutrition, CABI; First edition
- ▶ <http://www.fao.org/agriculture/dairy-gateway/milk-production/dairy-animals/small-ruminants/en/>
- ▶ <http://www.fao.org/docrep/015/an450e/an450e00.pdf>