Effects of management practices and nutrition on the welfare and productivity of dairy sheep

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Stress has a biological cost for the animals

Stressors events can cause

- ❑ **reduction of normal biological functions** (e.g. loss of milk)

- ❑ **development of diseases** (mastitis, lameness, etc)
- ❑ **decrease in reproductive performance**

- ❑ **alteration of milk composition** (e.g. SCC)

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Stress has a biological cost for the animals

The stressors considered in this presentation are associated to:

1. **Animal temperament**
2. **Heat and cold stress**
3. **Nutritional unbalances**
    - **Energy balance and body reserves**
    - **Protein excess**
    - **Micronutrient deficits**

Animal temperament

The impact of ewes temperament on milk yield is great during the whole lactation

Variable	Calm		Nervous
Fertility at 3 yrs	1.524 *		1.321
Milk yield x lactation at 2.5 yrs (kg)	188.9 **		144.8
Milk yield x lactation at 3,5 yrs (kg)	190.7 **		135.8
Milk yield x lactation at 4,5 yrs (kg)	173.7 **		111.1

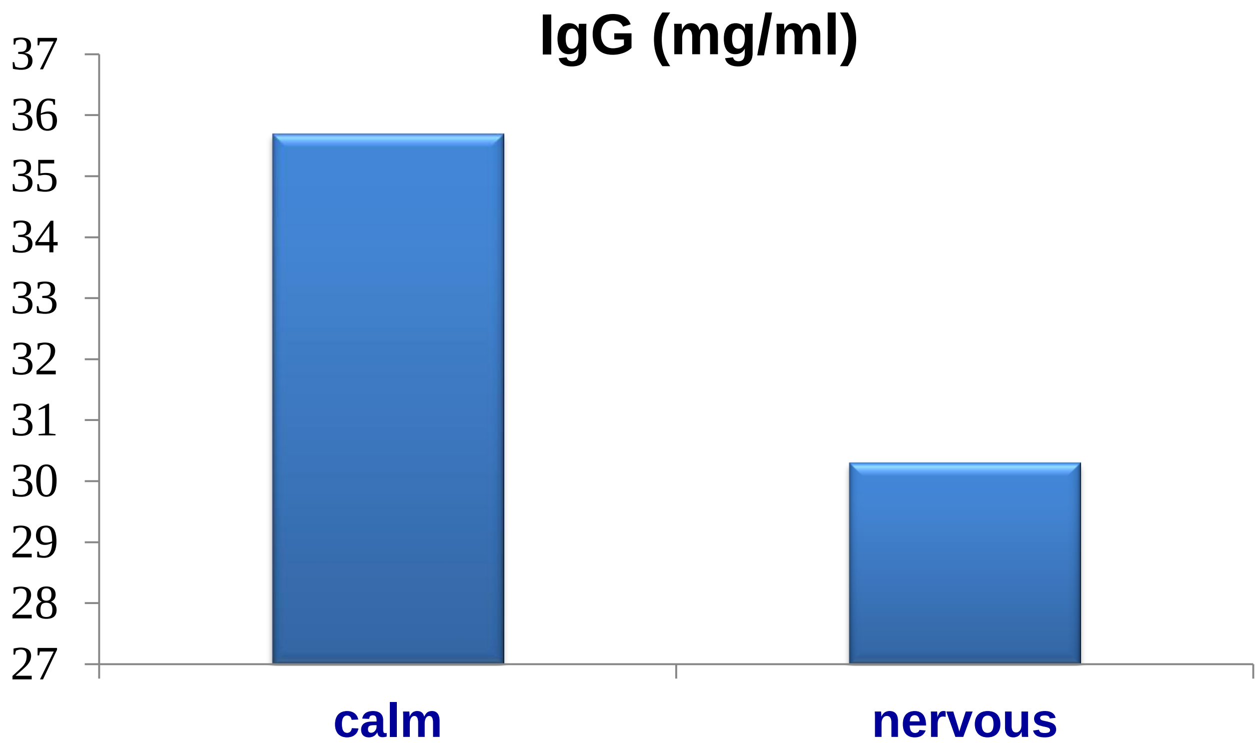
*** P < 0.05 ** P < 0.001**

Similar results in other sheep breeds (Murray et al., 2009; Paior et al, 2010)

(Dimitrov-Ivanov and Djorbineva, 2003)

Animal temperament

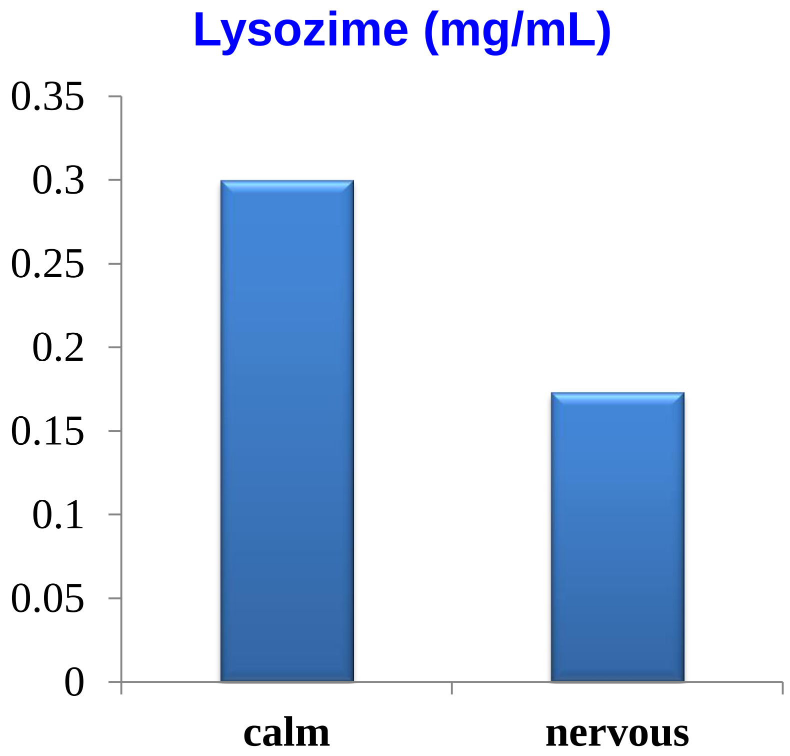
Ewes selected for calm temperament have a greater concentration of immunoglobulin G in their colostrum than nervous ewes

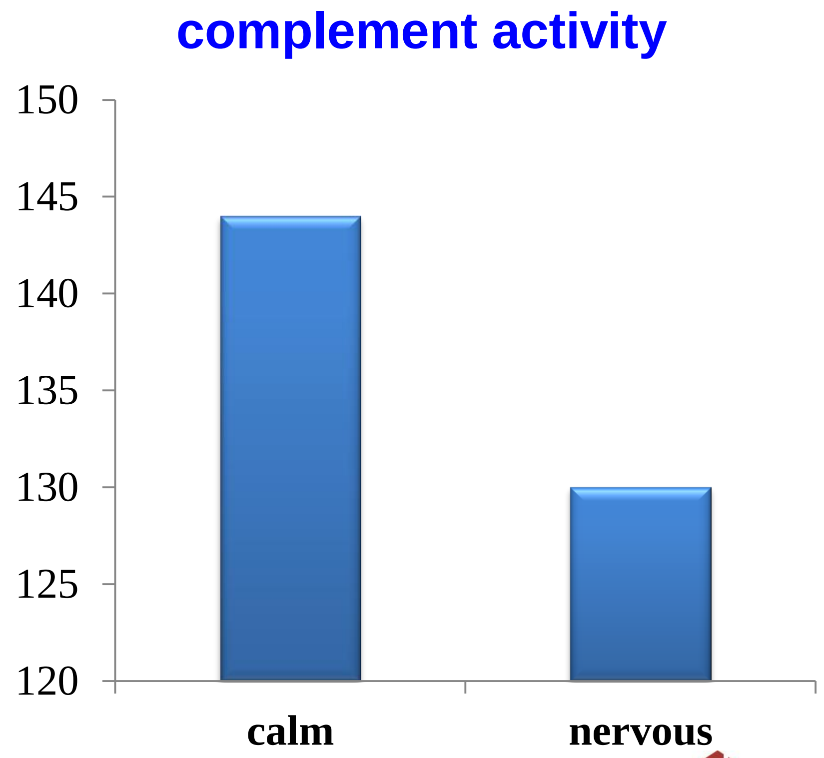


Hart et al. 2009 – Proc. Association for Advancement of Animal Breed. and Genetics: 576-579

Animal temperament

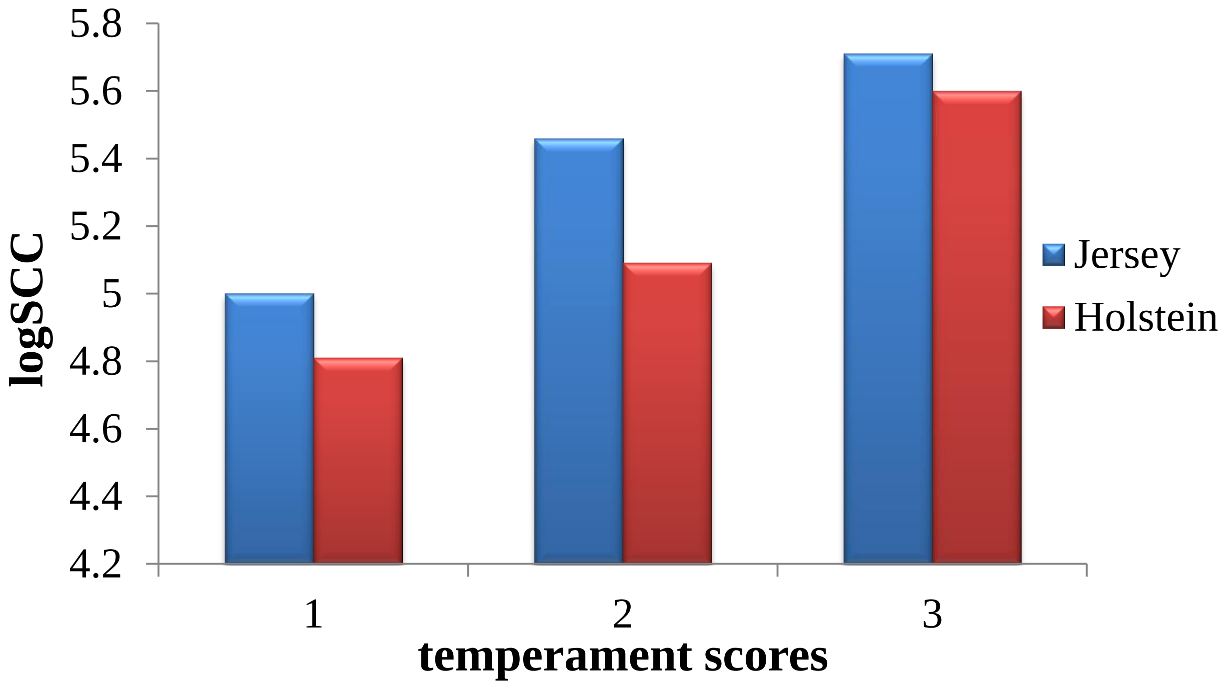
Blood lysozyme concentration and alternative pathway of complement activity (APCA) values in calm and nervous dairy ewes





Animal temperament

In dairy cows the SCC in milk increase from calm to less calm animals



What about sheep?

Animal temperament

As a conclusion, temperament plays a major role on the effects of stressors on dairy sheep

What to do?

- dairy sheep **management** should consider their temperament

- we should **select against nervous animals**

Heat and cold stress

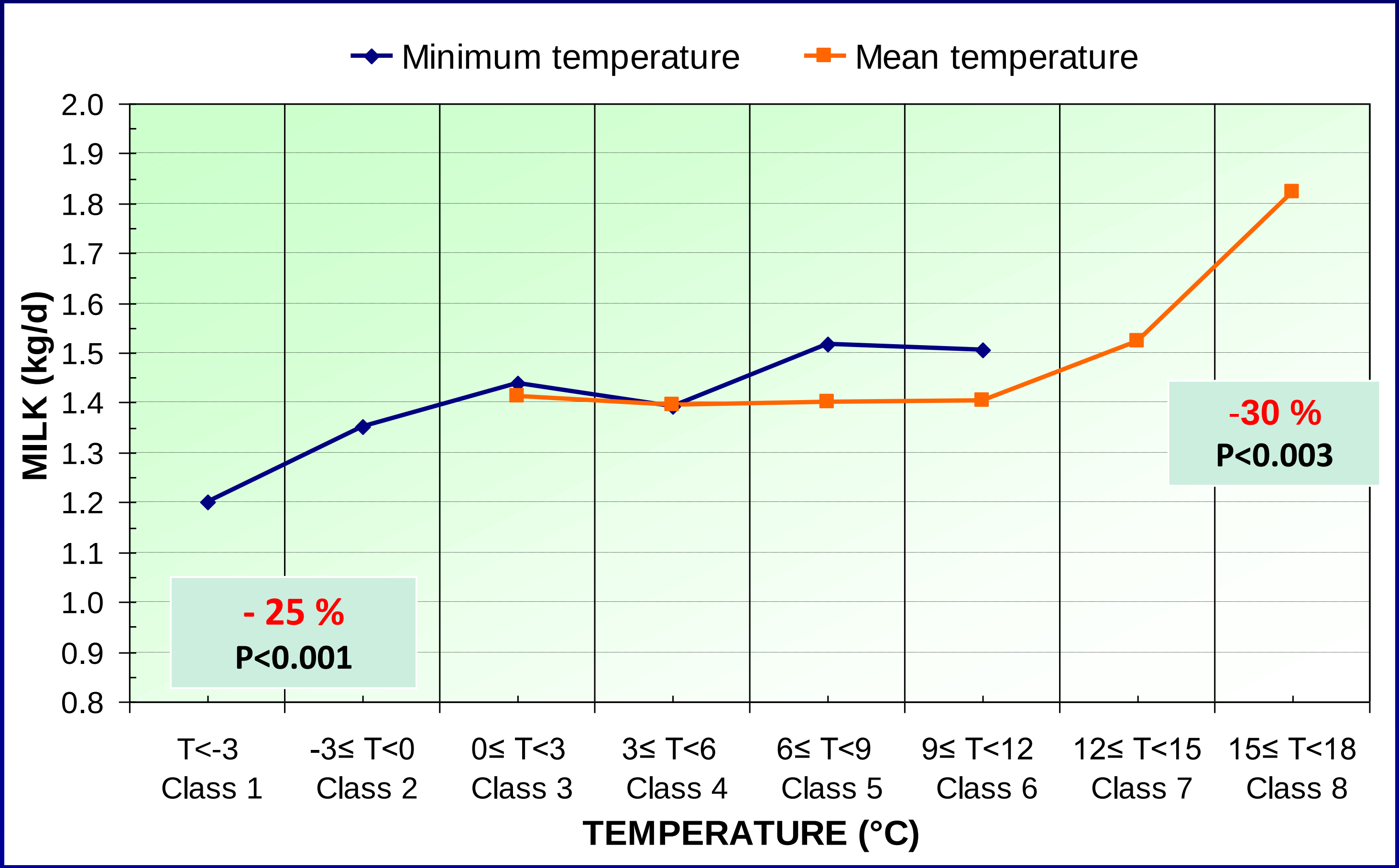
- **Sheep** are considered **resistant to extreme weather conditions**, for their wool (cold stess protection) and small size (low sensitivity to heat stress)

- But welfare is reduced when temperatures are outside their optimal range

- Sheep exposed to non-optimal temperatures have a series of **adaptive physiological responses, which can influence negatively milk yield and quality, reproductive performance and immune system** (Sevi et al., 2001; Sevi et al., 2002; Peana, 2005).

Cold stress in dairy ewes on pasture

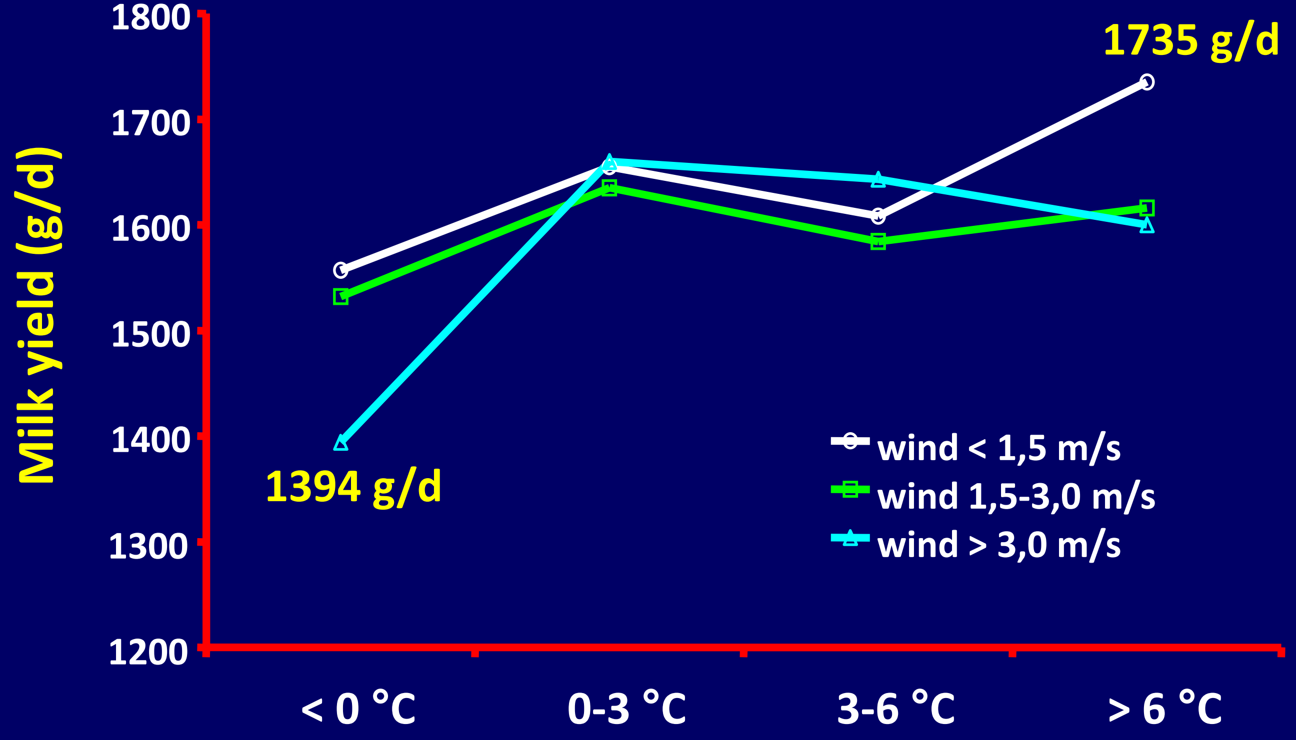
Measurements (between 15 of January and end of April for 2 years) in 5 dairy sheep farms of Sardinia (60-463 m a.s.l.). Data covariated for time (days in milk)



Cold stress can markedly decrease milk yield even in Mediterranean climatic conditions

Peana et al. 2007 - Ital.J.Anim.Sci. Vol. 6 (suppl. 1), 577-579

Cold stress in dairy ewes



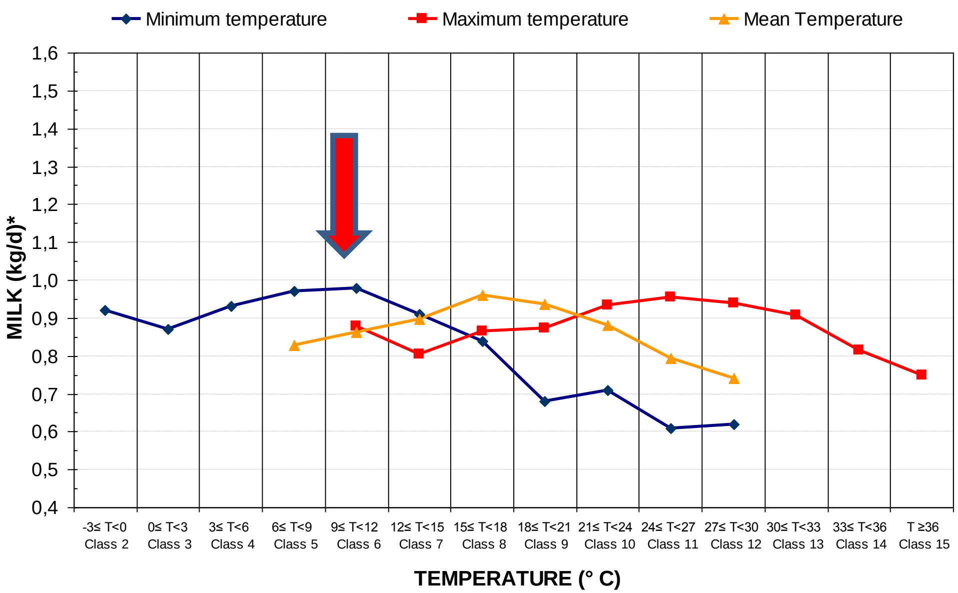
Interaction between <u>wind speed</u> and <u>minimum temperature</u> (P<0.01)

No effect of Tmax, rainfall, relative humidity: limitations in the structure of the data and effects of night shelters

Peana et al. 2007 - Ital.J.Anim.Sci. Vol. 6 (suppl. 1), 577-579

Heat Stress in Sarda dairy ewes on pasture

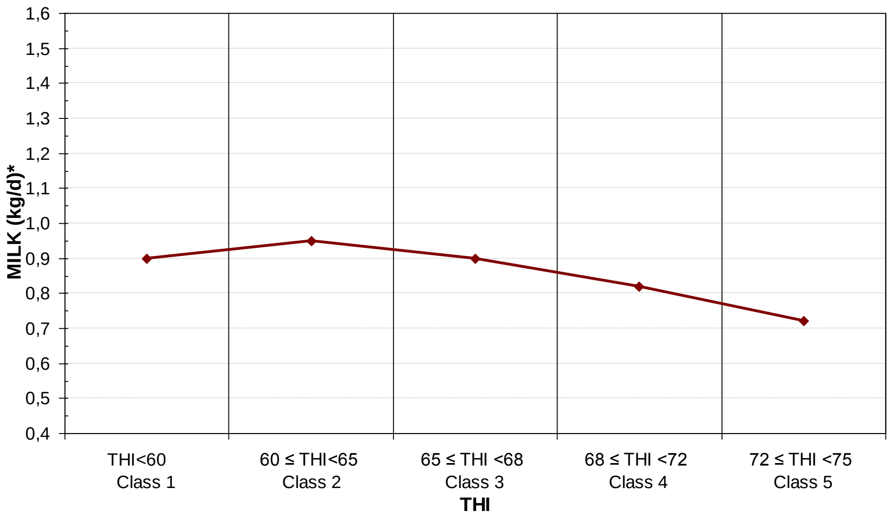
(data of 10 dairy farms, 2 years from April to July)



Tmin: **- 36 % milk production**
optimal: 9-12 °C

Tmax: **- 21 %** milk production;
optimal: 24-30 °C

Tmean: **- 23 %** milk production;
optimal: 15-21 °C



THI: **- 25 %** milk production;
optimal: 60-65 °F

WIND: Alleviated heat stress when > 1.5 m/s to 2.4 m/s

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Peana et al. 2007 - Ital.J.Anim.Sci. Vol. 6 (suppl. 1), 577-579

Heat stress in CONFINED dairy ewes

Re-elaboration of data from a nutritional experiment

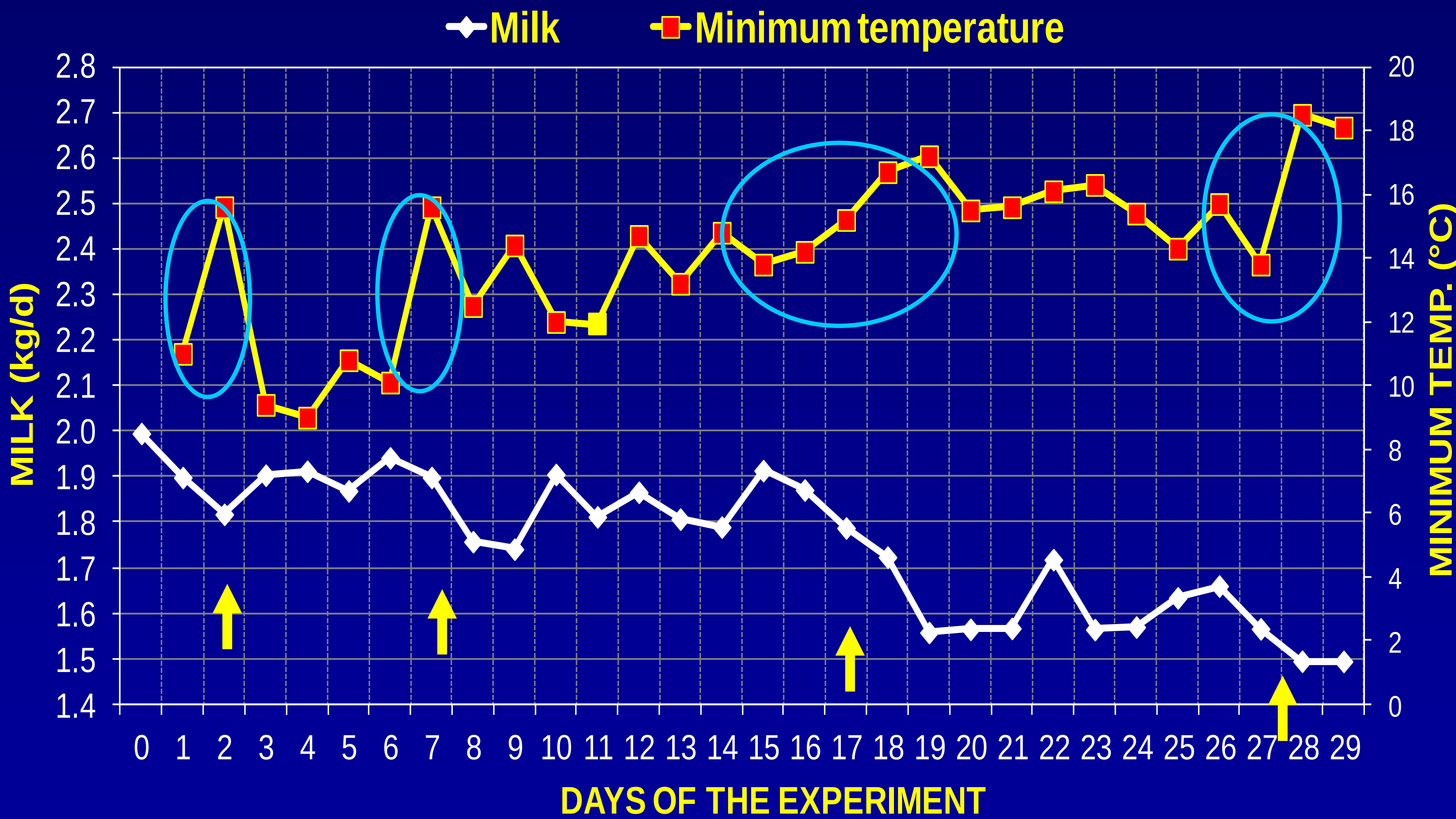
Ten Sarda dairy ewes (5th-6th month of lactation) were kept into metabolic cages and fed *ad libitum*

High temperature → (May 20th - June 18th 2003)

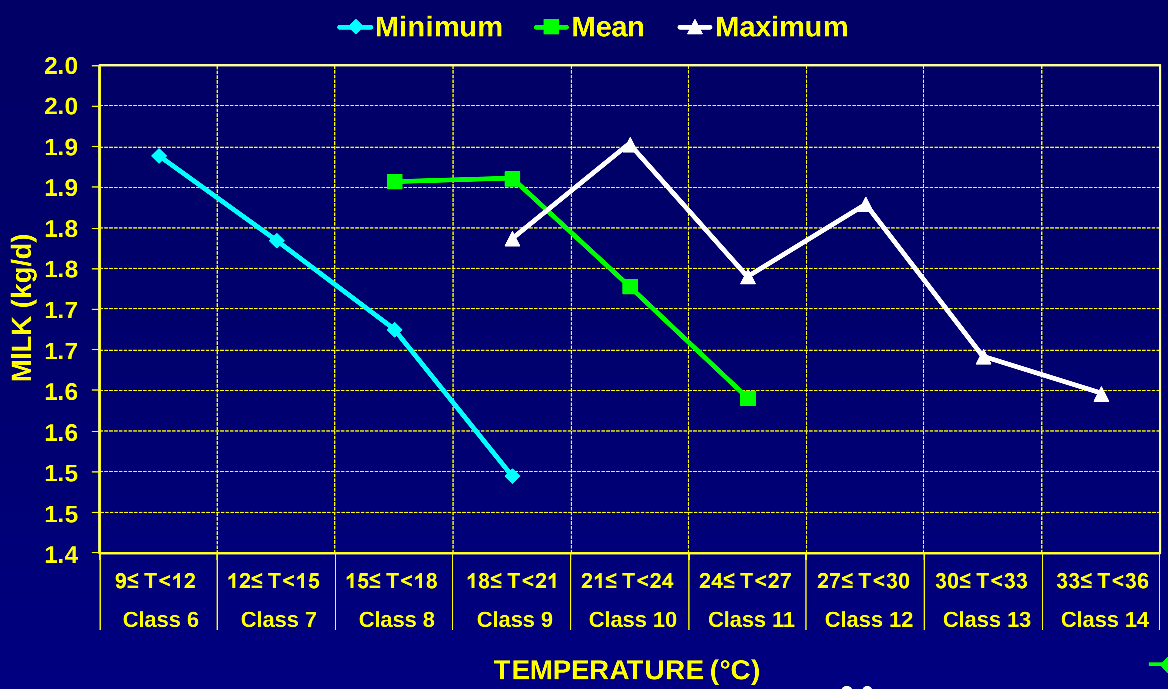
Peana et al. 2007 - Ital.J.Anim.Sci. Vol. 6 (suppl. 1), 577-579

Heat stress in CONFINED dairy ewes: milk yield

Milk yield inversely associated with min and mean T, THI, THI_hours



Peana et al. 2007 - Ital.J.Anim.Sci. Vol. 6 (suppl. 1), 577-579

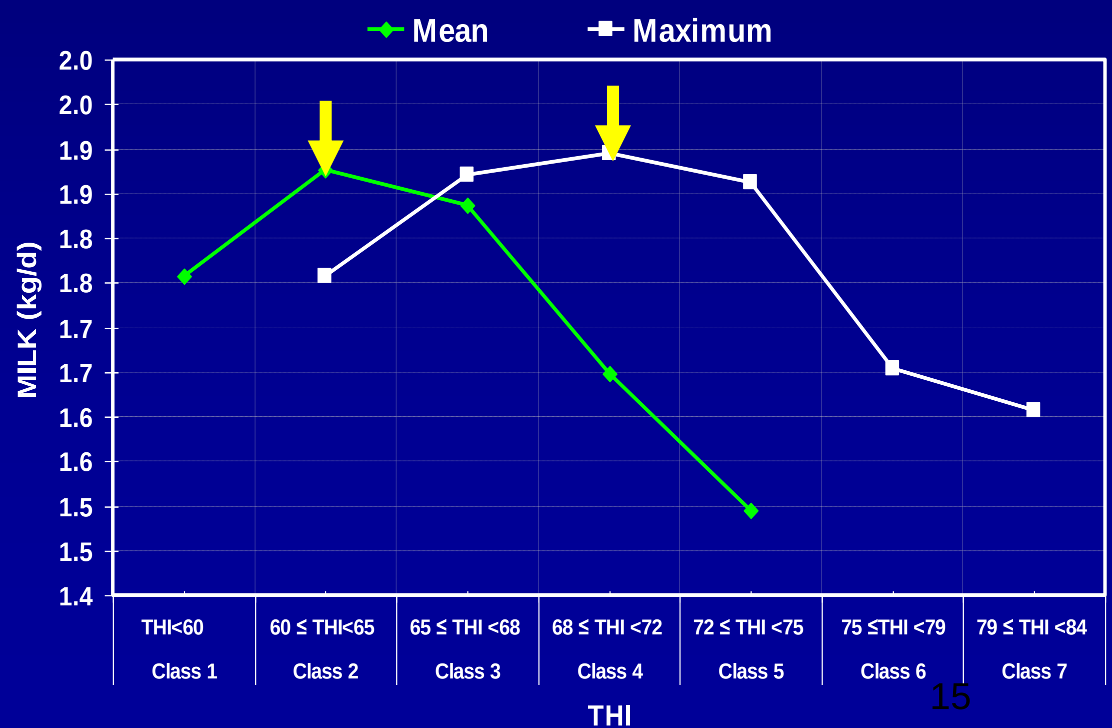


Tmin, Tmax, Tmean

Maximum negative effects on MY (-20%) associated to increase of Minimum Temperature

THI

-20 %



Peana et al. 2007 - Ital.J.Anim.Sci. Vol. 6 (suppl. 1), 577-579

Heat stress in CONFINED dairy ewes: milk composition

Effects on milk composition

Composition	Heat effect
Fat (%)	no
Protein (%)	low decrement
Lactose (%)	low increase
Urea (mg/l)	no
SCC (cells/ml)	high increase

Heat stress increased SCC by 60%

T Max	SSC/ml, x 1000	THI	SSC/ml, x 1000
21-24 °C	236	60-65 °F	246
27-30 °C	267	65-68 °F	301
30-33 °C	350	68-72 °F	355
33-36 °C	375		
	$P<0.002$		$P<0.005$

Peana , 2007

HEAT STRESS: Valle del Belice dairy sheep in Sicily

(83,000 test day records from about 6000 ewes)

Heat stress starting at 74 of THI based on max temp

This corresponds to the THI of 60-65 °F based on mean temp found by Peana et al. (2007)

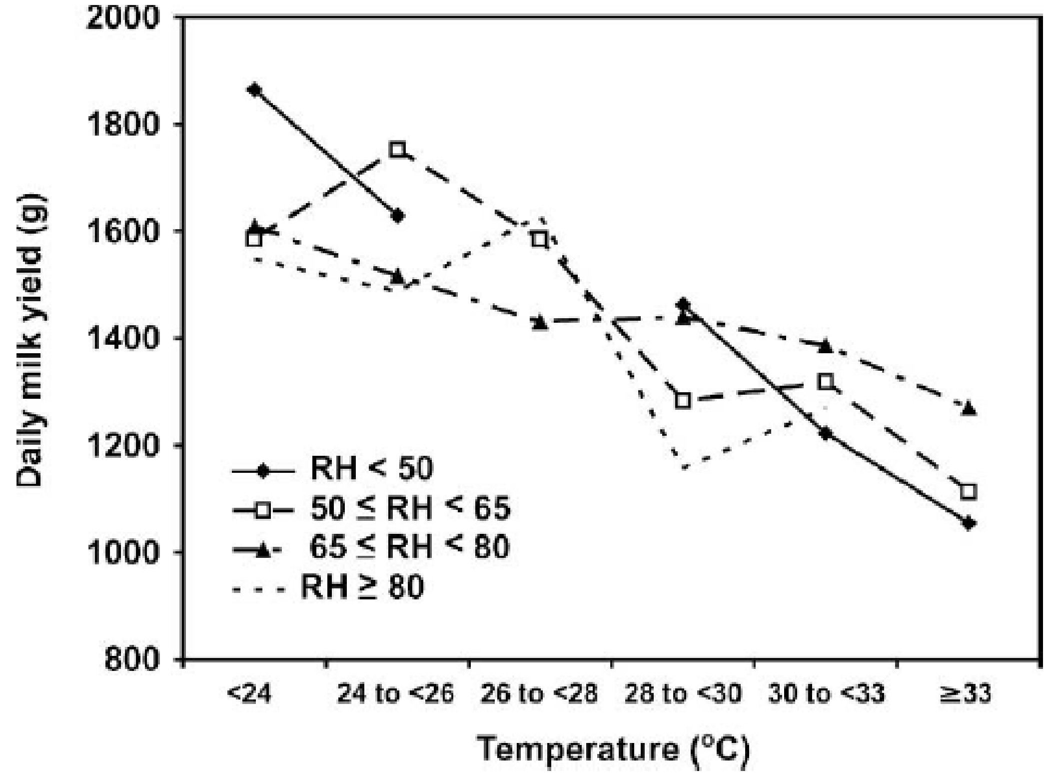


Figure 2. Effect of maximum temperature and average relative humidity (RH) (1 d before) on daily milk yield. Some maximum temperature-relative humidity combinations did not occur.

Finocchiaro et al. - J Dairy Sci. 2005 88(5):1855-64.

Cold and heat stress in dairy ewes
SUMMARY

Daily milk yield decreased when

- Mean temperature: above or below 15-21 °C
- Min temperature: above or below 9-12 °C
- Max temperature >21-24 °C (>24-30 °C in GRAZING ewes)
- THI_{mean} > 60-65 °F

Wind negatively affected production in winter and positively in spring-summer

Heat stress increased SCC by 60%

Heat stress sensitivity of dairy sheep surprisingly high, maybe because in spring-summer BCS is usually high

Nutritional unbalances

Nutritional unbalances can have broad effects on production performances, welfare and health status

- **Macro-nutrient unbalances**
  - ✓ Energy and body reserves
  - ✓ Energy/Protein ratio
  - ✓ Dietary protein
  - ✓ Fiber content and structure
- **Specific micro-nutrient deficits**
  - ✓ Mineral (Se, Zn, Mn, Fe)
  - ✓ Vitamin (vit. E, vit. A, beta-carotene, vit. C)

Energy balance, body reserves and BCS

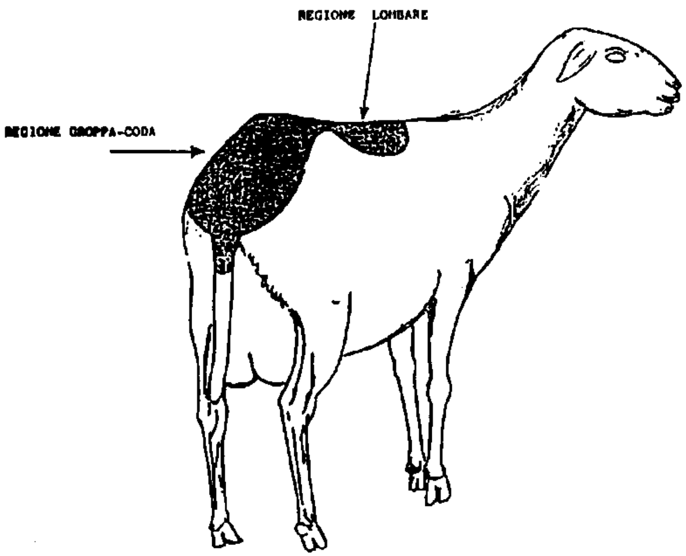
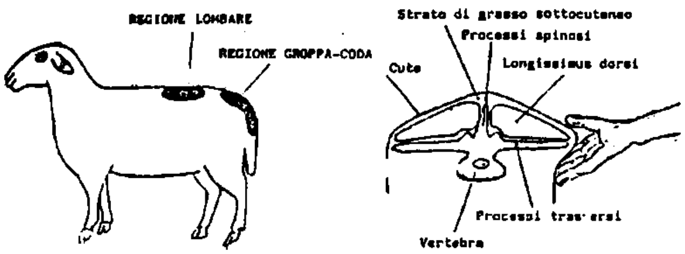


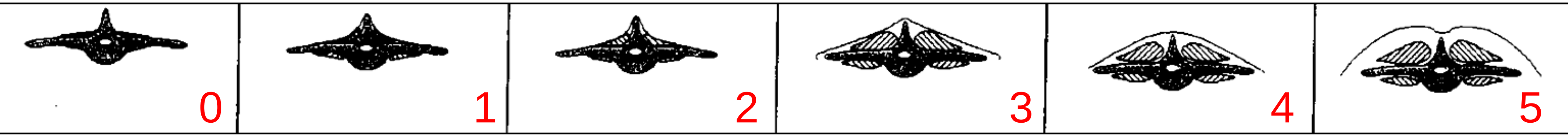
FIGURA 7 — Area da ispezionare visivamente e al tatto (sempre con la stessa mano e dallo stesso lato) per definire lo stato d'ingrassamento della pecora



Body condition score (BCS)

Used to:

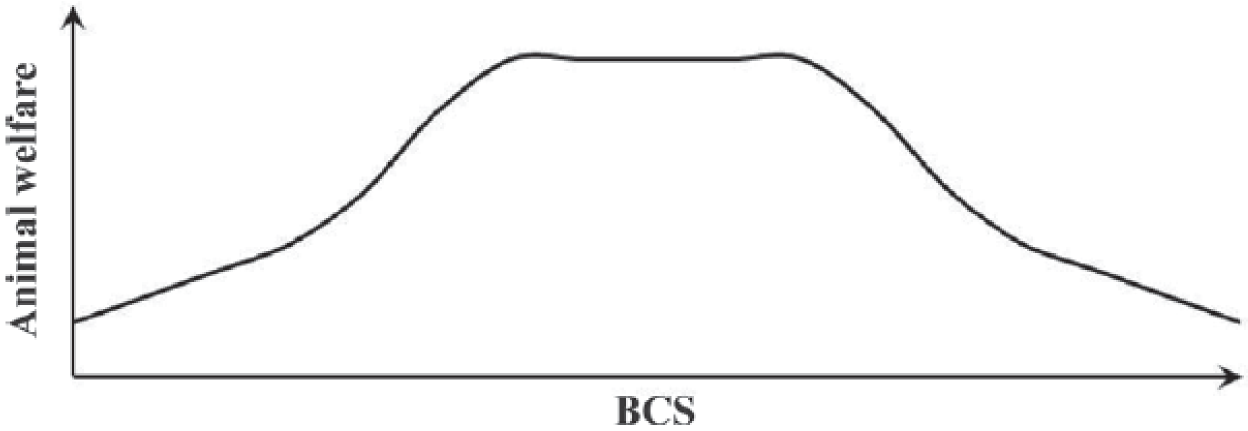
- **persue optimal body reserve status in the various physiological stages**
- **estimate the energetic cost of body reserve variations**
- **indicator of welfare?**



Energy balance, body reserves and BCS

Extreme BCS reflects an increased risk of compromised animal welfare (Roche et al., 2009)

- ❑ **in dairy cattle**: effects on milk production, reproduction, immune function, heat stress (fat) or cold stress (thin), metabolic disorders
- ❑ **in sheep?**



Relationship between BCS at mating and reproductive efficiency (Vatankhan et al., 2012)

BCS	Fertility (% pregnant ewes)	Fecundity (lambs born x mated ewe)	Total weight of the lambs at birth (kg)
1.0	30%	0.34	3.62
2.0	76%	0.77	3.48
2.5	88%	0.95	3.78
3.0	96%	1.19	4.09
3.5	97%	1.19	4.20
4.0	97%	1.12	3.71

BCS and health status of dairy ewes in the transition period (-15 d to +30 d from lambing)

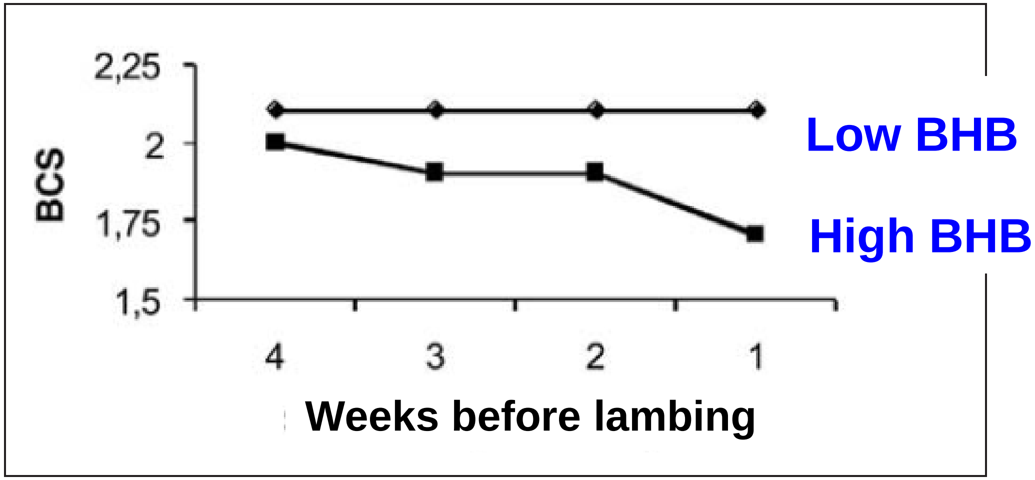
(Karagiannis et al., 2014)

	BCS	Health problems	
		NO	YES
Thin	BCS <2.75	69%	31%
Normal	BCS 2-5-3.5	88%	12%
Fat	BCS >3.5	67%	33%
BHB (mmol/l)*		0.849	1.118
NEFA (mmol/l)*		0.345	0.494

* at -30 d

Health problems (% of 241 ewes controlled): pregnancy toxiemia (2.6%), placental retention (1.4%), metritis (8.6%), clinical mastitis (4.8%), culling (8.2%, for diseases or low milk yield)

Subclinic ketosis in sheep: effects on immune defenses (Lacetera et al., 2001, 2002)



Subclinic ketosis =
BHB >0.86 mmol/L

	Low BHB (<0.86 mmol/L)	High BHB (>0.86 mmol/L)
Blood IgG (g/L)	14.5 ± 2.9 *	7.1 ± 2.7
Total IgG in the first colostrum (g/L)	8.1 ± 1.6 **	1.6 ± 0.8

* P<0.05: ** P<0.01

Sublcinical ketosis → Immunesuppression → increases susceptibility to infectious diseases (e.g. metritis and mastitis)

Can we monitor energy balance with BCS?

BCS variations:

- Difficult to assess short term variations

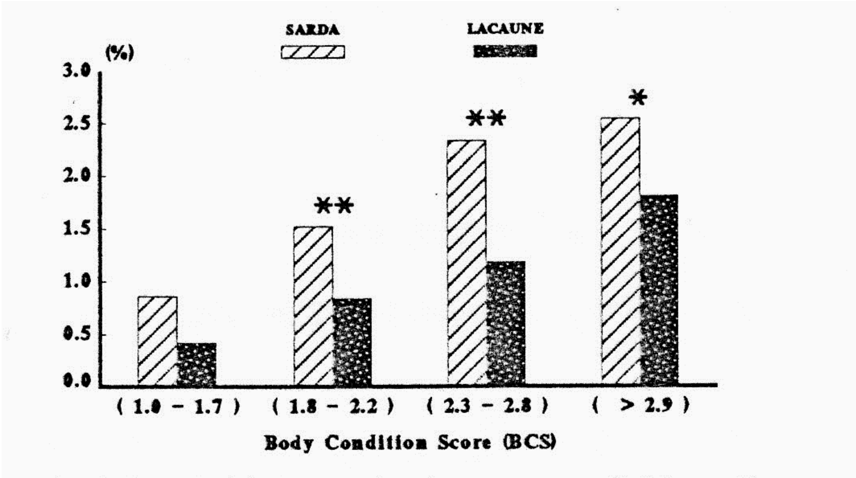
- Small range of variation of BCS in some dairy breeds, due to their high visceral fat accumulation

  e.g. in Sarda ewes 75% of 2240 records of 9 farms had BCS between 2.50 and 2.75 (Gaias, 2013)

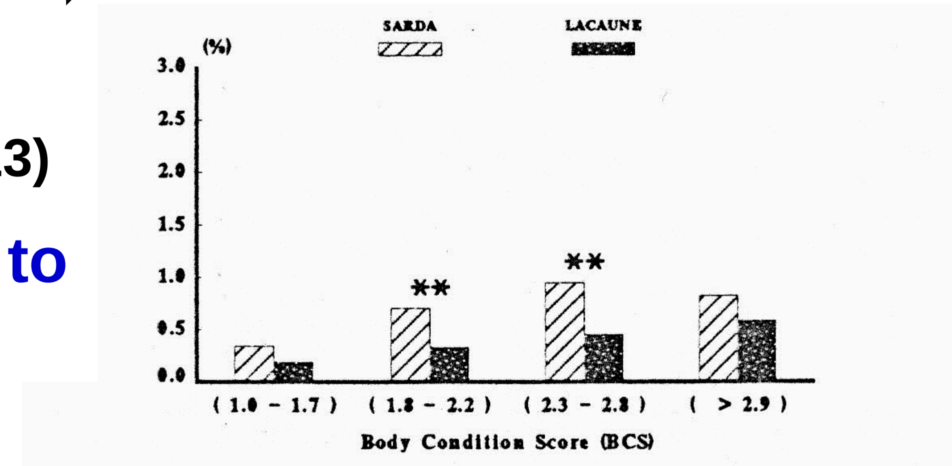
- Little data to associate BCS to body fat in dairy sheep

BCS vs. visceral fat in Sarda and Lacaune ewes (Ronchi et al., 1993)

Pelvic fat, % LW



Perirenal fat, % LW



Body fat content vs. BCS in sheep

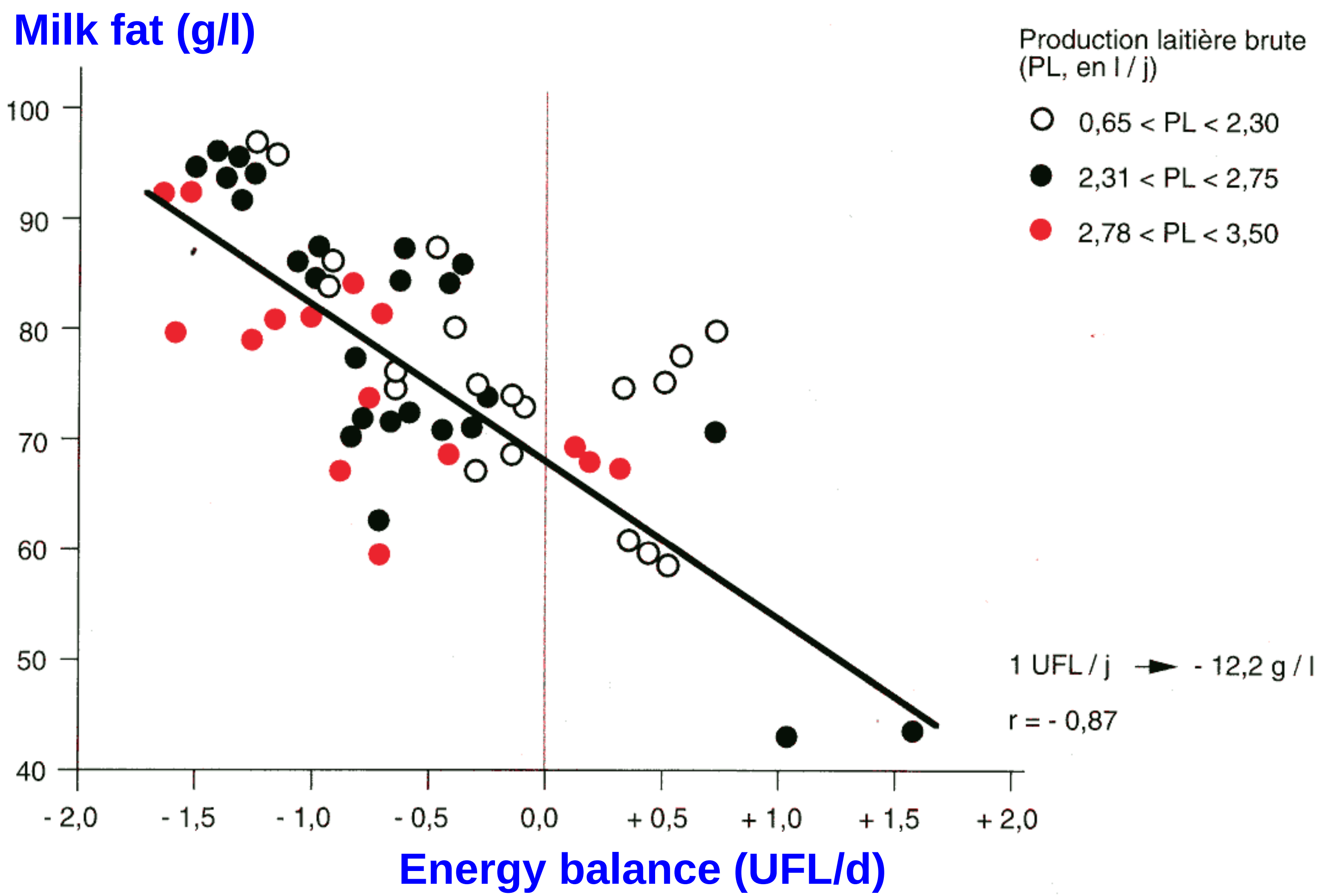
Body fat, as % of empty body weight (Cannas et al., 2007)

BCS 0-5	SRNS *	Aragonesa	Churra	Lacaune	Merino	Sarda	Wester-range
1	11.4	7.2	9.6		22.4		10.3
2	20.1	13.9	20.2		28.8	6.9	16.2
2.5	24.4	17.6	24.6		32.0	18.1	19.1
3	28.8	21.5	28.5	25.6	35.2	31.8	22.0
3.3	31.4	23.9	30.6	32.7	37.1		23.8
4	37.5	29.9	34.7		41.6		27.9

* Small Ruminant Nutrition System

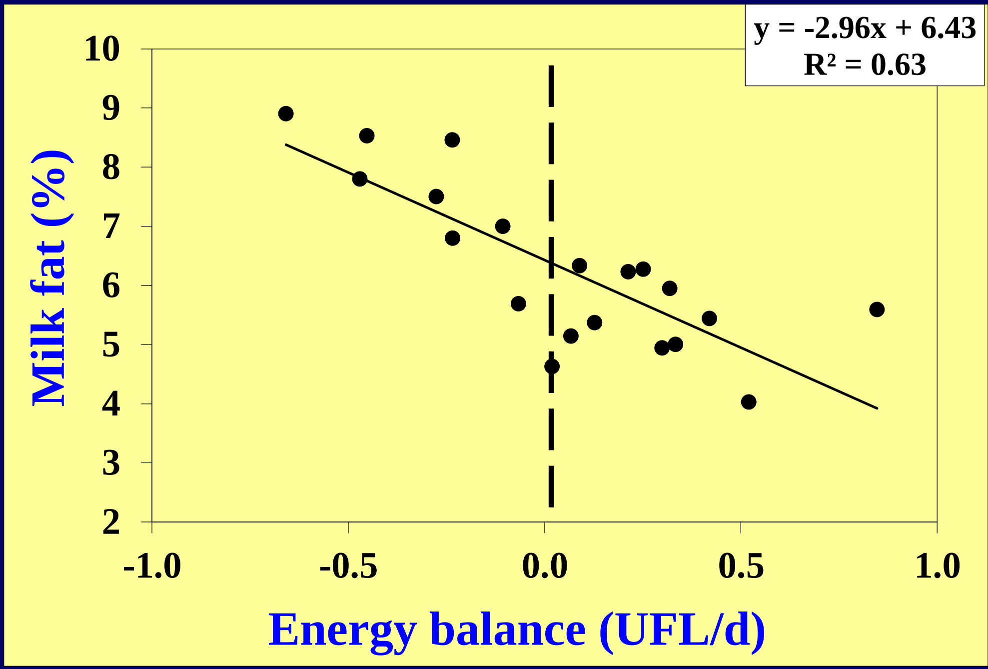
- **Very little data available**
- **High variability among the few breeds studied**

Monitoring ENERGY BALANCE by using MILK FAT CONTENT in dairy sheep

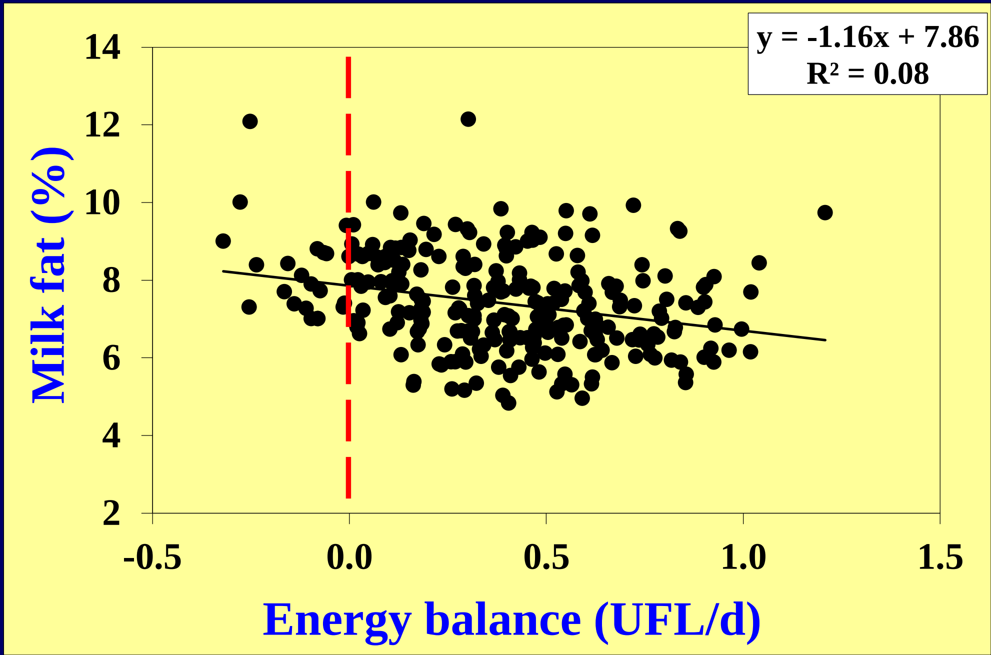


Bocquier & Caja (2001)

Energy balance vs. milk fat in Comisana dairy ewes (Avondo and Cannas, 2002)



Milk yield 1.2 - 1.6 kg/d



Milk yield 0.4 - 0.8 kg/d

Effect of the energy balance (LW variations) in the fatty acid profile of the milk of Sarda ewes

(*Rossi & Pulina, 1991*)

Fatty acids (%)	Live weight variations (kg per week)		
	+1,5	-1,1	-3,8
C4:0	3,31	2,49	2,21
C6:0	2,81 a	1,29 b	0,84 b
C8:0	2,87 a	1,09 b	0,65 b
C10:0	5,62 a	2,70 b	1,52 b
C12:0	4,07 a	1,88 b	1,10 b
C14:0	9,84 a	6,96 a	3,43 b
C16:0	22,86	24,67	24,15
C16:1	1,50	1,56	1,57
C18:0	7,14 a	10,93 a	13,58 b
C18:1	16,91 a	21,52 a	28,47 b
C18: 2	5,42	5,86	6,47
C18:3	0,31 a	0,27 a	0,65 b

Short-term undernutrition

In many instances dairy ewes fed on pasture can have, expecially during winter, **short periods of marked undernutrition**

- **What are the effects?**
- **Are they different depending on BCS?**

Effects of short-term feed restriction on milk yield and composition, and hormone and metabolite profiles in mid-lactation Sarda dairy sheep with different body condition score

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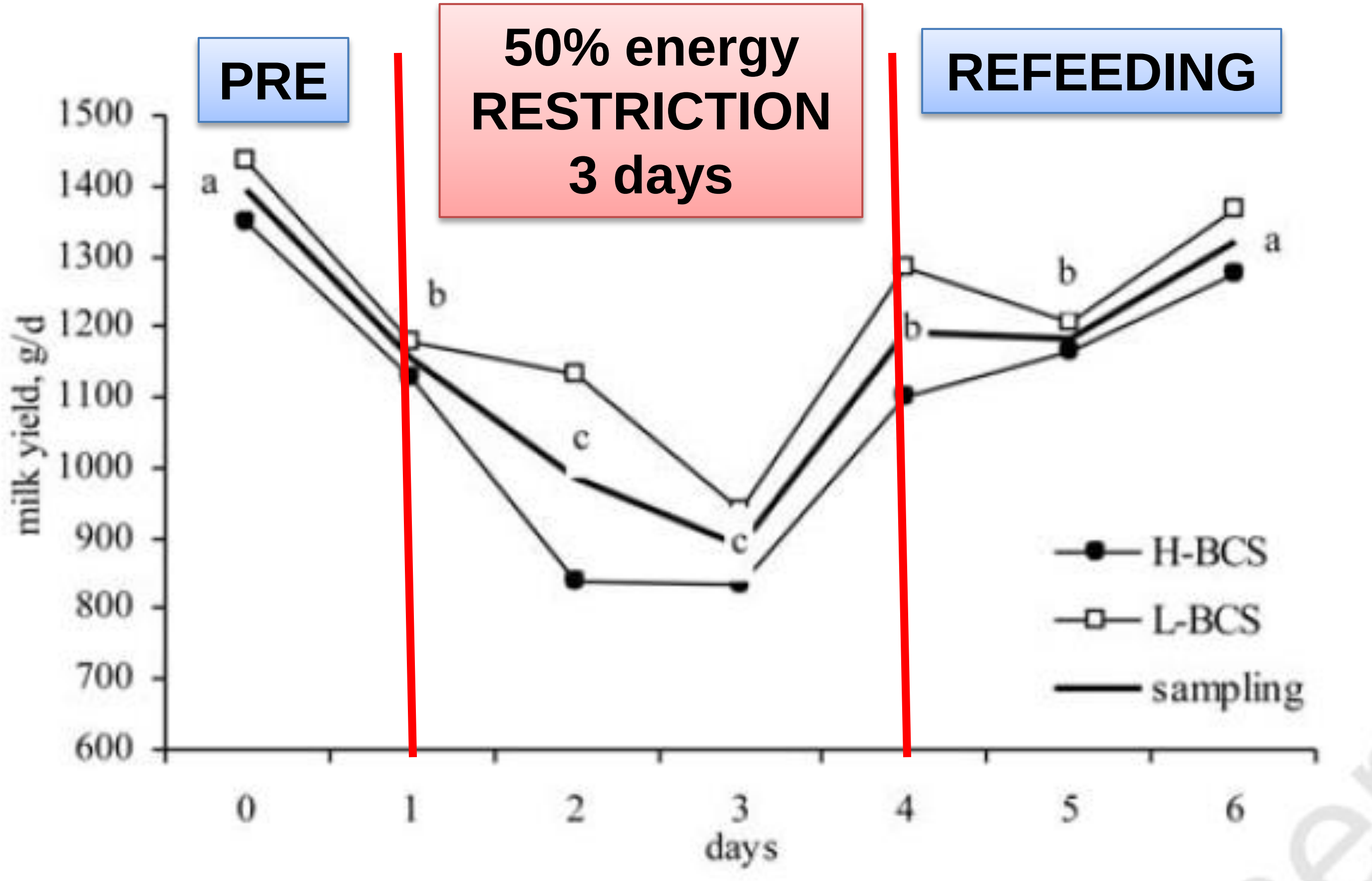
Short-term undernutrition



H-BCS
BCS>2.5
BCS = 2.92±0.12 (mean+SD)

L-BCS
BCS<2.5;
BCS 2.28±0.07 (mean+SD)

Milk production decreased by 35%, with a tendency for higher losses for ewes with high BCS

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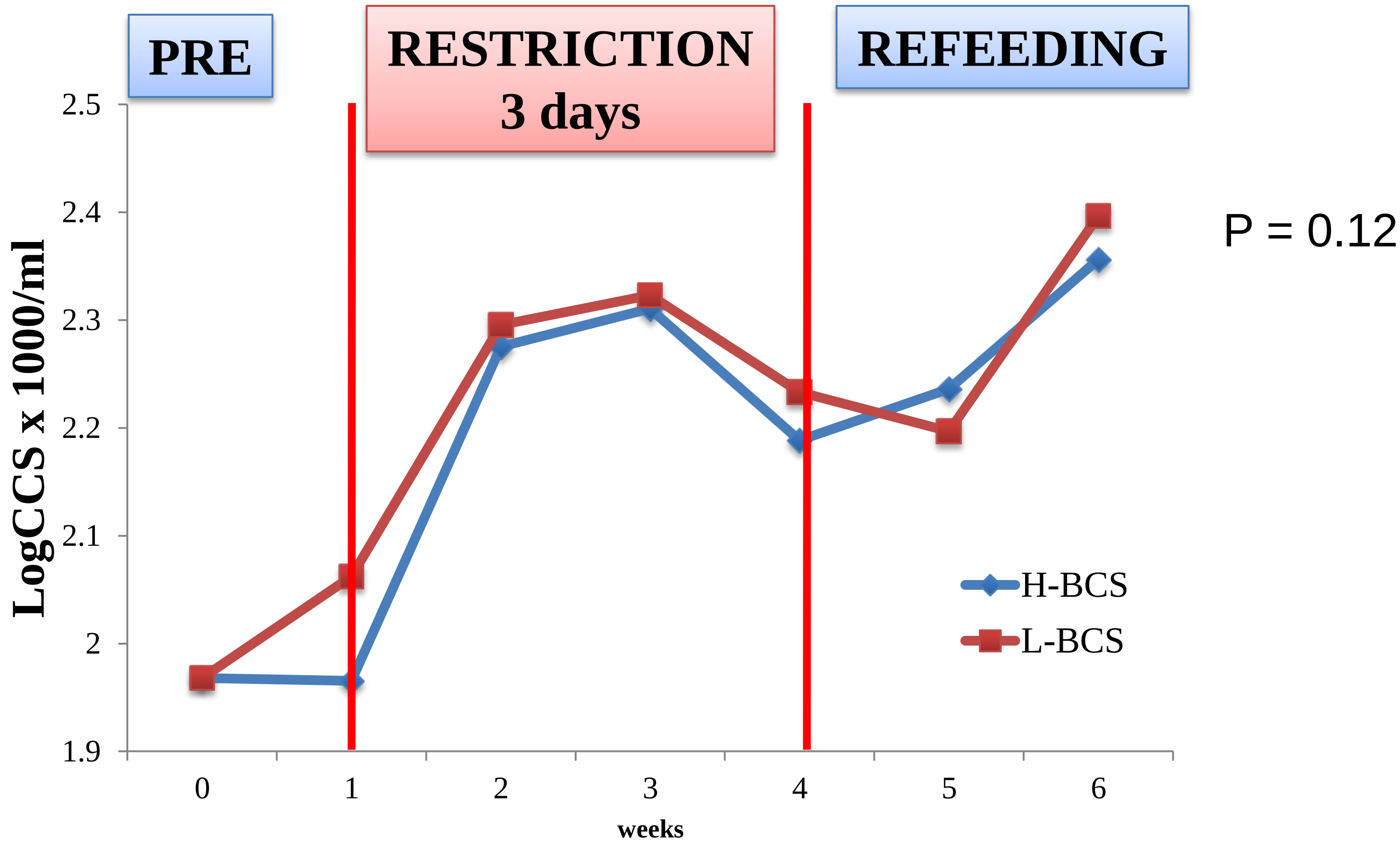
Pulina et al. 2012 - Ital J Anim Sci vol.11:e28

Short-term undernutrition



Increase of SCC, not restored during refeeding period

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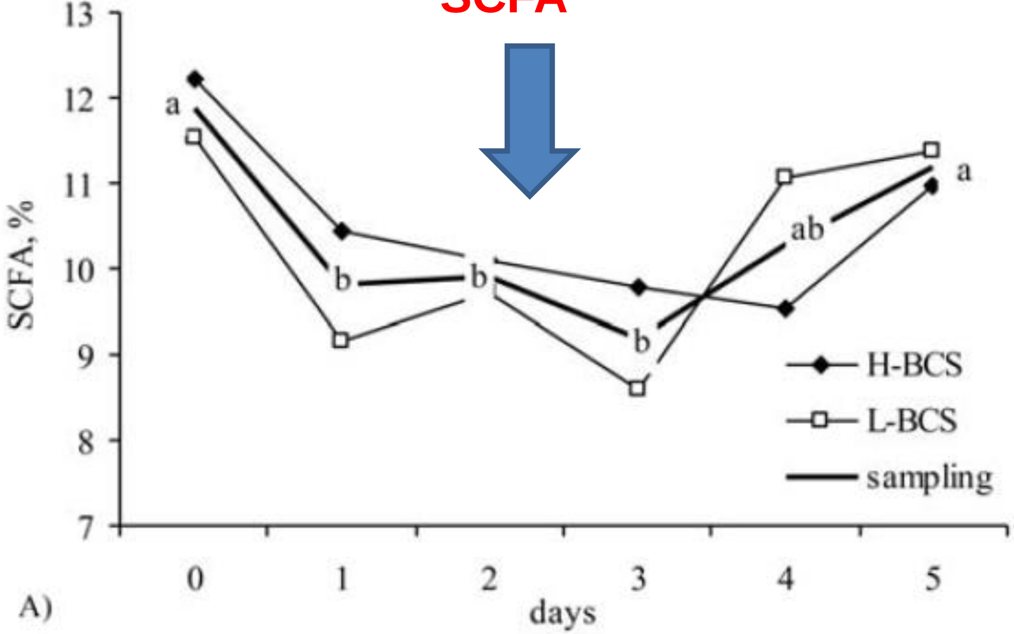
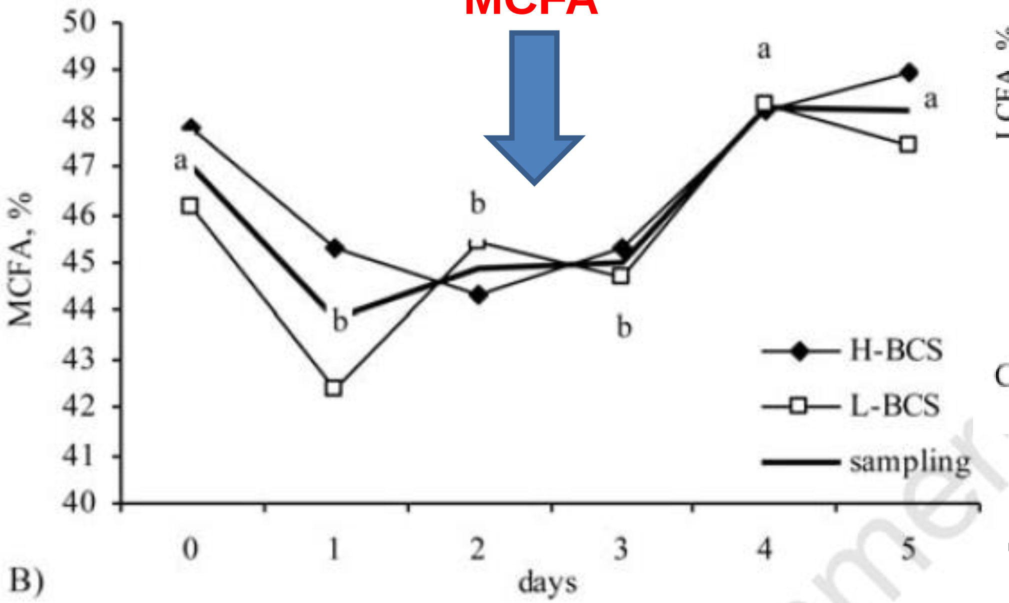
Milk short (SCFA, C4-C10) **and medium** (MCFA, C12-C17) **fatty acids decreased** and **long chain** (LCFA, (≥C18) FA **increased** during the feed restriction period in ewes with H-BCS and L-BCS.

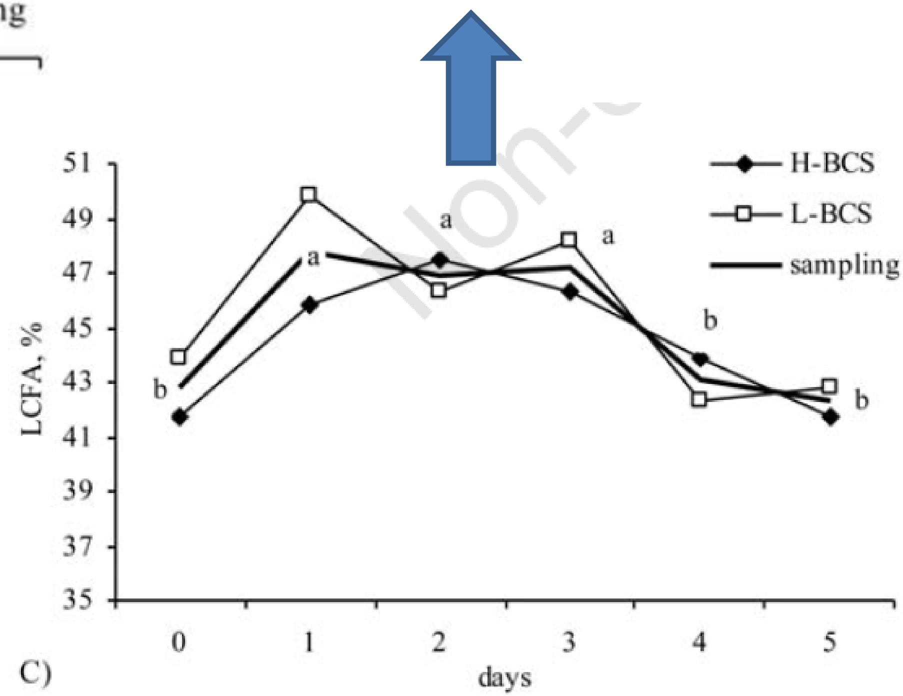
SCFA



MCFA



LCFA



Pulina et al. 2012 - Ital J Anim Sci

Can we monitor energy balance?

- **BCS** = not always appropriate, especially in short term assessments
- **Milk fat content** or its variations over time
  - Affected by level of production
- Milk fatty acids? **They can be analyzed with MIR (e.g. Milkoscan) techniques on a routine basis,** as for example done by the Regional milk lab of Sardinia

ASSOCIAZIONE REGIONALE ALLEVATORI DELLA SARDEGNA

Misurando	Descrizione Risultato	Espressione Risultato	Tecnica di Prova
Grasso	Gr.	g/100 ml	FT Infrarosso
Proteine	Prot.	g/100 ml	FT Infrarosso
Lattosio	Latt.	g/100 ml	FT Infrarosso
Cellule somatiche	Cell.	cell/µl	Citometria di flusso
Punto crioscopico	Cr.FT	°H	FT Infrarosso
Carica batterica totale	C.Bat.	UFC/µl	Citometria di flusso
pH	pH FT	pH	FT Infrarosso
Urea	Ur.FT	mg/dl	FT Infrarosso
Acidi grassi saturi	A.G.S.	g/100 g	FT Infrarosso
Acidi grassi insaturi	A.G.I.	g/100 g	FT Infrarosso
Acidi grassi monoinsaturi	A.G.M.	g/100 g	FT Infrarosso
Acidi grassi polinsaturi	A.G.P.	g/100 g	FT Infrarosso
Cloruro di sodio	NaCl	mg/100ml	FT Infrarosso

Excess of dietary PROTEIN in grazing sheep

- **Pasture in vegetative stage** are often **too rich in CP** (up to 30% DM), especially soluble protein

- **Fluid and diarroic feces** often associated to this condition when sheep fed on pasture ad libitum
  - e.g. at least 30% of the flock in Sardinia in late winter

- **Milk urea** > 50-60 mg/dl

- **Field observed effects:** malsabsorption, increased incidence of mastitis and feet problems, energy waste, reproductive disorders, others

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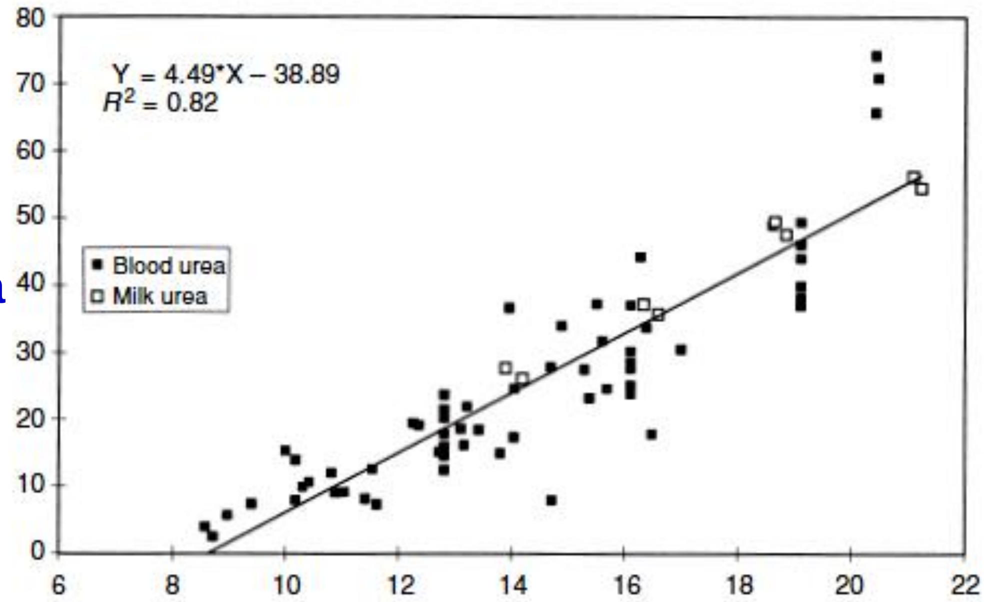
Blood or milk urea and reproduction in sheep

Milk urea and reproduction efficientcy at the artifical insemination (Molle et al. (1998)

Milk urea, mg/dl	< 30	30-45	> 45
Fertility at first insemination	58 %	51 %	46 %
Fertility at first insem. + 1st subsequent heat	78 %	82 %	71 %
Prolificacy at first insem. + 1st subsequent heat	1.36	1.42	1.52

Milk urea and dietary CP in dairy sheep (Cannas et al., 1998)

Milk urea mg/dl



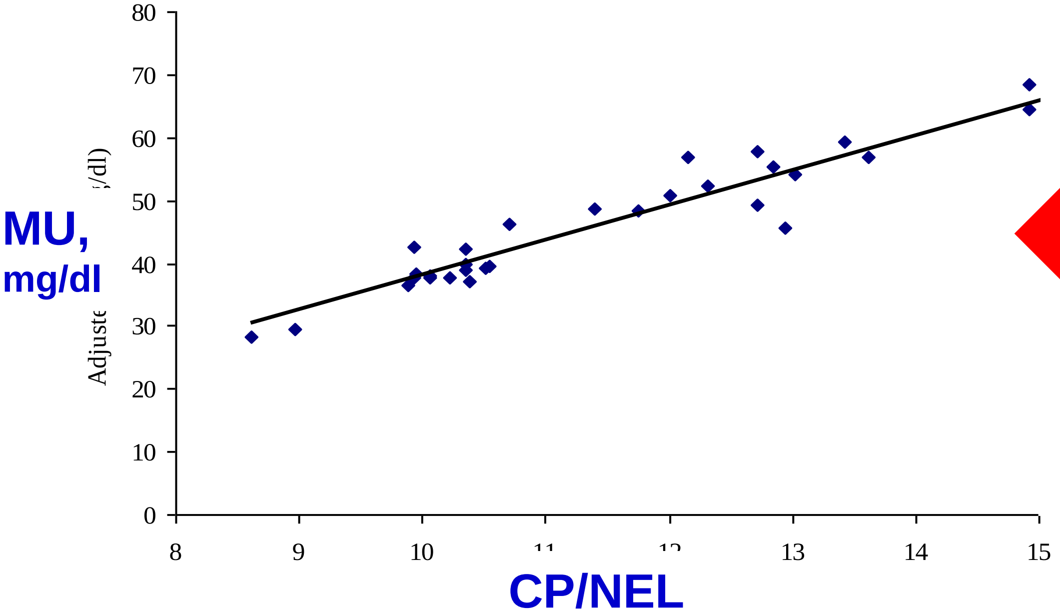
Diet CP, % DM

Fig. 6.6. The relationship betw... (MU) or blood urea (BU) in dairy, meat and wool sheep (Cannas *et al.*, 1998). Each point represents the average of an experimental treatment.

Table 6.12. Relationship between MU and dietary CP concentrations in sheep (predicted by using the regression equation reported in Fig. 6.6). When dietary CP concentration is unknown, MU may be used for its estimation.

CP (% DM)	12.0	12.5	13.0	13.5	14.0	14.5	15.0	15.5	16.0
Urea (mg/dl)	15.4	17.6	19.8	22.0	24.2	26.4	28.6	30.8	33.0
CP (% DM)	16.5	17.0	17.5	18.0	18.5	19.0	19.5	20.0	20.5
Urea (mg/dl)	35.2	37.4	39.6	41.8	44.0	46.2	48.4	50.6	52.8

Milk urea vs. dietary CP and Nel of the diet in Sarda (Giovannetti et al., 2010)



Based on dedicated experiments on Sarda ewes and metanalysis of the literature

NEL diet Mcal/kg of DM	CP diet (g/kg DM)								
	120	**130**	**140**	**150**	**160**	**170**	**180**	**190**	200
1.2	38	42	47	52	56	61	65	70	74
1.3	34	38	42	46	50	55	59	63	67
1.4	30	34	38	42	46	50	54	57	61
1.5	27	30	34	38	41	45	49	52	56
1.6	24	27	31	34	38	41	45	48	52
1.7	22	25	28	31	35	38	41	44	47
1.8	19	23	26	29	32	35	38	41	44

In red: more frequent values during lactation

Micronutrient and immunity of mammary glands

TABLE 2. Summary of micronutrient effects on mammary gland immunity.

Micronutrient	Observation	Reference
Se	Decreased efficiency in neutrophil function	(20, 38, 73)
	Improved bactericidal capabilities of neutrophils	(21, 38)
	Decreased severity and duration of mastitis	(21)
Vitamin E	Increased neutrophil bactericidal activity	(38, 87)
	Decreased incidence of clinical mastitis	(20, 87)
	In combination with Se, decreased prevalence of IMI at calving	(87)
Vitamin A	Decreased SCC	(73, 81)
	Moderated glucocorticoid levels	(81)
β-Carotene	Increased bactericidal function of phagocytes	(19)
	Increased mitogen-induced proliferation of lymphocytes	(73, 81)
Cu	Deficiency decreased neutrophil killing capability	(43)
	Deficiency increased susceptibility to bactericidal infection	(32)
Zn	Deficiency decreased leukocyte function	(32)
	Deficiency increased susceptibility to bacterial infection	(32, 73)

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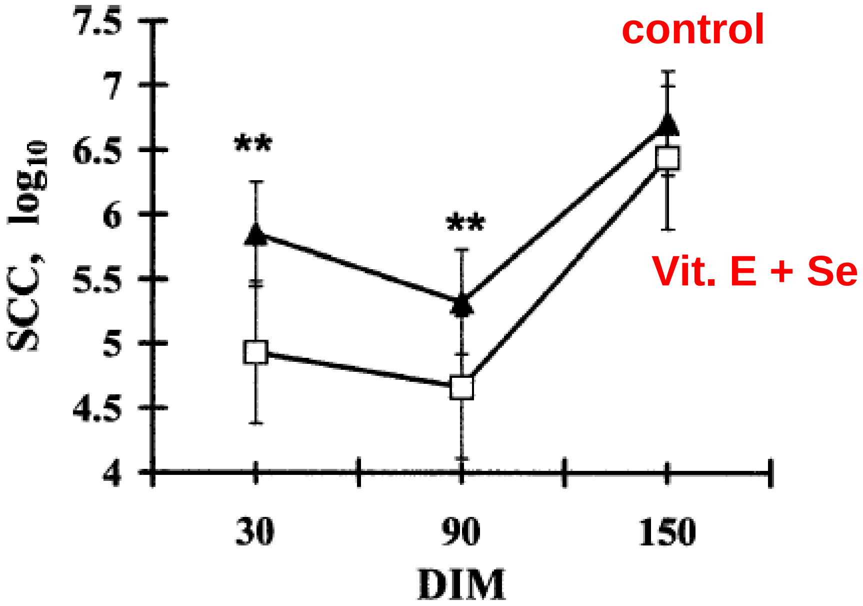
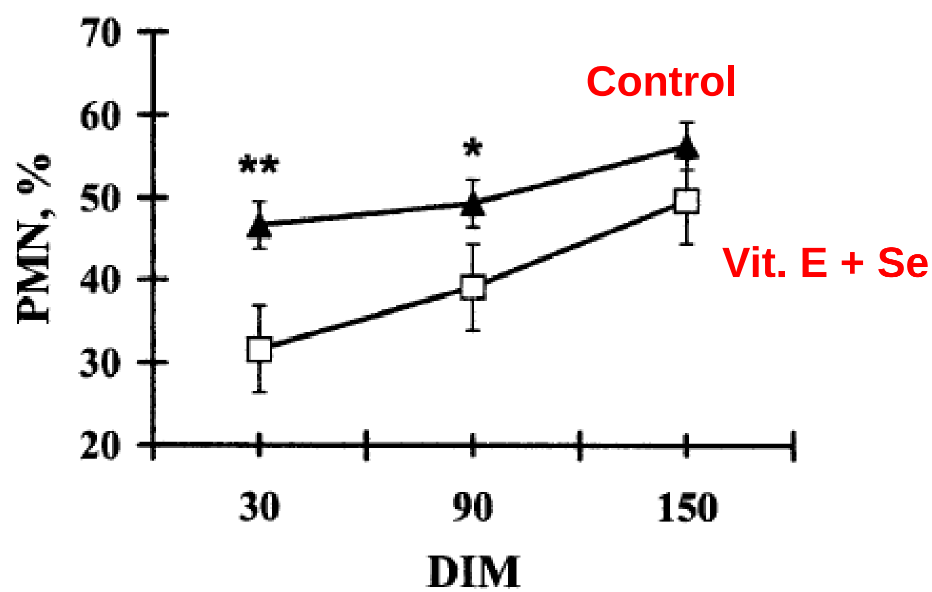
From Sordillo et al., 1997 – J Dairy Sci, 80: 1851-1865.

Se and Vitamin E in dairy sheep



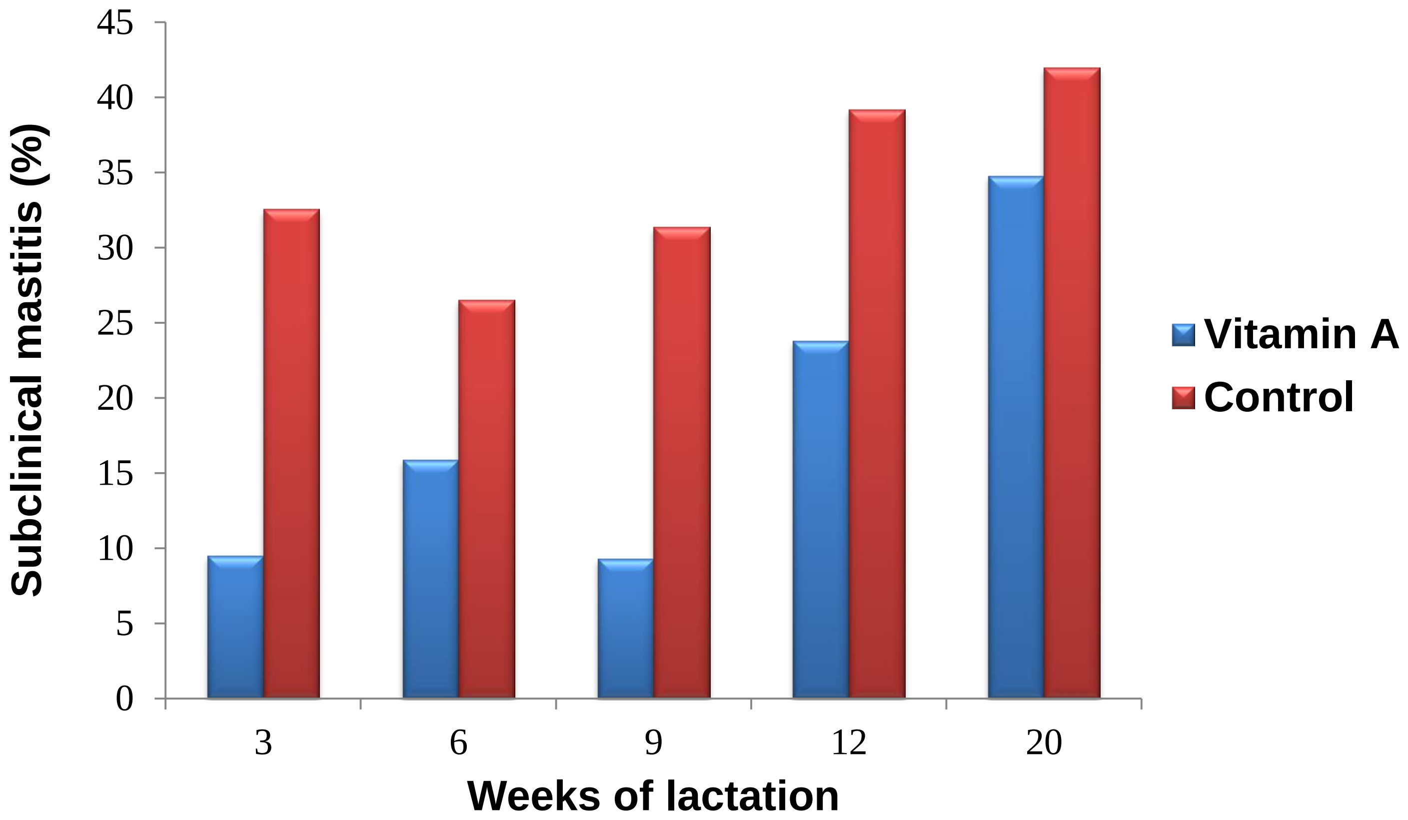
Parenteral administration of two subcutaneous injections of **vitamin E** and **Se** (5 mg and 0.1 mg/kg of body weight, respectively) during the dry period



RESULTS: Decrease of SCC and PMN in milk during the subsequent lactation

Morgante et al., 1999 - Journal of Dairy Science, 82.

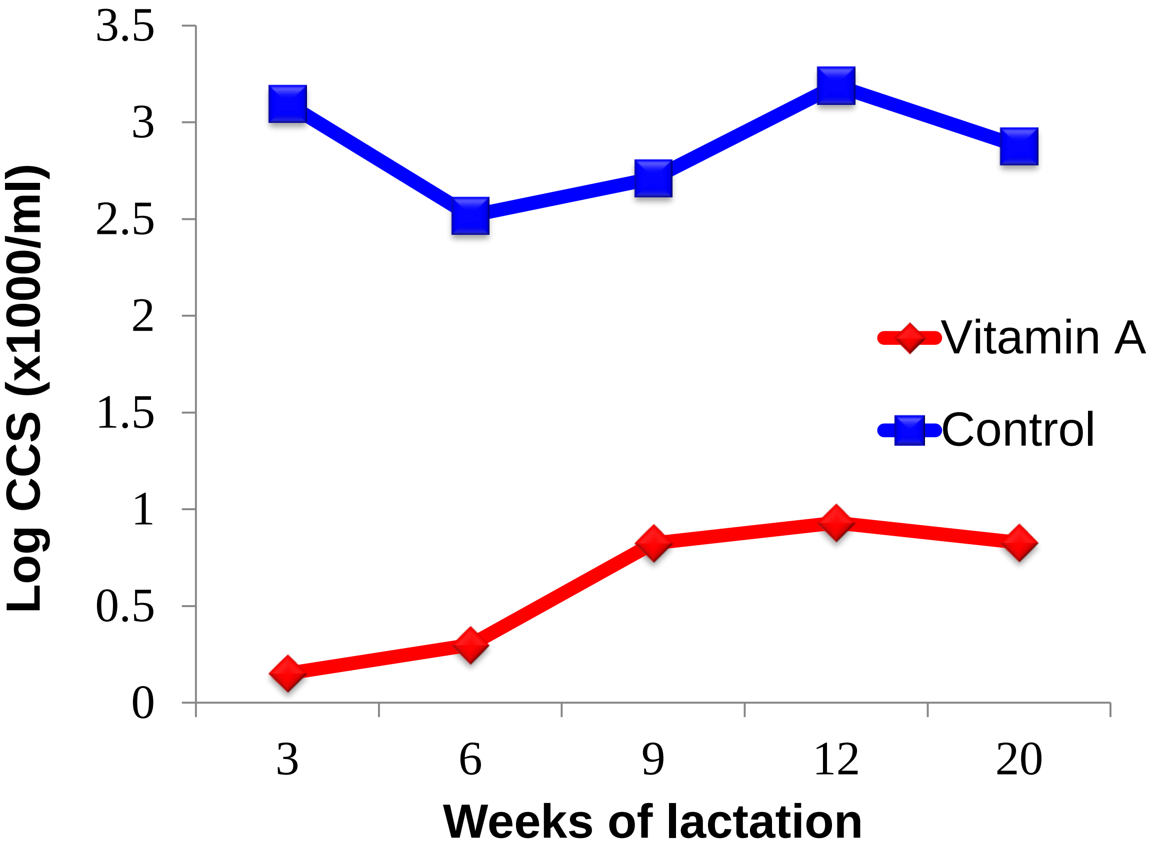
Vit. A and subclinical mastitis in dairy sheep



Intramuscular injection of **vitamin A** (3500 IU/kg BW) every 3 months by **reduced incidence of subclinical mastitis** in Greek dairy ewes

Koutsoumpas et al. (2013) - Small Ruminant Research 110: 120– 123.

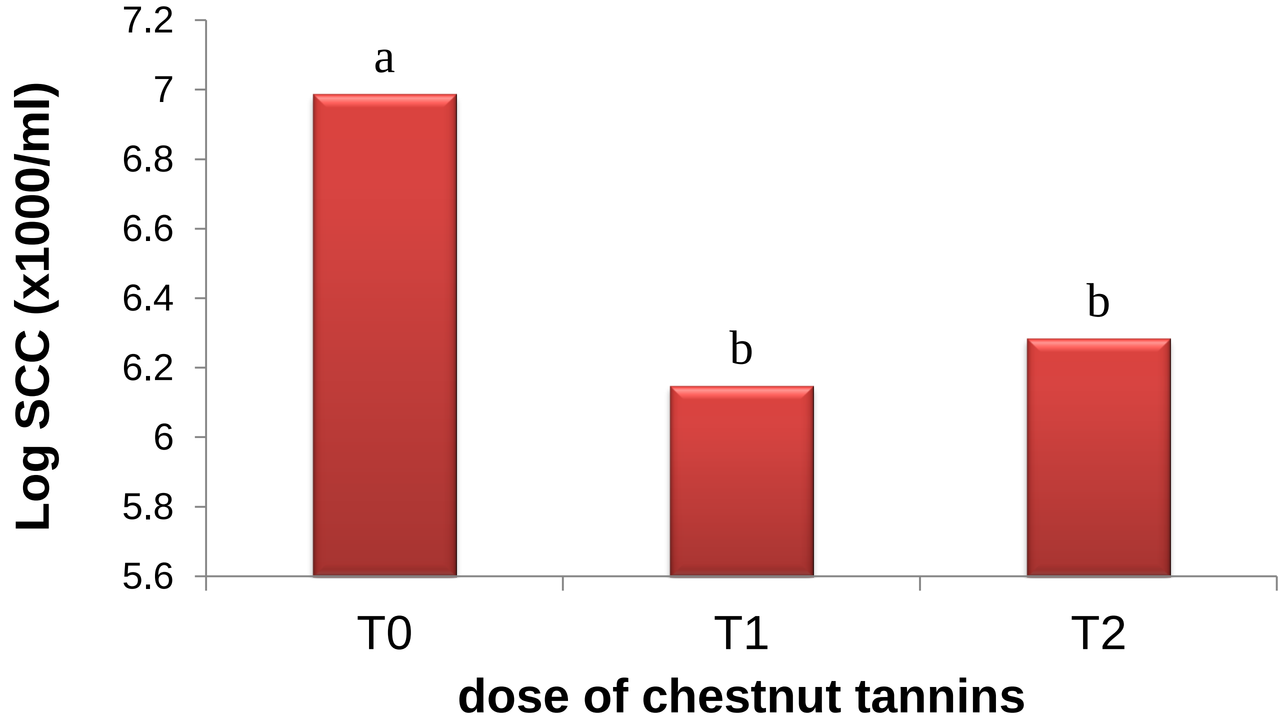
Vit. A and milk SCC in dairy sheep



Koutsoumpas et al. (2013) - Small Ruminant Research 110: 120– 123.

Chestnut tannins and milk SCC in dairy sheep

Dietary supplementation of chestnut tannins reduced milk SCC of sheep on alfalfa based pastures without affecting milk yield



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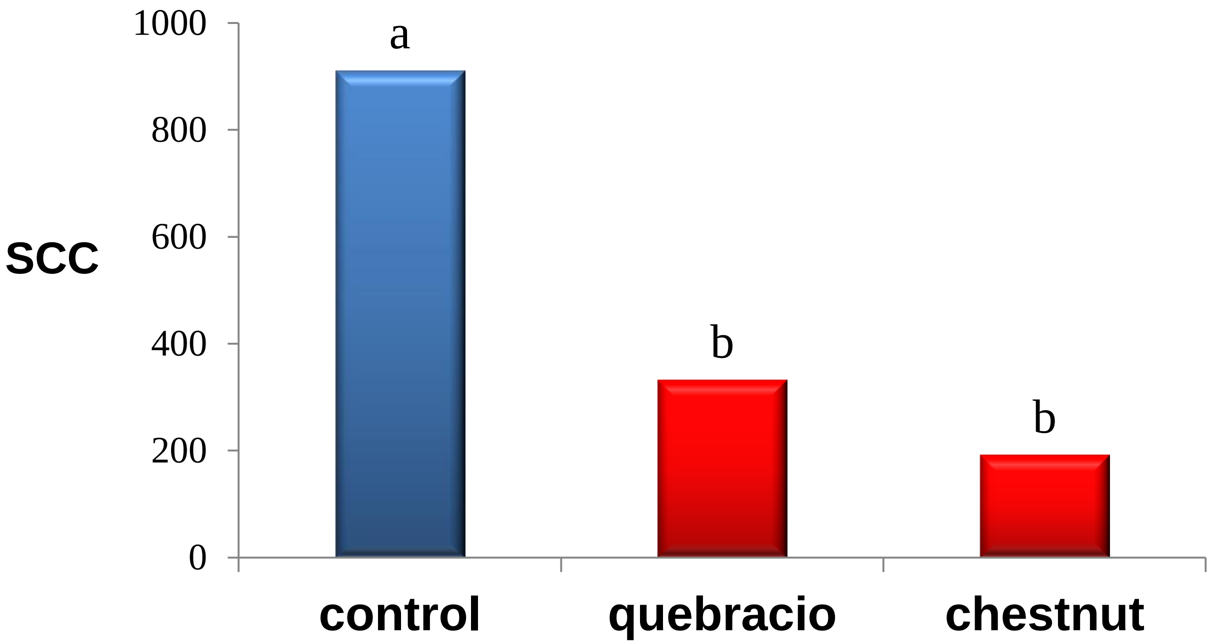
Pulina et al. 2010 – 3rd EAAP Int. Symp. Energy and Protein Metabolism and Nutrition, Parma

Chestnut and quebracho tannins

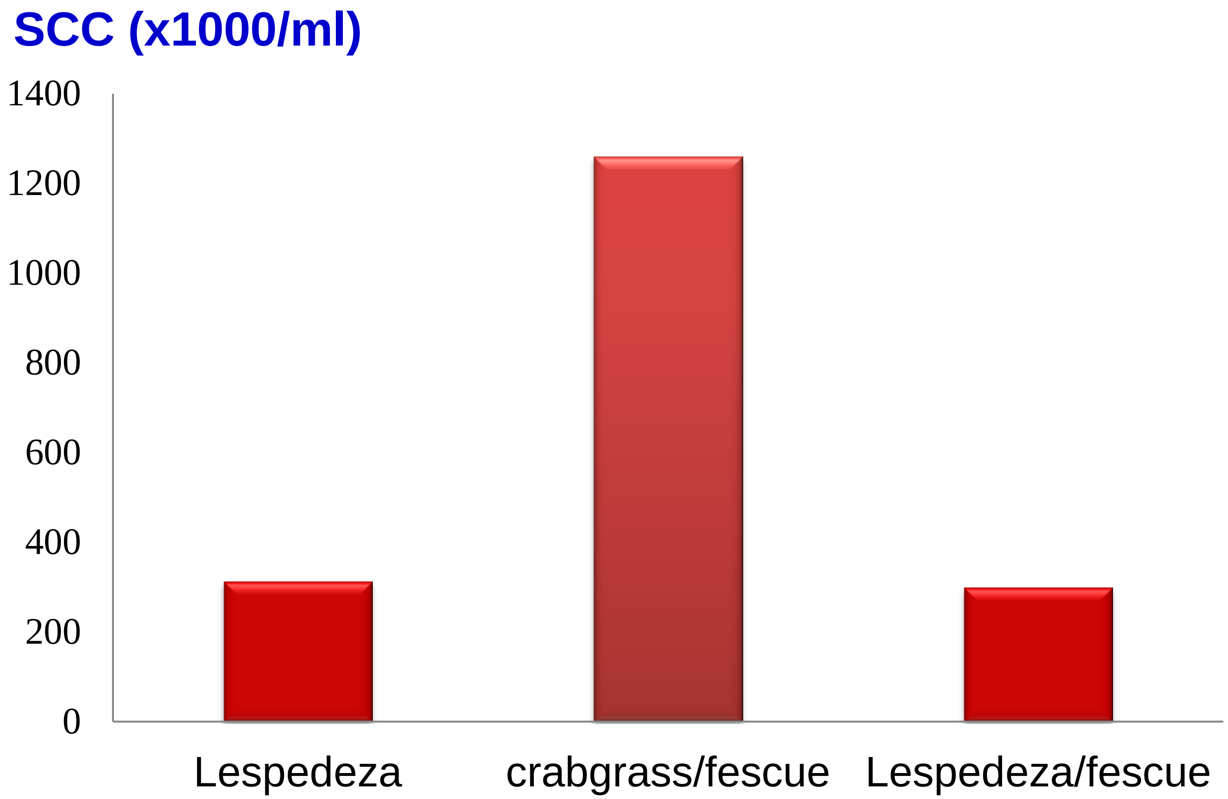
SCC in milk of Sarda ewes grazing on *Medicago polymorpha* pasture supplemented with chestnut and quebracho tannins (40 g/d)



Castañares et al. 2011 - *Ital J Anim Sci vol.10:S1: p. 96 (abstr).*

Tannins of *Lespedeza cuneata*

Goats grazing on pasture containing *Lespedeza cuneata (Fabaceae*) produced milk with lower SCC



Min et al. / Veterinary Parasitology 130 (2005) 105–113

Conclusion

- **As for dairy cattle, dairy sheep are subjected to various stressors that can affect their productity, welfare and health**

- **These problems are increasingly common, due to the:**
  - current high milk yield of dairy sheep
  - utilization of rich diets and cultivated pastures
  - increased number of large dairy sheep farms, in which individual monitoring of the animals is not feasible

- **Compared to cattle, there is need to develop more accurate and sensitive nutritional indicators that combine welfare and production**

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Thank you for your attention !

- Cosa fare per migliorare il benessere animale e ridurre il CCS nel latte? Curare la lettiera in modo che le superfici con cui la mammella viene a contatto siano asciutte e pulite Evitare sovraffollamento degli animali Creare comfort pre-mungitura con adeguate zone di attesa Prestare maggiore attenzione ai comportamenti degli allevatori nei confronti dei loro animali Curare l’ alimentazione, evitare brusche variazioni e stress da sottonutrizione

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Grazie per l’attenzione

- Calm ewes have in responce to syncronization (Hart et al., 2008)
  - Higher spontaneous ovulation (1.63 v 1.26, P=0.003)
  - Higher ovulation rate (1.83 v 1.57, P=0.03)
  - Higher multiple gestation (Calm 1.60 v Nervous 1.35, P=0.03)

- Lambs born from calm mothers have (Blache & Bickell)2010
  - a higher survival between birth and weaning
  - higher IgG intake

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The impact of ewes temperament on milk yield is great during the whole lactation

Variabile	Calm		Nervous
Fertility at 3 yrs	**1.524 ***		**1.321**
Milk yield/lactation at 2.5 yrs (kg)	**188.9 ****		**144.8**
Milk yield/lactation at 3,5 yrs (kg)	**190.7 ****		**135.8**
Milk yield/lactation at 4,5 yrs (kg)	**173.7 ****		**111.1**

*** P < 0,05 ** P < 0,001**

(Dimitrov-Ivanov and Djorbineva, 2002)

Comparative antimicrobial activity of tannin extracts from perennial plants on mastitis pathogens

Susce

Table 3. Relative susceptibilities of mastitis-causing *S. aureus* to various plant tannin extracts.

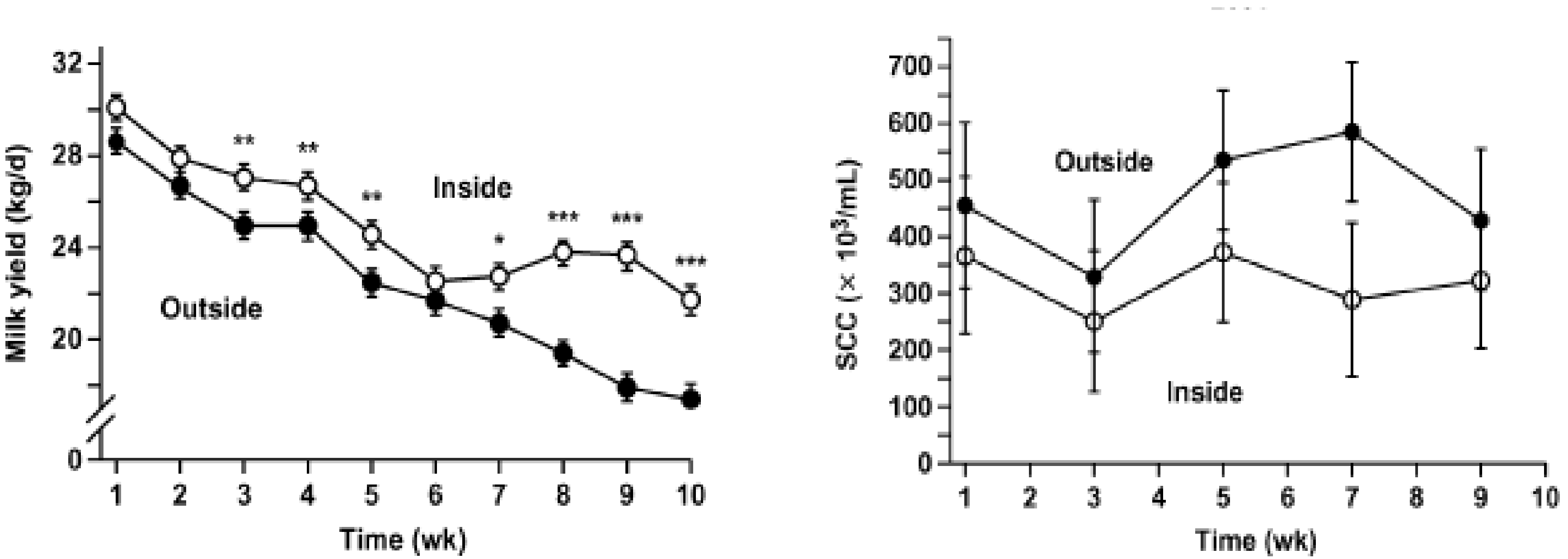
Item	Diameter of inhibition (mm)[1]			P-value		
	2	4	8	mg/ml SEM	Linear	Qudratic
Black jack	12	14	17	0.30	0.001	9,91
Sericea lespedeza	9	10	12	0.56	0.01	NS
Sumac	8	9	10	0.36	0.02	NS
Plum	7	7	7	0.01	NS	NS
Post oak	15	19	23	1.09	0.001	NS
Locust	15	15	19	1.44	0.01	0.05
Shinnery oak	18	22	23	0.75	0.01	0.01
Skunk bush	10	14	13	0.98	0.01	NS
Quebracho	7	9	11	0.15	0.01	0.05
Control (sterile water)	-	-	-			
Penicillin-G		10 IU				
ANOVA		51		0.98		
Sources of tannins (ST)				0.001		
Dose (D)				0.001		
ST x D				0.001		

NS = not significant ($P > 0.05$). Inactive (-); Moderately active (7 - 14); highly active (> 15).
[1]Included diameter of disc (6 mm).

Min et al. 2008 - Scientific Research and Essay Vol.3 (2), pp. 066-073.

2. HEAT STRESS: dairy cows

In dairy cows Heat stress decrease milk yield and increase milk SCC



Inside = animali mantenuti all’interno con ventilazione
Outside = animali in ambiene esterno senza ventilazione

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Smith et al. 2006 - JDS

4. STRESS AND MANAGMENT

alterazioni nella manifestazione dell'estro negli ovini in seguito a stress legati al management dell'allevamento

trattamento	N.	ritardato	bloccato	% sul totale
isolamento	9	1	3	44
trasporto	8	1	5	75

Ehnert & Moberg, 1991 - J.*Anim.* Sci

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- In Sardinia a Regional Plan aimed at improving sheep welfare by using as target the reduction of bulk milk SCC was launched.
- The bulk milk SCC is used the main indicator to evaluate the accessibility of the farmer to the economic subsidies.
- In particular, farmers who adhere to the plan must have an annual geometric mean of bulk SCC lower than 1,500,000 cells/ml (RAS, 2011).
- 'specific objective of Measure 215 - Payments for the welfare of the animals has the aim to improve the welfare conditions of sheep and goats by using farming practices that have a positive influence on animal welfare. The farmers must create effective and stable rearing conditions that can reduce animal stress and the risk of disease especially mastitistis and lamness.
- The expected result is a general improvement of animal welfare, which will be monitored through the Content of Somatic Cells (CCS) of the milk.
- The goal is the reduction of the CCS, to less than1 million somatic cells per ml of milk calculated as the geometric mean of monthly checks in companies that adhere to Measurement.

6. Micronutrient deficit

micronutrient and immunity of mammary glands

Nutrient	component		function
Se	Glutatione perossidasi	citosol	Converte il H_2O_2 in acqua
Cu, Zn, Mn	Superossido dismutasi (SOD)	citosol	Enzima che converte i superossidi in H_2O_2
Fe	Catalasi	citosol	Converte il H_2O_2 in acqua
Vit. E	Alfa-tocoferolo	membrana	Interrompe i processi di perossidazione degli AG
carotene	Carotene	membrana	Previene l'inizio delle reazioni di perossidazione

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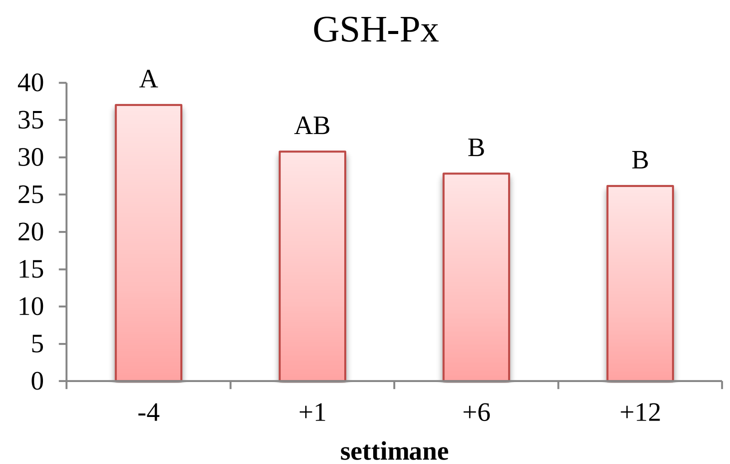
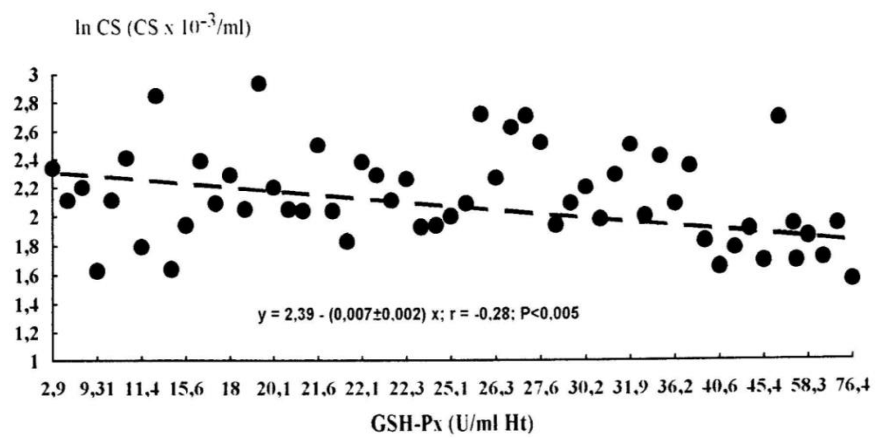
STUDIO PRELIMINARE SULLE RELAZIONI TRA LO STATO NUTRIZIONALE NEI CONFRONTI DEL SELENIO E LE CELLULE SOMATICHE DEL LATTE IN OVINI DI RAZZA SARDA ALIMENTATI CON UNA DIETA CARENTE DI SELENIO.

INDICATORE DI SE CARENZA?

uno Ronchi, Nicola G. Lacetera, Umberto Bernabucci, Alessandro Nardone



La carenza di Se nella dieta comporta una riduzione dei livelli eritrocitari del GSH-Px



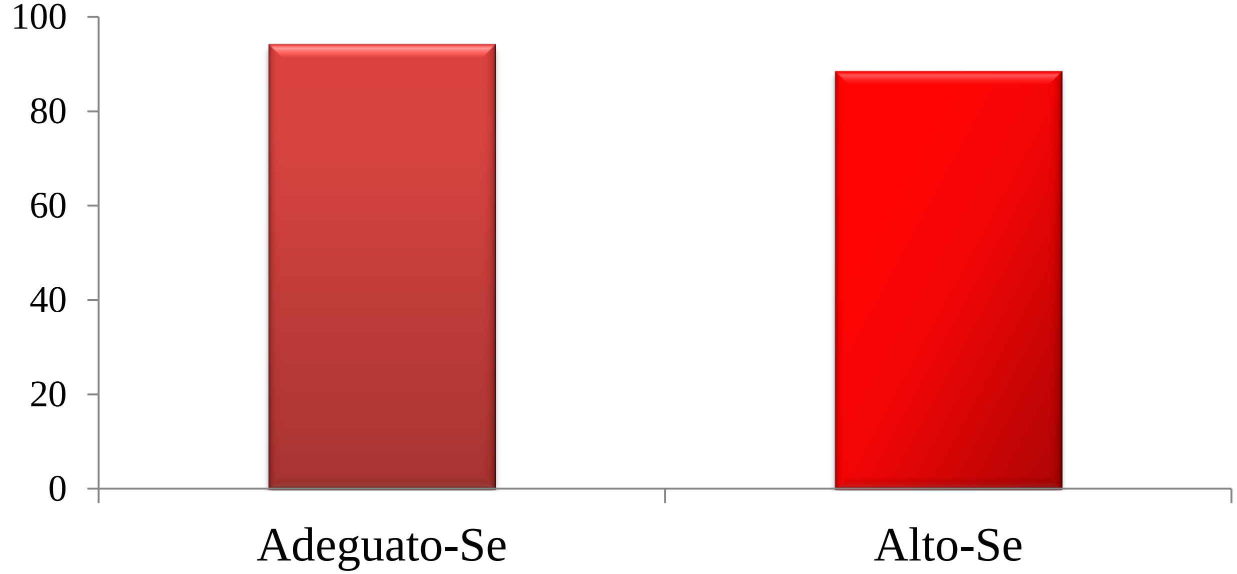
relazione negativa tra i livelli eritrocitari di GSH-Px e CCS del latte

Ronchi et al., 1994 - Proc. Int. Symp. "Somatic cells and milk of small ruminants", Bella.

6. 3. Se in dairy sheep

La supplementazione di Selenio oltre i fabbisogni degli animali non comporta effetti positivi sul CCS del latte di pecore rispetto ad una dieta con adeguato apporto di Selenio

CCS (x1000)/ml



Ase = 11.5 µg Se·kg of BW per day

Hse = 77.0 µg Se·kg of BW per day

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Meyer et al., 2011 – J Anim Sci, 89: 1627-1639.

1. Sheep temperament

The selection of dairy sheep on calm temperament before milking did not affect the milk yield and its composition in Merino ewes

	calm	nervous	P
Milk yield, g/d	462	394	ns
Fat, %	6.02	6.04	ns
Protein, %	5.62	5.54	ns

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T.L. Murray et al. / Small Ruminant Research 87 (2009) 45–49

5. Milking management of primiparous ewes

Milking management is a critical point in primiparous sheep.
The time of adaptation of primiparous to machine milking or the pre-partum training to milking parlour can stress the animals and affect the welfare, health status and production performance of dairy sheep

Primiparous ewes ... multiple stressors events

- ✓ Separation of lamb 30 days after lambing
- ✓ First impact with the milking parlor
- ✓ First impact with machine milking
- ✓ Regrouping with new animals (multiparous ewes already in milking)

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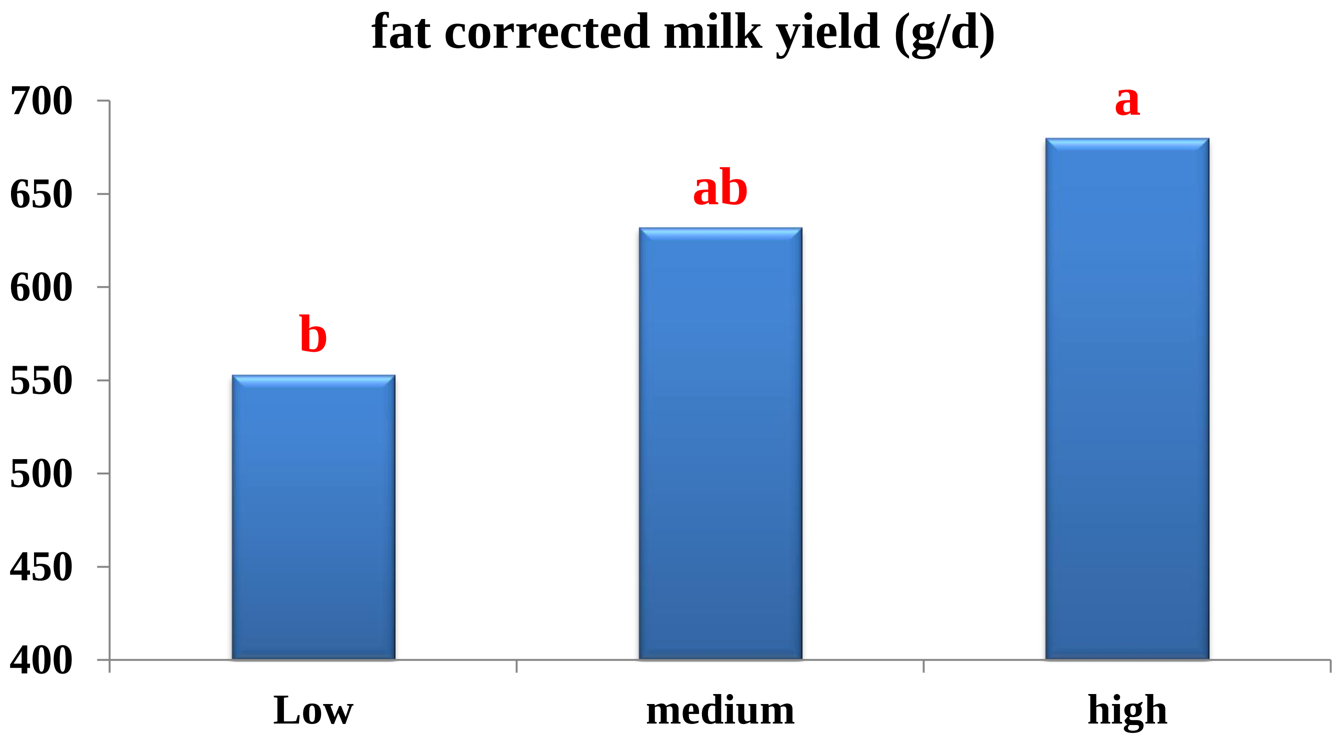
Rassu et al. 2006 – J. Dairy. Sci. 89(Suppl. 1):303 (abstr.).

4. Housing: ventilation

Ventilation reduce heat stress because improve thermal exchanges between the animal's body surface and the environment



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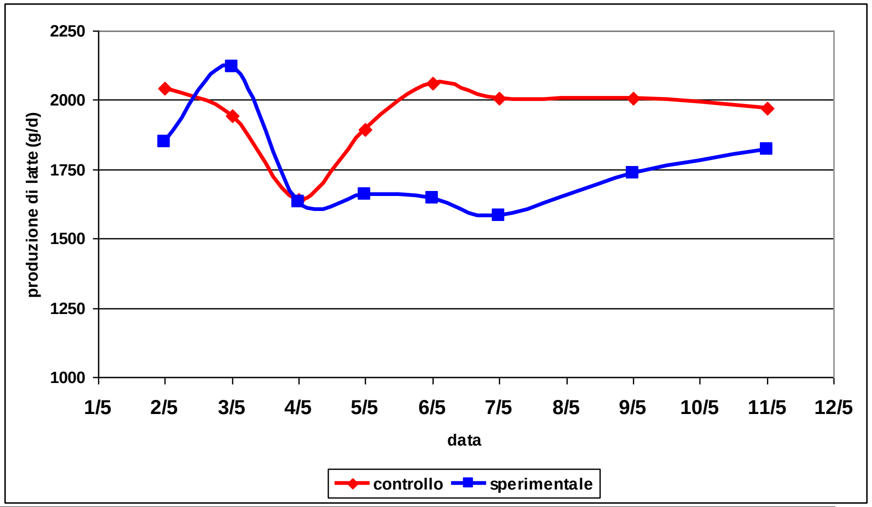
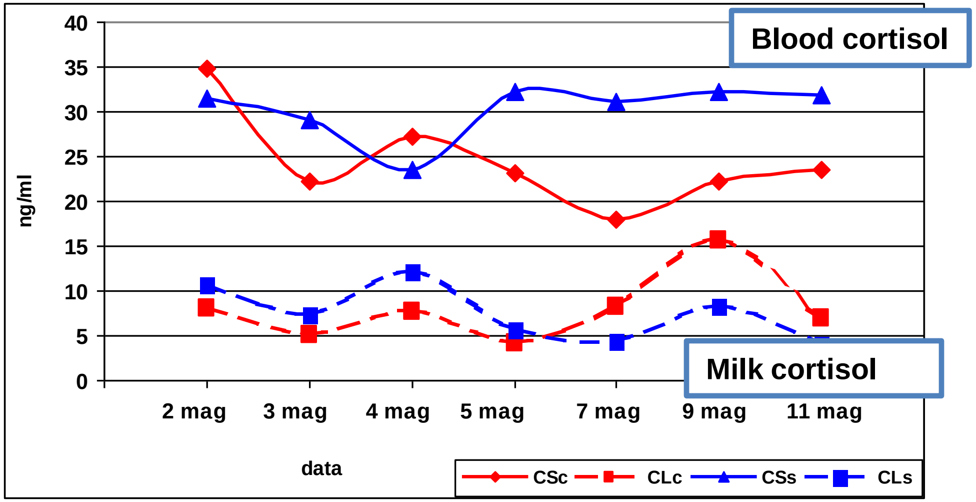
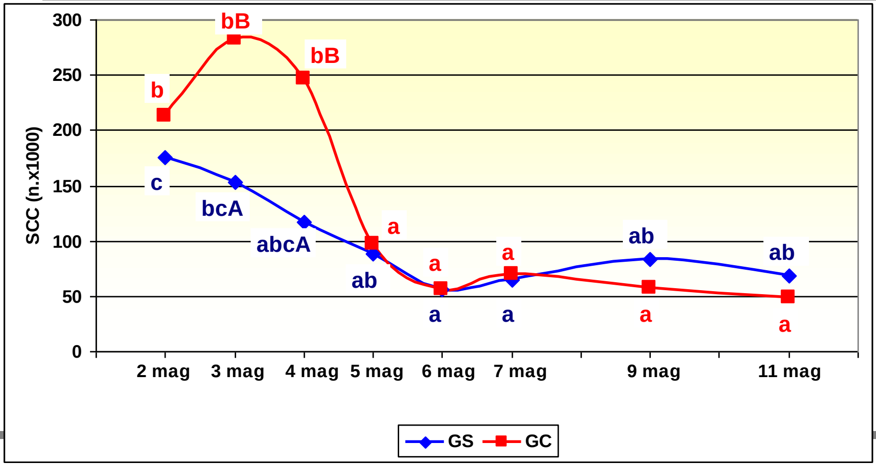
Sevi et al., 2002 – J. Anim. Sci. 80:2349–2361

5. Milking management: primiparous ewes

primiparous dairy ewes that started to enter the milking parlour 1 week before the weaning of lambs showed a significantly lower milk SCC on the first 3 days than untrained ewes.

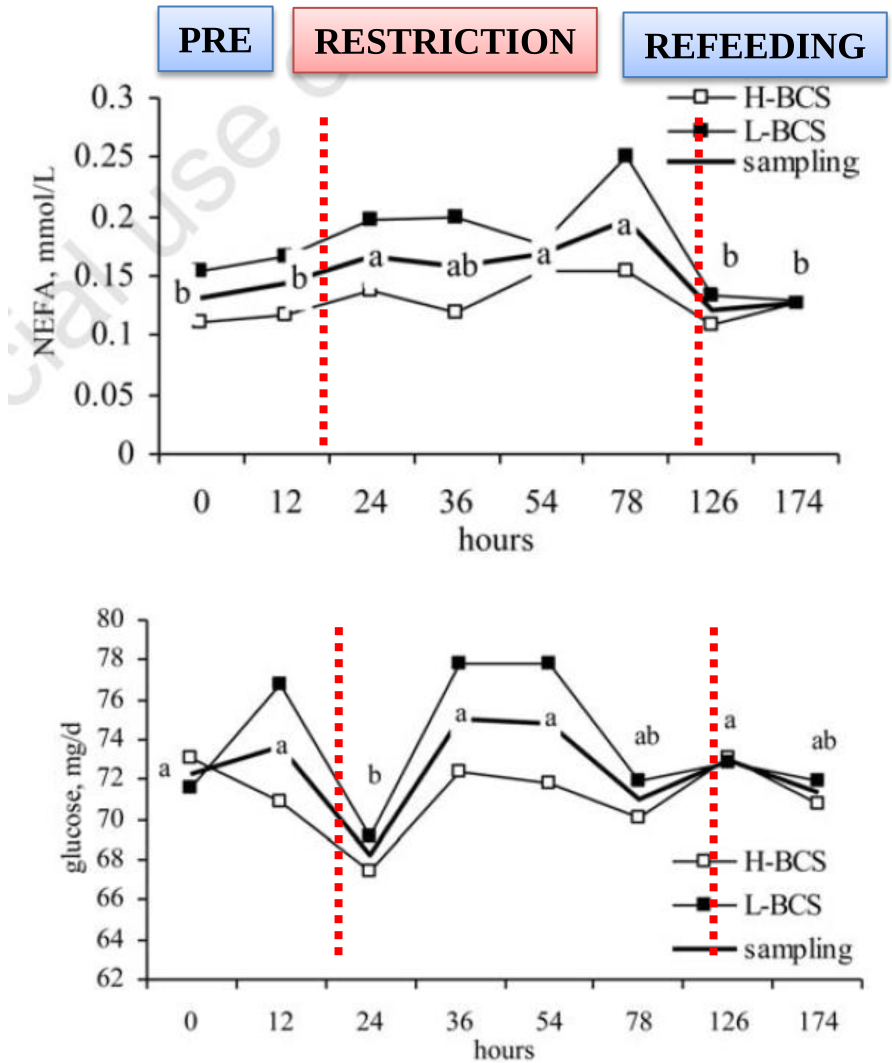






a week of training in the machine parlour was not long enough to allow a reduction of the stress caused by machine milking and weaning in primiparous ewes.

6.1. Undernutrition (short-term)



- Short-term feed restriction increased significantly the NEFA and glucose in plasma

4. Housing: ventilation

High ventilation increase milk yield and CAS and decrease the NH_3 and CO_2 in the air compared to low ventilation (*$P < 0.05$*)

ventilation	Low	Medium	High
FCM yield, g/d	807 b	831 ab	891 a
Casein, %	4.6 b	4.8 a	4.8 a
NH_3, ppm	25.7 a	25.5 a	19.0 b
CO_2, ppm	1500 a	1422 a	825 b

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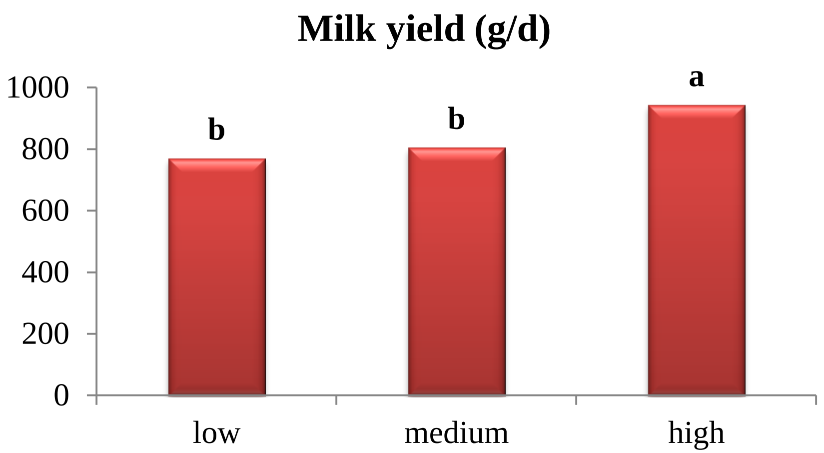
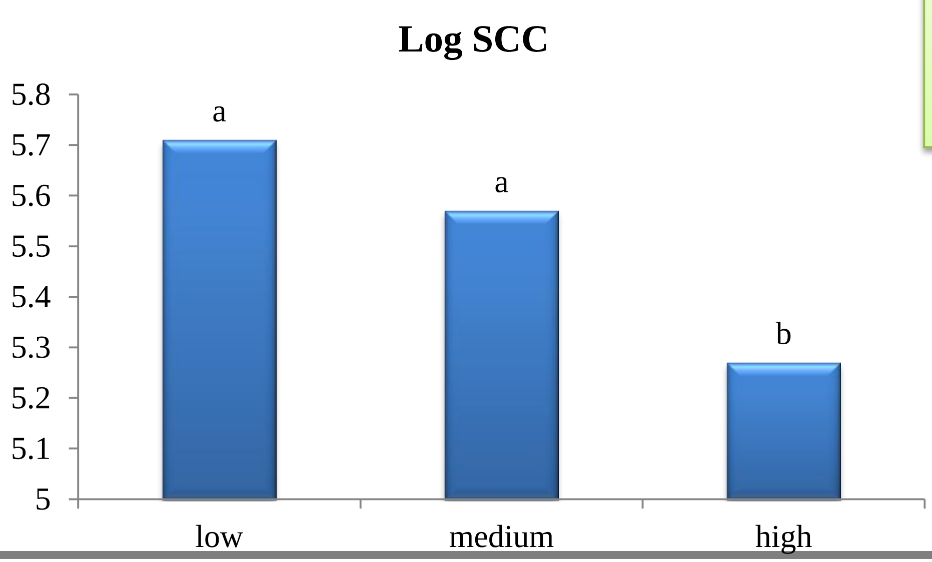
Sevi et al., 2002 – J. Anim. Sci. 80:2349–2361

4. Housing: air space allowance





Higher milk yield and lower SCC as airspace/animal went from low (4.1 m^3) to medium (5.6 m^3) or high (7.3 m^3) values

Sevi et al., 2001 - J. Dairy Sci. 84:2632–2640

Blood or milk urea and reproduction in sheep

Blood urea and embrio vitality in meat sheep (Bishonga et al, 1994)

Blood urea (mg/dl)	8-19	23-39	34-50
Ovultation rate (eggs/ewe)	4.1	2.9	2.4
Vitality of embrios at the extraction	0.80	0.66	0.25
Vitality of embrios a 72 h	0.70	0.66	0.00
Fertility	0.75	0.71	0.33

Milk urea and reproduction efficientcy at the artifical insemination (Molle et al. (1998)

Milk urea, mg/dl	< 30	30-45	> 45
Fertility at first insemination	58 %	51 %	46 %
Fertility at first insem. + 1st subsequent heat	78 %	82 %	71 %
Prolificacy at first insem. + 1st subsequent heat	1,36	1,42	1,52

1. Negative Handling

Relationships between human-animal interactions and productivity of commercial **dairy cows.**

Variable	Stress and productivity variables					
	CORTISOL	YIELD	PROTEIN	FAT	SCC	CONCEPTION[b]
Stockperson behavior						
POS	0.08	–0.25*	–0.28*	–0.25*	–0.22	0.37**
NEG1	0.35**	–0.36**	–0.34**	–0.33**	0.10	–0.17
NEG2	0.14	–0.14	–0.16	–0.16	0.25*	–0.31*
NEG12	0.34**	–0.36**	–0.35**	–0.33**	0.16	–0.25
INTERACT	0.20	–0.41**	–0.42**	–0.39**	–0.02	0.06
NEG12%	0.26*	0.10	0.13	0.07	0.26*	–0.37**
NEG2%	0.01	0.08	0.07	0.05	0.18	–0.34*
Cow behavior						
%IN1	–0.35**	–0.14	–0.13	–0.14	0.04	0.26
%IN3	–0.38**	–0.03	0.00	–0.01	0.20	0.38**
TIMETO1	0.25*	0.05	0.04	0.06	0.02	–0.35*
FDa[c]	0.13	–0.27	–0.25	–0.18	0.17	–0.20
FDp	0.05	–0.11	–0.12	–0.11	0.07	–0.09

Hemsworth et al., 2000 J Anim Sci. 78(11):2821-31.

Welfare and productivity of dairy sheep

Positive handling of animal, good farming practices and balanced diets, reducing the emotional or physical stress of dairy animals, help to increase the productivity and to maintain the health status of animals

- **ENVIRONMENTAL CONDITIONS**
  - group size, animal densities and the human-animal interactions (calm and nervous temperament)
  - extreme temperatures (heat and cold stress)
- **MANAGMENT PRACTICES**
  - Housing
  - Milking
- **NUTRITION**
  - Energy, Energy/protein balance
  - Micronutrient unbalance (mineral and vitamin)
  - Protein excess and shortage

Heat stress: exposition to solar radiation

In hot environment conditions the **protection or exposition to solar radiation** in the morning (PROM, EXPM) or in the afternoon (PROA, EXPA) affect milk yield and composition of dairy ewes

	morning		afternoon	
Item	PROM	EXPM	PROA	EXPA
Milk yield, g/d	784.1	706.3	767.4	765.7
6.5% FCM, g/d	792.1	711.7	791.2	787.9
Protein yield, g/d	51.0	46.7	50.0	51.2
Casein yield, g/d	38.4[a]	34.8[b]	38.9[a]	39.2[a]
Fat yield, g/d	51.8[a]	46.4[b]	52.3[a]	52.1[a]
Lactose yield, g/d	37.2	32.8	35.8	36.3
Protein content, %	6.50	6.62	6.51	6.69
Casein content, %	4.90	4.93	5.07	5.12
Fat content, %	6.61	6.58	6.82	6.80
Lactose content, %	4.75	4.64	4.67	4.74
SCC, $\times 10^3$	538	669	545	617
PMNLC, $\times 10^3$	92[b]	166[a]	101[b]	133[ab]

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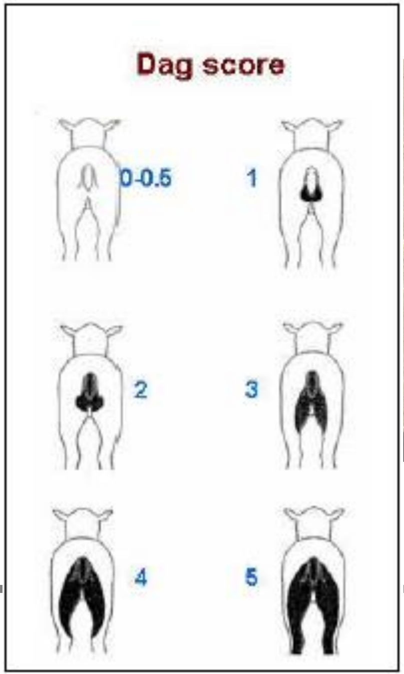
Sevi et al. 2001 - Journal of Dairy Science Vol. 84, No. 3

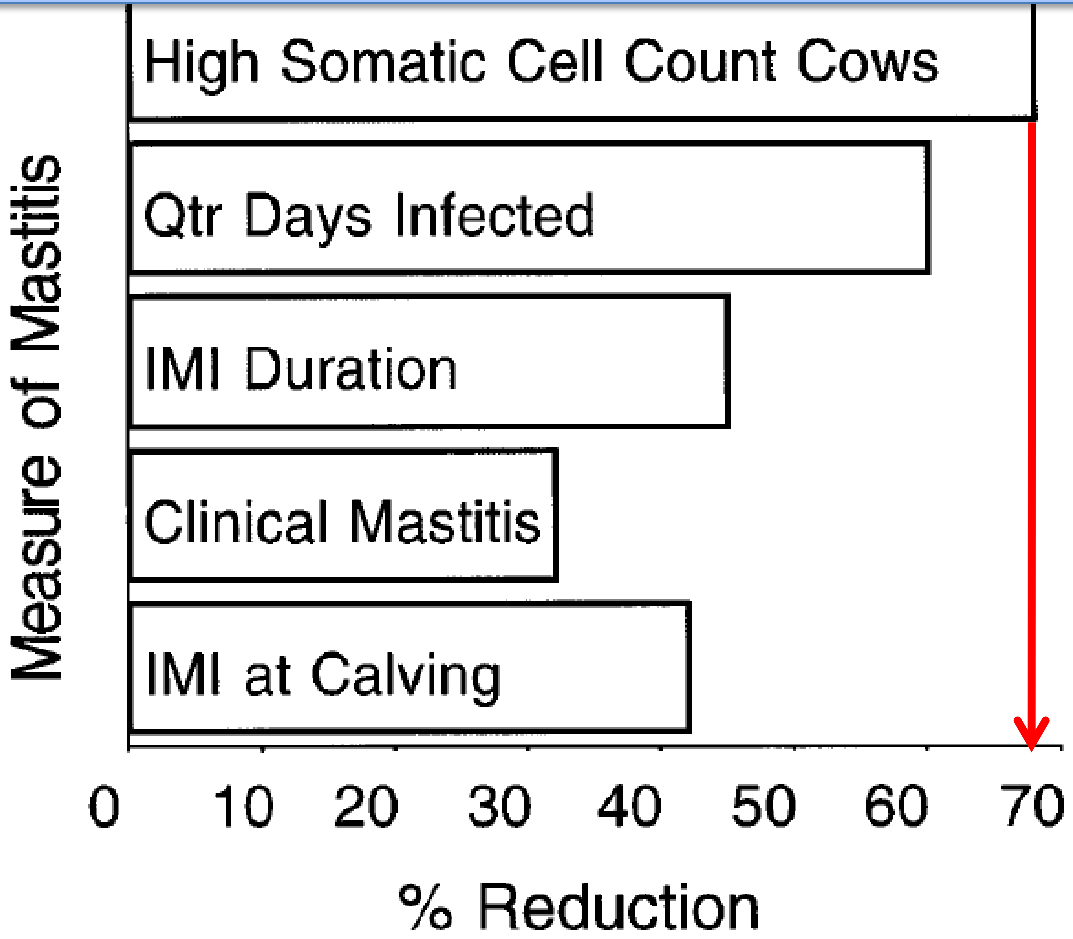
Excess of dietary PROTEIN in grazing dairy ewes

- Optimal values of milk urea?
- Fecal and dag score?
- Welfare and health effects?
- Interaction with gastrointestinal parasites?



6. 3. Micronutrient: Se and Vitamin E

The reduction in mastitis variables following dietary supplementation of Se (0.3 ppm) and vit. E (1,00 IU) in first-lactation dairy cows



Smith et al., 1997 – J Anim Sci, 75: 1659-1665.

6. Se and Vitamin E in dairy sheep

SCC and differential cell counts in milk of Comisana ewes administered with 3 subcutaneous injections of vitamin E (5 mg/kg BW) and Selenium (0.1 mg/kg BW) from 3 days before parturition

	control	Vit E + Se	P
Milk, g/d	1078	1174	ns
SCC (x1000/ml)	190	88	**
LogCCS	11.4	11.0	**
Linear score	2.83	2.28	**
Lymphocyte (%)	7.93	10.33	**
Macrophages (%)	48.9	63.1	**
PMNL (%)	40.1	22.8	**
Epithelial cells (%)	1.49	1.93	*

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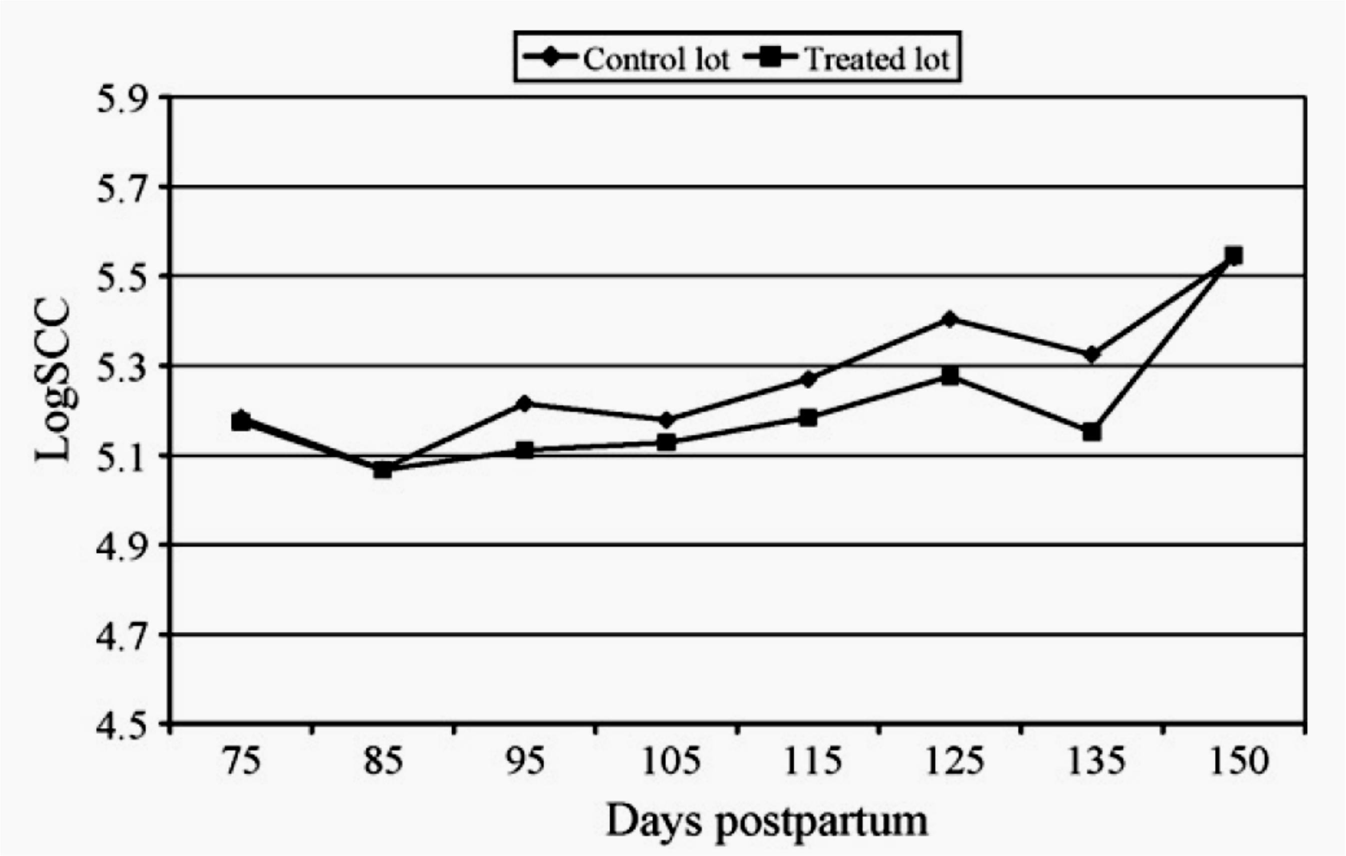
Morgante et al., 1995 - Proc. 30th Int. Symp. SIPZOO, Milano.

6. Beta-carotene in dairy sheep



No significant effect

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Raynal-Ljutovac et al. / Small Ruminant Research 68 (2007) 126–144

Over-nutrition: protein excess

Sometimes lactating ewes can experience energy and nutrient intake exceeding their needs, especially with respect to dietary protein level.

Excessive nitrogen intake can have a deleterious impact on animal welfare, due to an overloading of renal draining activity, and to high levels of ammonia release in sheep houses and urea in milk.

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