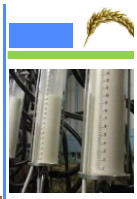
Improvement of the conformation of the mammary gland in Dairy Sheep

By Johanne Cameron, agr. M.Sc. Sheep Specialist



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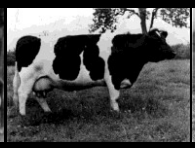
In search of perfection…

Holstein 1919



Holstein 1950

Holstein 1960

Born in 1962 - Ex 94 4E

2

In search of perfection…

Holstein 1970

Born in 1971 - Ex 96

Holstein 1980

Born in 1979 - Ex 91

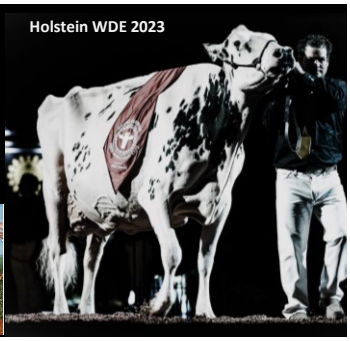
Holstein 1990

Born in 1995 - Ex 95 4E

3

In search of perfection…

Holstein WDE 2023



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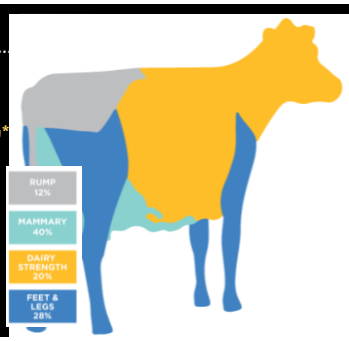
In search of perfection…

- ✓ Improvement of dairy character
- ✓ Improvement of the mammary system*
- ✓ Improvement of body capacity
- ✓ Improvement stature (height)…
- ✓ Improvement of feet and legs
- ✓ Improvement of rump structure

Why ?

How ?



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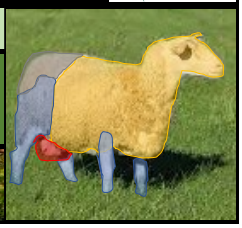
And what about the Dairy Sheep Industry… ?

- New conformation program developed by SEMRPQ for Dairy sheep breeders
- Emphasis on udder conformation on our classification program

PRESENTATION PLAN

- Scientific review : what have been done around the world
- The classification project in Quebec… for North America



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Scientific review
What have been done around the world

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Analysis of udder conformation

- Why improve conformation of the mammary gland ?
  - Improve « milkability»
    - A conformation that facilitates emptying of the udder when ewe are milked
    - Kinetics of milk emission : fast and a good flow
      - Without intervention or manipulation of the mammary gland
  - Improve work (milking is easier, faster and more efficient)
  - Improve total milk production
  - Improve milk quality (SCC) and health of the mammary gland

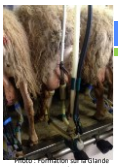

Photo : Formation sur la traite mammaire. MAPAQ/CEPOQ. 2020
Crédit : R. de Cremoux

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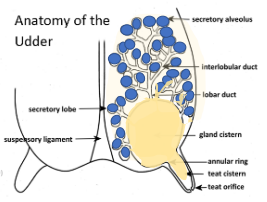
Mammary gland conformation

- Some interesting notions…
  - Dairy cattle
    - 70 % alveolus and 30 % cisternal part
  - In small ruminant
    - 30% alveolus and 70 % in cisternal part
    - Variations between species, breeds and lactation stage
    - Meat breeds : < 30% of milk from cistern (Caja et al., 1999)
    - Dairy breeds : in general > 50% of cisternal milk

(Caja et al., 2000; Nudda et al., 2000; McKusick et al., 2002)



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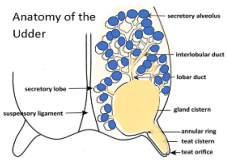
Sheep mammary gland

- Some notions…
  - Selection for better milk production in ewe
    - Increase of cisternal part
    - Better storage milking capacity between milkings (Novai et al., 2008)
    - An udder "adapted to milking", produces more milk from the cistern after the ejection reflex (Marnet and McKusick, 2001)
  - Caution, this selection affect « milkability »
    - Cisternal part more heavy, heavier and lower
    - Detachment of the mammary gland, teats poorly positioned



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The first external assessments of the mammary gland
« typology »

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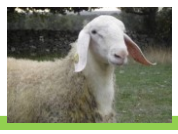
The first external assessments of the mammary gland

- 1974 - Sagi and Morag - Israël – Assaf
  - Relation between ease of milking and udder conformation
    - Monitoring a herd of 175 Assaf ewes (Awassi * EF)
    - Average production of 305 liters (without the period with the lambs – 1,7 lambs/ewe)
    - Effect of teat position and importance of separation of the 2 quarters (2 glands)



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The first external assessments of the mammary gland

- 4 types of mammary gland

Unclassified = 6 ewes

n = 36 ewes | n = 72 ewes | n = 56 ewes | n = 5 ewes

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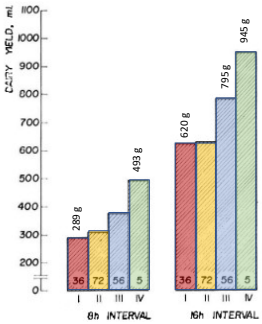
- Comparison with milk production
  - After an interval of 8 and 16 hours between milking
  - Average age and number of months in lactation similar between groups

Significative differences for 8h milking interval
TYPE 1 vs TYPE 4
289 g vs 493 g $p < 0,05$

Significative differences for 16h milking interval
TYPE 1 vs TYPE 4
620 g vs 945 g $p < 0,01$



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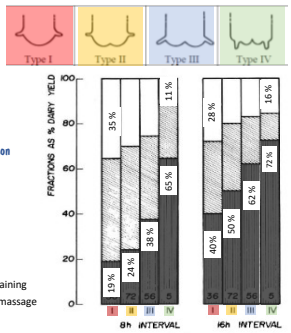
- Evaluation of « milkability »
  - Milk by machine :
    - Milk without any massage (no intervention)
  - Milk by machine/massage :
    - Milk obtain after a vigorous massage and pressure on the cisternal part
  - Manual milk draining :
    - Complete manual emptying, after removal of the milking liners

All differences were significatives



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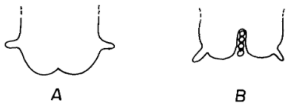
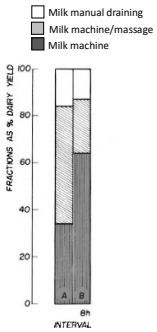
- A test carried ouf on animal from TYPE 2
  - 8 best ewes of the group
  - Hand placed at the level of the suspensory ligament
  - Same operator



Milk machine $p<0,001$
- ✓ Improvement of 34 % to 64 % after an interval of 8h
- ✓ Improvement of 50 % to 69 % after an interval of 16h
- ✓ No difference in manual emptying fraction



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Work continue on typology …

- 1979 - Jatsch et Sagi – Awassi and Assaf breeds

- ✓ Udder conformation change for some female during lactation
  - ✓ These deformations significantly affect milk production and adaptation to milking
- ✓ Udder consistency has little effect on milk production and milking ability
- ✓ Teat position, division of the mammary gland and malformations = negative effects
- ✓ Adaptation to milking decreases with age and with a more advanced stage of lactation

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Work continue on typology …

- 1980 – Gootwine and al. – Assaf breed
  - Evaluation of conformation, productivity and heritability
    - 544 ewes from 2 to 5 years (269 primiparous)
    - Classification carried out 20 to 60 days after lambing
    - Heritability calculated for 451 half-sisters (19 differents sires : group of 9 to 47 half sisters)

	GRADE			
Evaluated trait	I	II	III	IV
Udder shape	Close to the body	Medium	Loose	Other
Teat position	High	Low diagonal	Low	Other
Teat lenght	Short	Medium	Long	Other
Teat tickness	Thin	Medium	Thick	Other

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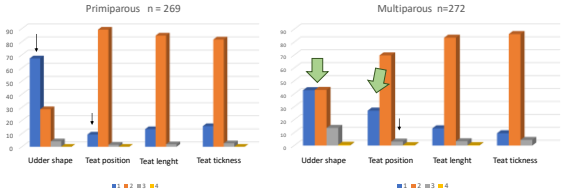
- Comparison of the udder of mature ewes vs primiparous
  - Biggest differences between multiparous and primiparous females
    - ✓ Udder shape (lower)
    - ✓ Teat position (higher)

27 % of the population : Udder conformation unsuitable for milking



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- Evaluation of genetic links between animals in the population
  - Genetic links for poor mammary gland conformation
    - 68 mother/daughter pairs in the group
    - Strong and significant link for teat positioning ($p<0,05$)
    - No significant link for other traits
  - Heritability of traits
    - Moderate : 0,23 - Teat thickness
    - Higher : 0,42 - Teat position
    - Strong genetic link : importance of a good selection
    - Essential to have a good evaluation methodology

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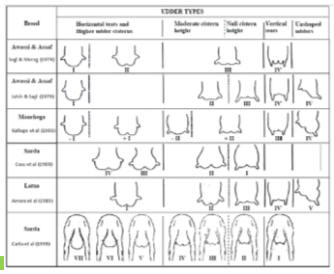
Adjustment of typology to several dairy breeds

- Classification of females in different types
- Types varied according to :
  - Teat position
  - Height of the cistern



Adapted from Rovai and al., 2004

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Development of a more descriptive and detailed method

- Labussière and al. 1981 – France – Lacaune breed
  - Analysis method with defined criteria and addition of objective measurements
  - Repetition of 3 series of measurements, by 2 operators
    - Goal : define a data collection methodology and a typology for the Lacaune breed (repeatability of measurements)
    - Evaluate the relationships between production and milk emission kinetics
  - Animals used and methodology
    - 22 Lacaune, 4 ewes in 1st lactation and 18 in 2nd lactation (Milked 2 X / day 7h30 and 16h30)
    - Evaluation of conformation in afternoon (14h to 16h) – Around 8h after morning milking
    - Test day record between 65° and 80° day of lactation
    - 3 series of measurements (3 days interval between measurements on the same animals)
    - No preparation of the udder before milking

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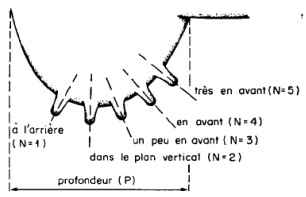
A more descriptive and better detailed method

- Teat position (N), udder depth (P)



Udder depht (P)

Measured with a caliper Between the rear of the udder and the front abdominal attachment point

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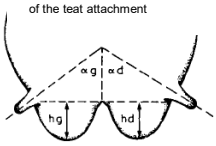
A more descriptive and better detailed method

- Teat angle (α) et cistern height (h)

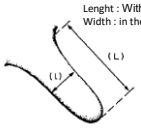
α = Measured with a swivel protractor
Angle with vertical

h = Between the lowest point and the level of the teat attachment



- Lenght (L) and width (l) of teats

Measured with a caliper
Lenght : Without stretching the teat
Width : in the middle part



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A more descriptive and better detailed method

- Rear surface of the udder (in cm ^{2})

Transparent board - Drawing

- Udder volume (ml)
  - Immersing udder in a large beaker of lukewarm water
  - Initial volume – remaining volume = Udder volume

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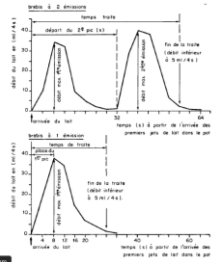
A more descriptive and better detailed method

- Comparison with different value during milking
  - Milk emission kinetics (1 or 2 milk release)
    - 11 females with 1 peak
    - 11 females with 2 peaks
  - Total milk production
    - Milk machine
    - Milk massage/machine (after manipulation)
    - Milk manual draining



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A more descriptive and better detailed method

- Some results …
  - Bigger udder = Greater milk production
  - The size of the udder is relatively small (1123 ml) compared to daily production (779 ml)
  - The volume and rear surface of the udder is greater in animals with 2 peaks (more milk)

	22 ewes	2 peaks	1 peak	Significative effects
Milk machine (ml)	**614,64**	751,14	**478,14**	P < 0,01
Milk massage/machine (ml)	116,02	117,50	114,55	NS
Milk manual draining (ml)	48,52	40,68	56,36	NS
TOTAL MILK (ml)	**779,18**	909,32	**649,05**	**P < 0,05**

More milk from cisternal part in females exhibiting 2 peaks

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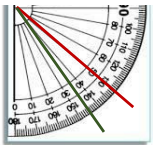
A more descriptive and better detailed method

- Some results …
  - Average teat size : 32,53 mm long and 15,29 mm wide, average teat angle of 41,8 °
  - Longer teats are also wider
  - Teats implanted in front of the udder are more horizontal = cistern is deeper
  - Teat angle is more acute in females with 2 peaks
    - Females with one peak = 48,0 °
    - Females with 2 peaks = 35,2 °



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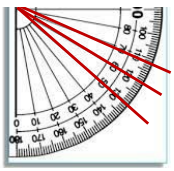
A more descriptive and better detailed method

- Some results…
  - Manual draining increases in females that have a deeper cistern (high, horizontal teats)
  - Ewes with one peak :
    - Produce less milk
    - Little milk ejection reflex
    - Higher proportion of poorly positioned teats > 45°
    - Deeper cistern, due to the positioning of the teats
    - Single-peaked females that had better maximum flow :
      - Less horizontal teats, shorter and smaller diameter teats



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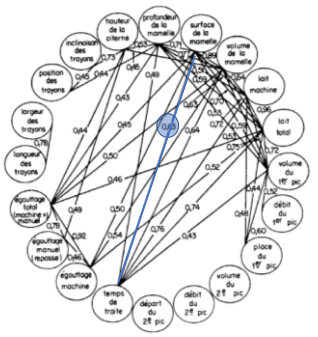
A more descriptive and better detailed method

- A ton of correlations !
- Labussière and al., 1988
  - Morphology description of several Mediterranean breeds
    - Sarde
    - Manchega
    - Tsigaya
    - Churra
    - Serra de Estalla
    - Karagouniko



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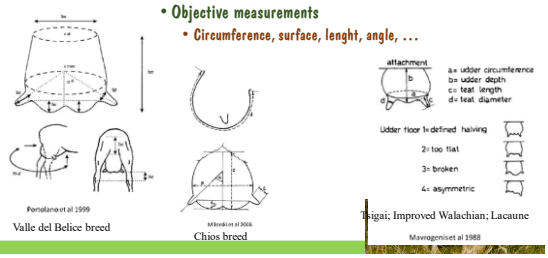
Other morphological evaluation studies were developed

- Objective measurements
  - Circumference, surface, lenght, angle, …



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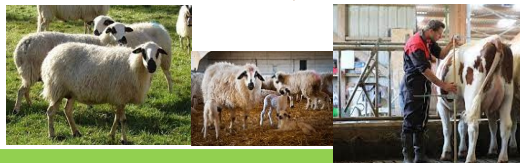
The beginning of linear classification… 1996

- More defined than types and different from very precise and complex measurements
  - Ranking on a 9 points grid
  - Evaluation on 4 criteria and on the general udder conformation
  - Authors: de la Fuente et al., 1996 (Race Churra – Spain)



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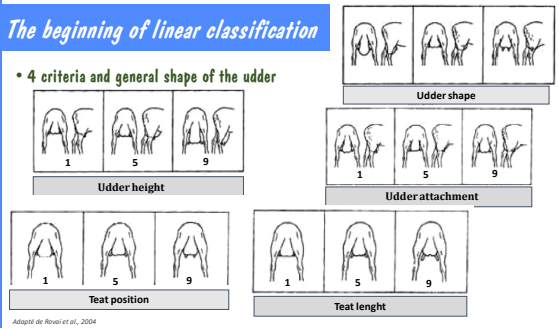
The beginning of linear classification

- 4 criteria and general shape of the udder



Adapté de Rovai et al., 2004

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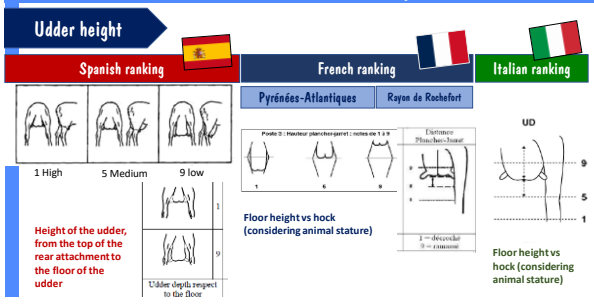
Different countries, different breeds, different scores…same goals

Udder height



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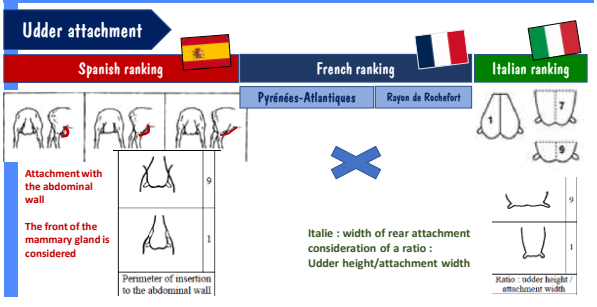
Different countries, different breeds, different scores…same goals

Udder attachment



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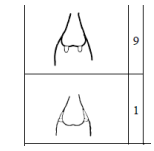
Different countries, different breeds, different scores…same goals

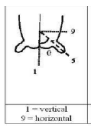
Angle des trayons — Effet sur la profondeur de la citerne

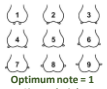
Spanish ranking	French ranking		Italian ranking
	Pyrénées-Atlantiques	Rayon de Rochefort	



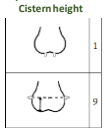
Optimum note = 9
9 = Teats pointing down
Minimum cistern height

Teats position
Good angle from vertical
Optimum note = 5





Optimum note = 1
Cistern height



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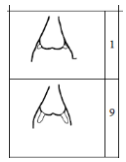
Different countries, different breeds, different scores…same goals

Teat size

Spanish ranking	French ranking		Italian ranking
	Pyrénées-Atlantiques	Rayon de Rochefort	



Teat size is determined by their length
Shorter teats are favored

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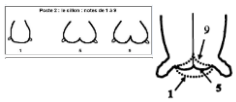
Different countries, different breeds, different scores…same goals

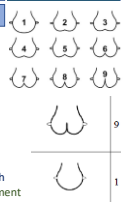
Furrow depth — Suspensory ligament

Spanish ranking	French ranking		Italian ranking
	Pyrénées-Atlantiques	Rayon de Rochefort	

The furrow is not evaluated
Can be estimated by combining
udder attachment and udder shape



Furrow depth (France and Italy)
Degree of separation of the 2 glands
Combination of furrow angle and furrow depth
Expresses the strength of the suspensory ligament



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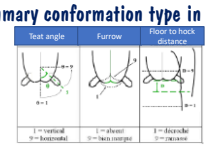
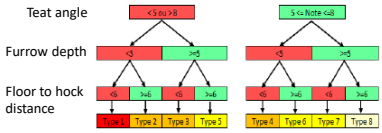
Classification on 3 main traits in France
Different mammary conformation type in France



Type 1 : Unwanted udder
Type 2 to 7 : Intermediate udder
Type 8 : Excellent udder



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A new program for the Dairy Sheep Industry

Société des éleveurs de moutons de race pure du Québec

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Classification for Dairy ewes in Quebec (Canada)

Société des éleveurs de moutons de race pure du Québec

- Projet subsidized by MAPAQ
- Request of Dairy Sheep breeders to our association - SEMRPQ
- Development of an electronic tool for data capture (Jacques Kirouac – Ewe Manage)
- Methodology
  - Scientific review about mammary gland assessment on Dairy Sheep
  - Preparation of drawings for "desired traits" assessments
  - Preparation of grids (1 to 9) and validations with breeders
  - Field test, lauch of the program and in the future, Conformation indexes

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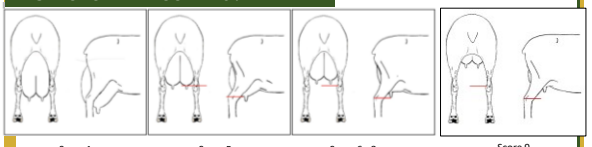
Traits evaluated in the Quebec classification program

Société des éleveurs de moutons de race pure du Québec

HEIGHT OF UDDER FLOOR = 20 %



Score 1 | Score 5 | Score 6 - 8 | Score 9 Attach to the body

Low under the hock 1 2 3 **4** **5** **6** 7 8 9 High

	1	2	3	4	5	6	7	8	9
Brebis laitières choix	0 %	10 %	40%	80%	100 %	80%	60%	40%	10%

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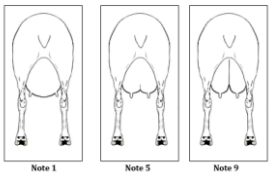
Traits evaluated in the Quebec classification program

Société des éleveurs de moutons de race pure du Québec

Furrow depth (suspensor) = 20 %



Note 1 | Note 5 | Note 9

Poor, absent 1 2 3 4 5 6 7 8 **9** High, strong and well defined

	1	2	3	4	5	6	7	8	9
Brebis laitières choix	0 %	10%	30%	45%	55%	65%	80%	90%	100%

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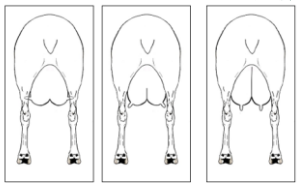
Traits evaluated in the Quebec classification program

Société des éleveurs de moutons de race pure du Québec

Teat position = 15 %



Note 1 | Note 5 | Note 9

Horizontal, pointing up and on the side 1 2 3 4 5 6 7 8 **9** Pointing down

	1	2	3	4	5	6	7	8	9
Brebis laitières choix	0%	10%	15%	45%	50%	65%	80%	90%	100%

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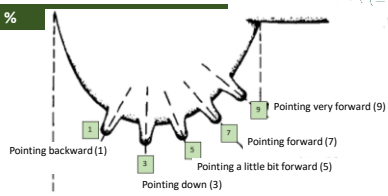
Traits evaluated in the Quebec classification program

Société des éleveurs de moutons de race pure du Québec

Teat angle = 5 %



Behind the udder 1 2 **3** **4** **5** 6 7 8 9 In front of the udder

	1	2	3	4	5	6	7	8	9
Brebis laitières choix	60%	90%	100%	90%	80%	50%	20%	10%	0%

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Traits evaluated in the Quebec classification program

Société des éleveurs de moutons de race pure du Québec

Strenght of front udder attachment = 10 %

Note 1. | Note 5. | Note 9.

Poor, week, narrow to the body 1 2 3 4 5 6 7 8 **9** Strong, wide and long attachment

	1	2	3	4	5	6	7	8	9
Brebis laitières choix	0%	10%	25%	45%	65%	70%	80%	90%	100%

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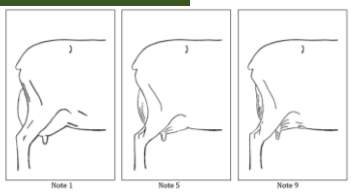
Traits evaluated in the Quebec classification program

Société des éleveurs de moutons de race pure du Québec

Texture = 5 %



Note 1 | Note 5 | Note 9

Fleshy, meaty 1 2 3 4 5 6 7 8 **9** Thin, supple

	1	2	3	4	5	6	7	8	9
Brebis laitières choix	0%	20%	30%	40%	55%	65%	80%	90%	100%

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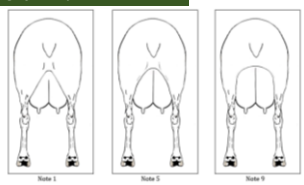
Traits evaluated in the Quebec classification program

Rear width attachment = 11 %



Narrow 1 2 3 4 5 6 7 8 9 Wide

	1	2	3	4	5	6	7	8	9
Brebis laitières choix	0%	20%	35%	45%	60%	70%	80%	90%	100%

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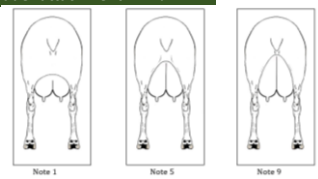
Traits evaluated in the Quebec classification program

Height of rear udder attachment = 12 %



Low 1 2 3 4 5 6 7 8 9 High

	1	2	3	4	5	6	7	8	9
Brebis laitières choix	0%	10%	20%	40%	65%	70%	80%	90%	100%

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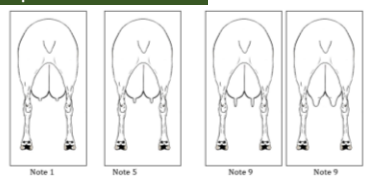
Traits evaluated in the Quebec classification program

Teat lenght and shape = 2 %



Too short 1 2 3 4 5 6 7 8 9 Too long, too big

	1	2	3	4	5	6	7	8	9
Brebis laitières choix	0%	20%	70%	90%	100%	90%	70%	20%	0%

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Traits evaluated in the Quebec classification program

The complete body can also be classified

Point	TRAITS	
40 %	Mammary gland	(9 traits)
30 %	Dairy capacity	(7 traits)
12 %	Feet and legs	(8 traits)
10 %	Bone structure	(4 traits)
6 %	Quality and position of teeth	
2 %	Breed character (head and breed type)	
100 %	TOTAL	

Shoulder, scapula, neck
Back strenght
Rump (width, length)
Rump (angle)

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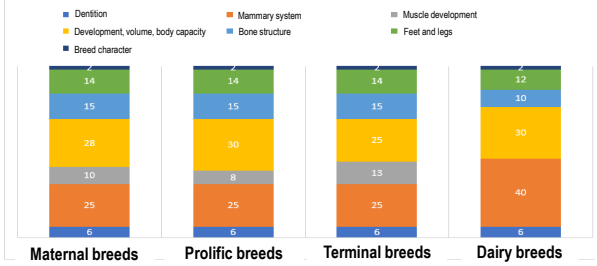
Proportion of point according to female breed type



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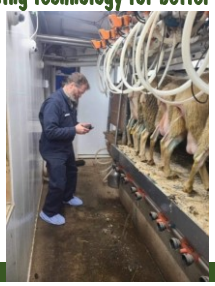
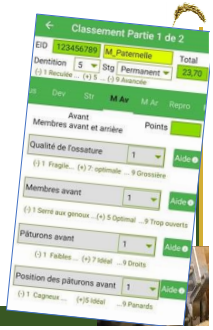
Traits evaluated in the Quebec classification program

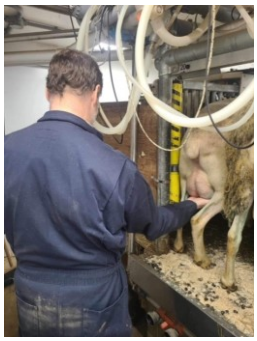
Using technology for better data capture



By Ewe Manage



54



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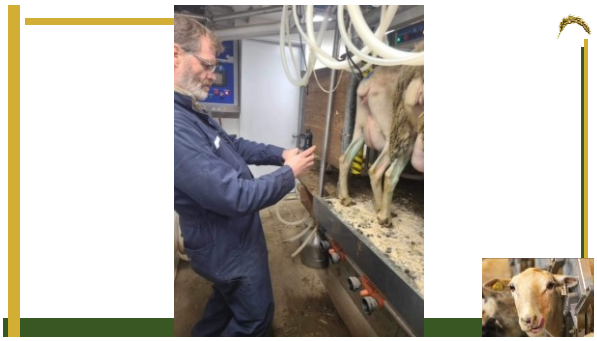

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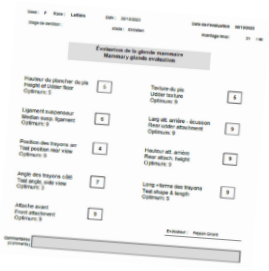

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Conformation and productivity

- Important link between milk production and milkability
- Conformation traits : moderate to high heritability (0,20 à 0,55)
  - Classification of a large number of daughers/sisters/mothers : increase the potential of improvement!
- Few studies, relation between milk quality vs udder conformation, but significative effects
- Genomic is coming ...
  - Many QTL identified in the different dairy sheep populations in Europe (udder conformation, teat position, milk release kinetics, udder depth, etc.)
  - A project on genomic is starting in Quebec
- Essential to classify animals with defined traits

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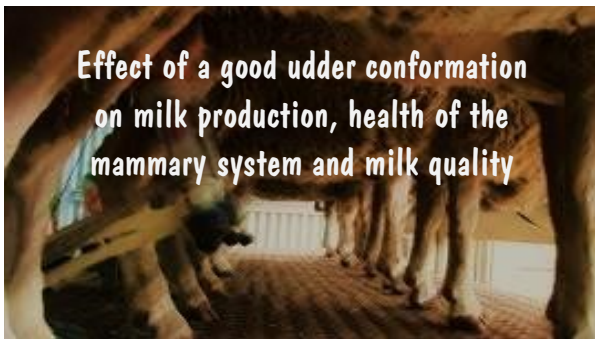

65

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Effects on milk production

- The best females have :
  - Bigger udder with bigger cistern
  - Adequate floor udder depth and adequate teat placement
  - Bigger udder circonference (abdominal attachment)
  - Deeper udder, better front udder attachment

Dzidic et al 2004 ; Seker et al., 2004 ; Salarie et al., 2007 ; Casu et al 2008 ; Onal et al., 2008; Inequez et al., 2009 ; Ayadi et al., 2011

Seker et al., 2004 ; Ayadi et al., 2011 ; Onal et al., 2008; Inequez et al 2009

McKusick et alk 99 ; Inequez et al., 2009 ; Ayadi et al., 2011

Seker et al., 2004 ; Inequez et al., 2009 ; Ayadi et al., 2011)

All traits that makes mammary gland better suited to mechanical milking
Less air entry, less friction, less compression

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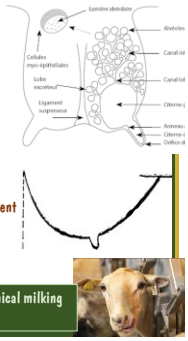
Effects on milkability

- Ewes that show better milkability have
  - Appropriate teat angle (pointing downward)

Sagi et Morag, 1974 ; Labussière 1988 ; Bruckmaier et al., 1997

  - Adequate cistern depht according to teat position and ligament
  - Better division of the mammary gland – strong suspensor

All traits that makes mammary gland better suited to mechanical milking
Less air entry, less friction, less compression



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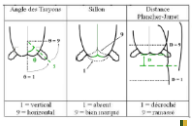
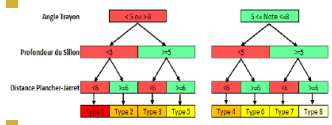
Effects on milk quality

- Project CASDAR MAMOVICAP (Institut de l'élevage - France)
  - Monitoring 15 farms in France (Roquefort area and Pyrénées Atlantiques)
  - Analysis of udder conformation and SCC





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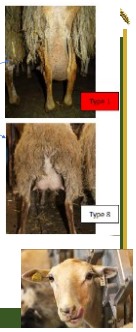
Effects on udder health and milk quality

Difference of 0,61 to 0,65 point of somatic cell score (depending of the area)
1 point of somatic cell score = doubling of the number of cells.

- Better udder conformation :
  - Better milking ability
  - Trend towards a better udder health

Detached udders or teats oriented too horizontally are associated with significantly higher cell scores.

These observations are similar to those made on divergent lineages.



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Effect on milk quality

- Allain and al., 2010
  - Study on 2 divergent dairy sheep lineage
    - HIGH SCC
    - LOW SCC
  - HIGH SCC ewes show a tendendy :
    - More detached udder
    - Longer teats
    - Teats more curved
    - Longer latency time during milk ejection

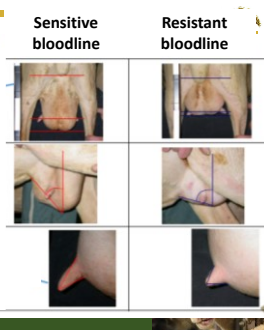

Photo : Formation Glande mammaire 2020. MAPAQ/CEPOQ. Crédit : de Cremoux

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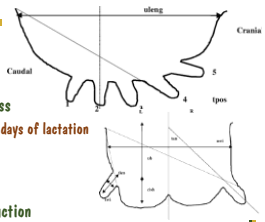
Effect on milk production/quality

- 1999 – McKusick and al. – East-Friesian cross
  - Series of objective measurements on 131 EF at 71 days of lactation
  - Compare to other breeds (scientific literature) *
  - Compare measurements to milk performances
- Results between conformation and milk production
  - Bigger udder circumference and bigger height = bigger milk production
  - Longer and deeper udder with deeper cistern = longer milking time
  - Cistern height positively correlated with fat percentage



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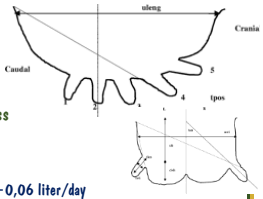
Effect on milk production / quality



- 1999 – McKusick and al. – East-Friesian cross
- Authors considered that :
  - For each increase of 1 cm of circumference = +0,06 liter/day
  - For each increase of 1 cm of udder height = + 0,11 liter/day
  - For each increase of 1 cm of cistern depth = + 0,12 % of fat

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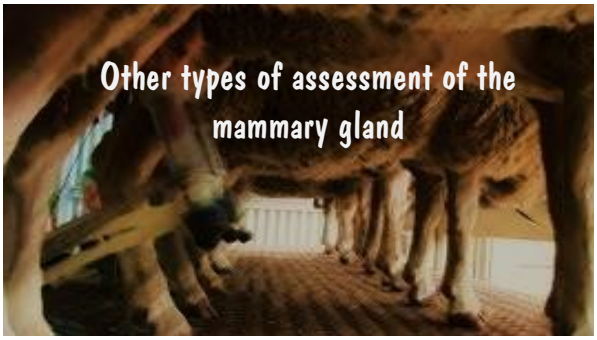

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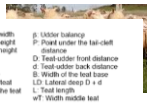
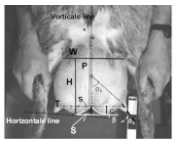
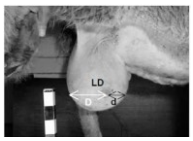
Imaging assessment



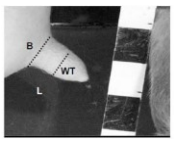
- 2003 – Marie-Etancelin. France – Lacaune
  - Comparison of French and Italian classification chart
  - Picture of the mammary gland, effect on milk production, milkability and conformation



Rear picture of the udder



Side view of the udder



Picture of the right teat

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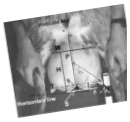
Imaging assessment

- Animals studied
  - 2 flock of Black-cross Lacaune*Sarde (BC) Sardaigne = 900 ewes
  - 2 bloodlines of Lacaune in France (n=550) – High and low milk production lineage
- Methodology
  - Classifiers from France → Italy and classifier from Italy → France
  - Using the classification grid of the country were they are evaluating
  - They classified the same females, 3 times, in afternoon before milking (2nd lactation)
  - Comparison to cumulative classification data from previous years
    - BC classified each month during their 1st lactation (16 237 data from 898 ewes)
    - Lacaune classified twice/year at their 1st lactation (1605 data from 655 females)



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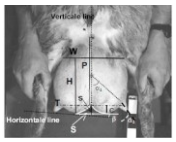
Imaging assessment



- Image analysis compare to classifiers
  - Macro developed by INRA
  - Allows extraction and calculation from image measurements
  - The goal was to analyze the feasibility and relevance of the technique
    - 28 ewes udder pictured + Objective measurements (angle protractor, caliper)
    - All females also pictured in both breeds LA et BC = 3 persons (light, ruler, black panel)
      - 874 primiparous BC at 3 months of lactation and 162 primiparous LA at 2 months of lactation
      - Pictures analysed by 2 operators of the system and correlations calculated

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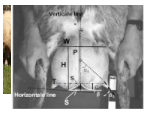
Imaging assessment



- Results
  - High correlations between classifiers using the same tables (0.73 to 0.89)
  - Except for Lacaune for udder attachment (not in the French grid – Less experience)
  - Analysis of the pictures allowed the extraction of original and reliable measurements

Comparison of objective measurements and pictures	Comparison pictures vs classifiers

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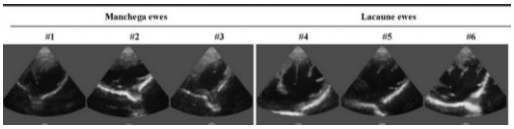
Intramammary assessment

- Ultrasound evaluation
- Allows the internal structures of the udder to be studied (Bruckmaier and Blum, 1992)
- Allow to evaluate the capacity of the mammary cistern (over different milking intervals)
- Analyze the distribution of alveolar milk and citernal milk



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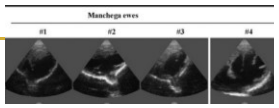
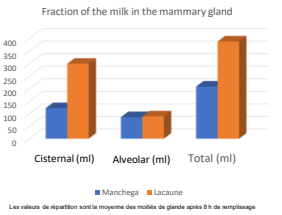
Intramammary assessment

- Rovai et al., 2008 (Lacaune/Manchega)



	Manchega	Lacaune	P
Daily milk production	0,94 l/j	2,07 l/j	0,001
Cisternal surface	12,4 cm²	24 cm²	0,001



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Effect on meat productivity

- Chez les brebis allaitantes … (Huntley et al., 2012)
  - Suivi de 67 agneaux dans un troupeaux commercial
  - Comparaison santé du pis, conformation et performances
  - Brebis avec un haut comptage de cellules
    - Glande mammaire pendante = Hausse de 9,6 % du SCC / cm de descente
    - Plus de blessures aux trayons = Hausse de 7,2 % du SCC/cm²
  - Agneaux plus légers =
    - Issus de brebis avec une position suboptimale des trayons et glande pendante (−1,38 kg)
    - Issus de brebis ayant > 400,000 cells/mL (−0,73 kg)

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La génomique au service du secteur ovin…

- Genome scanning for detection of quantitative trait loci (QTL)
- Several QTL affecting udder morphology traits were detected for the first time through
- methods consisting of extracting objective measurements from digital pictures
- and repeated udder scoring.
- QTL for udder traits have been reported
- in the Sarda×Lacaune population, the Lacaune - Manech families (Barillet
- et al., 2006) and in Churra ewes (Gutierrez-Gil et al., 2008).
- In the
- Lacaune-Manech population, genome-wise suggestive QTL were identified
- in OAR6 and OAR17 chromosomes for udder cleft (Barillet et al.,
- 2006).
- In the same population, QTL were also detected for traits related
- to the kinetics of milk emission, which are directly related to the machine-
- milking ability of the ewes. Avancée car difficile évaluer dans population commercia

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La génomique au service du secteur ovin…

- Spanish Churra sheep, most significant of these QTL was that identified in the
- proximal end of OAR7 for teat placement (Gutierrez-Gil et al., 2008). Avec comparaison avec grille de la Fuente 96

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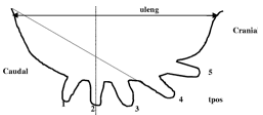
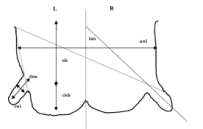
Effets sur la qualité du lait



- McKusick et al., 2001
  - East-Frisiean
  - verage daily milk production, milking time, percentage of milk fat, percentage or milk protein, and somatic cell count were 2 L/ewe/day, 174 sec, 5.07%, 4.77%, and 56,250, respectively. When compared to reports in the literature on other dairy breeds of sheep, our EF crossbred ewes had larger udder width (14.6 cm), cistern height (2.97 cm), and teat angle (58.3°); similar udder circumference (45.2 cm) and teat width (1.64 cm); and smaller udder height (14.6 cm) and teat length (2.6 cm).
    greater udder circumference and udder height had greater commercial milk yield
  - Greater udder length, udder height, and cistern height were associated with increased milking time
  - Cistern height was positively associated with percentage of milk fat
- It was estimated
- that for each cm increase in udder circumference and udder height,
- there was a relative increase of 0.06 and 0.11 litres respectively of daily
- commercial milk yield.
- In the same experiment, for each cm increase in
- cistern height there was a relative increase of 0.12% units of milk fat.



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Conclusion

heritabilities of some morphological udder and teat traits. When these traits are related to milk yield the greatest effects are observed for the udder width and height (also called depth). Main effects of teat traits are related to milk emission during milking.

Typology is recommended as a useful tool for the screening of animals, for example, in order to standardize groups for machine milking.

The linear scoring has been used widely in large scale researches. The values of linear scores were sufficiently repeatable and showed intermediate Heritability
udder shape showed high and positive
genetic correlation with udder attachment and teat placement, as a result of the main role of these traits in the definition of udder shape

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Utilisation dans les programmes génétiques

- Avant tout… il faut évaluer avec un système clair et défini !
- L'héritabilité et la répétabilité des caractéristiques morphologiques et leur relation avec la production Laitière et le temps de traite ont une influence si on souhaite améliorer la conformation du pis

Table 2: repeatabilities of udder traits within lactation

	Fernandez et al., 1997	Marie et al., 1999a	Casu et al., 2000	Ugarte et al., 2001
N	2 015	497	1 005	7 415
	Churra	Lacaune	Sarda	Latxa
Teat position	0.64	0.66	0.84	0.70
Udder depth	0.51	0.59	0.75	0.64
Udder attachment	0.48	-	-	0.57
Udder cleft	-	0.61	0.80	-
Teat size	0.54	-	-	0.91

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Utilisation dans les programmes génétiques

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Table 3: heritabilities of udder traits

	Fernandez et al., 1997	Marie et al. unpublished data	Carta et al., 2001	Ugarte et al., 2001
N	2 015	260	16 297[a]-8110[b]	7 415
	Churra	Lacaune	Sarda	Latxa
Teat position	0.24	0.49	0.39[a]	0.37
Udder depth	0.16	0.32	0.26[a]	0.23
Udder attachment	0.17	-	0.27[b]	0.23
Udder cleft	-	0.55	0.20[b]	-
Teat size	0.18	-	-	0.35

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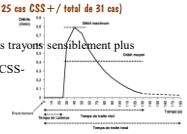
Effets sur la santé et la qualité du lait

Allain et al. (2010) :

- 2 groupes de brebis divergentes CCS + et CSS –
- unité expérimentale INRA de La Fage
- Écart entre les 2 lignées : 3 écart-types génétiques du score de cellules somatiques
- évalué la résistance aux infections intra mammaires naturelles de ces brebis à l'aide de mesures régulières de CCS, d'examens cliniques des mamelles et de bactériologies du lait
- a réponse corrélée de la sélection sur la cinétique d'émission du lait et l'anatomie de la mamelle et des trayons a été évaluée, respectivement, grâce à un automate de contrôle laitier développé par l'INRA et à l'analyse de photographies numériques
- Significativement plus de lait infectés dans lignées CSS+ et plus de mammite (25 cas CSS+/ total de 31 cas)
- Infection persistante = chez les CSS- (24/30)
- les mamelles des brebis de la lignée haute en cellules (CCS+) ont tendance à avoir des mamelles plus décrochées, des trayons sensiblement plus longs et plus courbés.
- Temps de latence lors éjection cinétique du lait plus long chez CSS-



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Effets sur la santé et la longévité

- Selon Allain et al. (2010), les mamelles des brebis de la lignée haute en cellules (CCS+) ont tendance à avoir des mamelles plus décrochées, des trayons sensiblement plus longs et plus courbés.

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- According to Legara and Ugarte (2005) the udders must have good attachment in order to produce enough milk without functional problems
- Teat position is important for the application of milking cups because the horizontal teats are bending due to the weight of the cups and their fall.
- In the majority of
- the studies, the teat placement was the trait with the largest genetic
- variability, which could be useful in breeding programmes in order to
- improve udder suitability to machine -milking (

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Effet de la conformation sur la productivité

Production laitière Awassi, EF, Bafra,Istrian, Manchega, Lacaune	
Augmentée	Réduite
Volume citernal plus grand (Salarie et al., 2007 ; Casu et al 2008)	Hauteur de la citerne (plancher bas et décrochement) Seker et al., 2004 ; Inequez et al 2009
Volume du pis total Seker et al., 2004 ; Iniquez et al., 2009 ; Onal et al., 2008 ; Dzidic et al 2004 ; Ayadi et al., 2011	Angle des trayons : Trayons haut et horizontaux (Serez et al., 2004 ; Onal et al., 2008 ; Inequez et al 2009 ; Dzidic et al, 2004)
Circonférence du pis (inequez et al., 2009 ; McKusick et alk 99 ; Ayadi et al., 2011)	
Distance plancher du pis et placement des trayons adéquats (Seker et al., 2004 ; Ayadi et al., 2011)	
Profondeur (largeur, et attache vers l'avant) Seker et al., 2004 ; Inequez et al,, 2009 ; Ayadi et al., 2011)	

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Effet de la conformation sur la productivité

Effet sur la trayabilité	
Avantage	Désavantage
Bon angle de trayons (Labussière 1988 ; Bruckmaier et al., 97)	Trayons trop horizontaux – influence le temps de traite
Citerne moins profonde vs trayons	Citerne trop basse (Onal et al., 2008)
Sillon plus définis et souvenu	

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