SUBTERRANEAN CLOVER AS FEED FOR FRIESIAN CALF: EFFECTS ON MEAT CARACTERISTICS AND ON LIPID OXIDATION

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Background

Subterranean clover (**SC**) is well known for its detrimental effects on reproduction; otherwise there are only few studies on anabolizing effects of the phytoestrogens (**PE**) which are present in SC. Many forages and legumes contain compounds showing estrogenic activity similar to that of the sexual hormones of animal origin. The most important estrogenic compounds present in the subterranean clover (**SC**) are the isoflavones genistein, biochanin and formononetin and they can reach up to 5% of dry weight. Many researchers described reproductive abnormalities in ewes associated with high levels of plant estrogens in subterranean clover pastures (Adams, 1995); they also stated that formononetin and its highly estrogenic metabolite equol were the major responsible for detrimental effects on reproductive function in sheep, whereas genistein and biochanin could play a positive role as growth promoters (Trenkle and Borroughs, 1978). In previous works a positive effect of SC extracts on the growth of mice and rabbits was detected. A further study carried out on ewes grazing **SC** showed an increased growth rate and no reproductive abnormalities (Pace *et al.*, 1994, Pace and Settineri, 1996; Pace *et al.*, 2000, a).

Objectives

The aim of this research was to compare the effects of two diets, respectively based on fresh **SC,** rich in phytoestrogens, and maize silage (control) on carcass and meat characteristics of entire and castrated Friesian calves.

Methods

16 Frisian calves, 8 of which were castrated, (average initial live weight =268kg) were divided into 4 groups and fed, for 2 months, on the following isoproteic diets: **A** (4 entire calves) and **B** (4 castrated) received, on dry matter (DM), 4.8kg of fresh **SC** + 3.5kg of maize grain and 0.9kg of concentrate; **C** (4 entire) and **D** (4 castrated) received 5.0kg of maize silage (**MS**) + 2.6kg of maize grain and 1.3kg of concentrate. **PE** average content of **SC** was of 0.92% on DM. All the animals were slaughtered at about 13 months and carcasses were chilled at 4 °C for 8 days. Conformation and fatness were measured using the classification system SEUROP with a scale of 15 points. At dissection, or after storage times of 4 and 8 days at +4 °C and 30, 90 and 180 days at -20°C, the following parameters were determined in samples of *Longissimus dorsi*, LD, muscle: ultimate pH, water losses in raw (by dripping) and cooked meat (in bath at 75°C for 50min.); colour, with C illuminant (lightness (L), chroma (C) and hue (H)) using Macbet 1400 colorimeter apparatus and finally hardness in cooked meat (kg/cm^2, Warner Bratzler Shear accessory, Instron 1011). Samples of about 40 g of the muscle were stored, with the same modalities, to determine lipid oxidation as 2-thiobarbituric reactive substances (TBArs); results were expressed as mg of malonaldehyde/kg of fresh meat (Raharjo and Sofos, 1993). Data were analysed with the following model with interactions: $y= \mu+A_i + B_j + T_k + (AB)_{ij} + (BT)_{jk} + (AT)_{ik} + \varepsilon_{ijk}$ where A_i = diets(1, 2); B_j =sex (1,.2); T_k = storage times(1, ...6).

Results and discussion

During the trial the animals were weighted twice a month, the **SC** administration lasted 67 days; **SC** positively influenced the total body gain of group **A,** while did not have any significant effect on castrated calves (**B**), therefore a strong increase of **B** average daily gain was recorded after about one month immediately followed by a consistent drop of growth, whereas groups **C** and **D** showed more regular growing curves (Pace *et al.*, 2000, b).

Slaughtering ages and weights were slightly higher in group **D** (Table 1), this result seems related more to the content of stomachs and rumen (SCW) and to the carcass conformation and fatness (CC and CF) that to carcass weights and dressing percentages; CF points resulted significantly lower on entire and castrated calves of groups **A** and **B**, indicating, as already noticed during feeding trial, that **SC** administration had some influence on carcass parameters.

The differences in cooked meat hardness (Table 2 and 3) were due essentially to group **D,** which resulted significantly more tough in respect to the other three groups (*vs* **A**: +20%, **B**: +26%, **C**: +32%); the higher value of hardness was influenced both by food and physical condition. Water loss values on raw and cooked meat did not show noticeable differences among groups, but higher values were, of course, recorded in increasing storage times because freezing and thawing generally cause a substantial increase in drip losses (Lawrie, 1988), moreover, at 90 and 180d the **SC** groups showed less water holding capacity in respect to **MS** animals (8.98 *vs* 4.33 and 7.92 *vs* 3.44; $P \leq 0.05$). No differences were recorded on pH values which ranged from 5.57 to 5.61.

Colour indexes resulted, in some way, inversely related to TBArs values and to storage times (Table 2-3): samples showed significant lower values of L, C and H indexes as TBArs numbers increase. In fact the lipid oxidation processes are strictly connected with colour stability of raw meat (Kanner et al., 1992). The results indicate, also, significant differences in TBArs values due mainly to group **A** but also to length of freezing or frozen storage periods (Table 2-3). Lower values of TBArs numbers were calculated at dissection ($P \leq 0.05$) if compared with the other differently stored samples; similar values were recorded when the meat was maintained at -20°C: oxidation ranged within completely acceptable limits but slightly high if compared to that of fresh meat.

Conclusion

Differences, due to the diets, were noticed essentially on both lower SCW and higher CF of **MS** groups. **SC** supply seems to produce una carcassa più magra.

Pertinent literature

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Table 1. Effects of sex and diets on: slaughtering age (SA, days) and live weight (SLW, kg), carcass (CW, kg) and stomach content weights (SCW, kg), dressing percentage (DP, %), carcass conformation and fatness (CC, CF, SEUROP).

GROUPS	S A	S L W	C W	S C W	D P	C C	C F
A	376.3	360.5	194.13 (ab)	47.98 a (a)	53.88	7.42 ab	3.27 C c
B	369.0	345.0	186.75 (b)	47.93 a (a)	54.31	6.63 b	4.20 BC b
C	379.8	356.0	194.12 (ab)	43.55 b (b)	54.48	7.81 a	5.60 A a
D	405.3	387.3	221.38 (a)	35.93 b (c)	56.98	7.88 a	5.15 AB a
Means	382.6	362.2	199.09	43.84	54.91	7.43	4.64
RMSE	38.702	42.745	25.899	6.038	2.561	0.680	0517

RMSE: Root Mean Square Error. In columns: A, B, C significant differences for P≤ 0.01; a, b for P≤ 0.05; (a), (b), (c) for P≤ 0.10.

Table 2. Effects of sex, diets and different storage times (after dissection) on physical quality parameters and on TBArs values of *longissimus dorsi* meat.

	Cooked Hardness	COLOUR L	COLOUR C	COLOUR H	Raw Water Losses	Cooked Water Losses	TBArs
Groups							
A, C	5.44 b	43.64 (a)	16.19 (b)	12.20 a	5.05	28.57	0.210 (a)
B, D	6.39 a	42.05 (b)	16.90 (a)	13.49 b	4.92	28.34	0.174 (b)
Diets							
SC	5.66 b	42.90	15.70 b	13.64 (b)	5.25	28.58	0.217 a
MS	6.18 a	42.79	17.40 a	14.07 (a)	4.71	28.33	0.167 b
Times (d)							
0 (+4°C)	6.10 a	43.24 a	20.19 b	14.73 a	1.64 d	27.80	0.097 c
4	5.81 ab	43.60 a	17.36 b	13.80 bc	3.77 c	28.67	0.264 a
8	5.41 b	43.87 a	18.30 b	14.29 ab	4.73 bc	29.69	0.259 a
30 (-20°C)	5.97 a	40.39 b	16.02 c	14.08 ab	7.40 a	28.99	0.212 ab
90	5.79 ab	42.98 ab	14.25 d	13.29 cd	6.65 ab	28.73	0.169 bc
180	6.44 a	42.99 ab	13.18 d	12.95 d	5.68 ab	27.83	0.152 bc
Means	5.92	42.84	16.55	13.85	5.20	28.48	0.192
RMSE	1.084	4.216	2.073	1.224	3.222	2.866	0.1107

RMSE: Root Mean Square Error. In columns, a, b: significant differences for P≤ 0.05; (a), (b), (c): for P≤ 0.10.

Table 3. Significant interactions of sex and diets on some physical parameters and on TBArs values.

	C. Hardness			Cooked W. L.			TBArs		
SC	**A, C**	**B, D**	On raws	**A, C**	**B, D**	On raws	**A, C**	**B, D**	On raws
MS	5.86	5.45	NS	29.55	28.58	*	0.254	0.182	**
On columns	5.02	7.33	***	27.60	29.08	NS	0.167	0.166	NS
	**	***		*	NS		**	NS	
	L			C			H		
SC	42.48	42.95	NS	14.95	16.46	*	13.58	14.84	***
MS	44.44	41.44	**	17.44	17.35	NS	13.69	13.30	NS
On columns	NS	***		***	NS		NS	***	

NS: non significant; *: significant differences for P≤ 0.10; **: for P≤ 0.05; ***: for P≤ 0.01.