Effect of the dam's feeding regimen on the meat quality of light suckling lambs

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ABSTRACT: In order to verify the effect of the introduction of concentrates without GMO risk and at low aflatoxin risk in the diet of grazing milk ewes on the quanti-qualitative production of meat of their milk-fed light lambs, two trials were carried out - in Sicily, on 32 Comisana lambs, slaughtered at 49±4 days (trial 1); and in Sardinia, on 28 Sarda lambs, slaughtered at 31±4 days(trial 2) - comparing the following grazing dams' feeding regimes: High stocking rate + Organic (barley – tickbean or pea) Concentrate (HO); High stocking rate + Conventional (maize-soybean) Concentrate (HC); Low stocking rate + Organic Concentrate (LO); Low stocking rate + Conventional Concentrate (LC). Lamb performances, carcass quality, meat colour and lipid content were not modified by dam's feeding regimen. However, significant differences were observed in the fatty acid (FA) composition of the intramuscular fat of the older suckling lambs of trial 1. The main variation concerned n-3 polyunsaturated FAs and conjugated linoleic acids.

Key words: Organic production, Feeding, Meat quality, Suckling lamb.

INTRODUCTION – In sheep rearing, grazing is generally the principal feed source in both organic and conventional production systems. Pasture management does not basically vary with the introduction of organic methods, whereas pasture supplementation does. Despite the low supplementation levels usually implemented in organic farms, the on-farm production of concentrates is often insufficient with consequent purchase of off farm organic concentrates. These may contain soybean, with a GMO risk, and maize, at risk for aflatoxin contamination. There is then scope to identify dietary supplements based on alternative safe feed sources. Typical Mediterranean legume grain crops can be used as a substitute for soybean, such as tickbean, proteic pea, lupin and chickpea, which are very flexible to use and easy to grow in the different agronomic situations. Maize is easily substituted in sheep diets by winter cereal crops and, given that the former represents the major source of aflatoxins, it is worth proposing diets that can avoid this risk.

The aim of the experiment was to verify the effect of the introduction of concentrates without GMO risk and at low aflatoxin risk in the diet of suckling ewes on the quanti-qualitative production of lamb meat. In particular the performances were compared of light lambs suckled by dams grazing at two stocking rate levels (low and high) and supplemented with either a concentrate with high risk of GMO and aflatoxins or a concentrate with nil or low GMO and aflatoxin risk.

MATERIAL AND METHODS – Two trials were carried out - one in Sicily (trial 1) at the Pietranera farm of Palermo University, the other in Sardinia (trial 2) at the Bonassai farm of the IZCS - comparing the following treatments, according to a two-way factorial design (stocking rate and concentrate type) with randomised blocks: High stocking rate + Organic Concentrate (HO); High stocking rate + Conventional Concentrate (HC); Low stocking rate + Organic Concentrate (LO); Low stocking rate + Conventional Concentrate (LC).

The lactating ewes, Comisana breed in Sicily and Sarda breed in Sardinia, grazed throughout the winter on pastures of Italian reygrass (*Lolium multiflorum*) and clover (*Trifolium alexandrinum,* berseem clover in trial 1 and *T. resupinatum,* Persian clover in trial 2). Half of each flock was assigned to plots with High (38 ewe/ha in trial 1 and 9 ewe/ha in trial 2) or Low stocking rate (23 ewe/ha in trial 1 and 6 ewe/ha in trial 2). Half of the groups with high and low stocking rate in each block were then assigned to the diets of conventional and organic concentrate, respectively. The concentrates were composed of the following roughly-ground (trial 1) or intact (trial 2) feed mixtures: Conventional Concentrate - maize and soybean meal in the ratio 80-20% in weight; Organic Concentrate - barley and tickbean in the ratio 80-20% (trial 1) and barley and pea in the ratio 68-32% (trial 2). During the suckling period the ewes were offered the concentrates in iso-energetic and iso-proteic quantities, i.e. between 500 and 600 g/head day.
The experiment involved 32 lambs of Comisana breed, slaughtered at the age of 49±4 days (trial 1) and 28 lambs of Sarda breed, slaughtered at 31±4 days-old (trial 2), with equivalent numbers of both sexes and coming from the four maternal dietary groups. Each lamb was weighed at birth and then weekly until slaughtering. At the end of suckling period, the lambs were transported to a slaughterhouse, where they were individually identified and weighed immediately prior to slaughtering. The carcasses were maintained at ambient temperature (>10 °C) for 6 hours before being chilled to 2 °C for 24 hours, when they were again weighed (carcass weight, including head and offals) and classified according to the EEC evaluation grid (Reg. EEC n° 2137/92, and n° 461/93). On the *longissimus dorsi* muscle were measured the pH with a Crison 52-32 electrode, and the colour of the cut section between the last thoracic and first lumbar vertebra, after one-hour blooming, with a Minolta CM-2600d spectrophotometer (system L*, a*, b*). Samples of *l. dorsi* muscle were then removed, vacuum-packed and frozen at -20 °C for analyses of total lipids and determination of the fatty acid composition of the intramuscular fat. The extraction of total lipids was performed according to Folch *et al*. (1957) and the fatty acids methyl esters were prepared using HCl metanolic (Pritam *et al*., 1988). Methyl esters analysis was performed on a gas chromatography equipped with mass spectrometric detector (Varian system, Saturn 2100T) and a SP-2380 capillary column (Supelco, Bellafonte, PA, USA). Peak identification was performed by comparison of the retention time and mass spectrum with respective standard and with mass spectral library (NIST-2000), and quantified using C19:0 as internal standard.
The daily weight gain was individually estimate by regressing the weekly body weight measurements on animal age. Data of each experiment were independently submitted to a two-way analysis of variance. The class of carcass quality was analysed by chi-square test.

Table 1. Body and carcass weight and quality, meat pH, colour and composition.

		Comisana breed Dam's feeding regime				SE(1)	Sarda breed Dam's feeding regime				SE(1)
		HO	HC	LO	LC		HO	HC	LO	LC	
Daily weight gain	g/d	236	213	209	220	33.0	223	204	196	218	35.5
Slaughter weight	kg	15.6	14.8	14.4	15.0	2.66	10.5	10.3	10.0	10.3	2.07
Carcass: weight	"	10.09	9.54	9.16	9.73	1.83	6.40	6.21	6.09	6.58	1.44
Yield	%	64.5	64.3	63.4	64.9	1.65	60.8	60.5	60.5	61.9	2.44
Fatness 1–4 point scale		2.6	2.3	2.2	2.2	0.62	2.1	2.4	1.7	2.0	0.71
1st quality freq.	%	100.0	87.5	62.5	75.0		85.7	100.0	57.1	85.7	
Longissimus dorsi:	pHu	5.67	5.85	5.77	5.67	0.247	5.45	5.49	5.47	5.40	0.051
Lightness, L*		39.7	40.6	39.8	39.6	2.21	41.4	43.4	42.7	40.8	2.45
Chroma, C*		12.5	12.3	11.5	12.1	1.45	11.6	11.9	11.8	11.6	0.748
Hue angle, h*		72.5	74.7	79.3	71.5	5.63	84.0	88.7	84.9	82.3	7.88
Total lipids	g/100g	2.10	2.23	2.18	2.10	0.334	2.12	2.16	1.62	1.90	0.396

RESULTS AND CONCLUSIONS – Lamb performances, carcass and meat quality data are reported in table 1. In both experiments, dam's feeding regime did not significantly influence these parameters. Thus, feeding suckling ewes on pasture supplements at low risk of GMO and aflatoxins, in comparison with conventional maize/soybean ones, at both high or low stocking rates, did not diminished the meat production of their light lambs.

Fatty acid (FA) composition of the intramuscular fat of suckling lambs is reported in table 2. The percentage of the main FA categories (SFA, MUFA and PUFA) did not change within trials. However, interesting and significant variations were observed in the long chain PUFA profile of the older lambs of trial 1, mainly linked to stocking rate. The variation concerned n-3 polyunsaturated FAs and conjugated linoleic acids (CLAs), the former being higher and the latter lower in meat from lambs suckling the ewes grazing at higher stocking rate. The acidic pattern of the younger lamb of trial 2 showed only slight tendencies to change in relation to dams' feeding regimen.

Table 2. Fatty acid composition of longissimus dorsi muscle (g/100 g identified FA methyl esters).

Fatty acid	Comisana breed Dam's feeding regime				SE(1)	Sarda breed Dam's feeding regime				SE(1)
	HO	HC	LO	LC		HO	HC	LO	LC	
SFA	37.4	39.8	39.9	38.3	2.99	37.1	34.1	34.3	35.3	3.11
MUFA	36.9	33.7	36.0	36.1	2.96	35.4	39.2	36.4	35.5	3.14
PUFA	25.7	26.5	24.1	25.6	3.90	27.5	26.7	29.3	29.2	3.07
PUFA n 6	17.0	17.1	16.8	16.8	2.33	17.7	18.0	18.9	18.6	1.86
PUFA n 3	6.41	6.91	5.44	6.65	1.17S	7.40	6.61	7.89	7.73	1.14s
n6/n3	2.69	2.51	3.13	2.54	0.31S,C	2.45	2.74	2.41	2.42	0.28
C18:3w3	2.62	2.57	2.62	2.61	0.38	2.85	2.49	2.88	2.65	0.44c
C20:3w3	0.41	0.43	0.36	0.36	0.08S	0.42	0.39	0.39	0.45	0.08
C20:5w3	1.79	2.01	1.42	1.88	0.58	2.00	1.73	2.08	2.24	0.46
C22:6w3	1.58	1.90	1.04	1.79	0.43S,C	2.13	2.01	2.53	2.38	0.62
C18:1w9 trans	4.31	3.29	3.29	4.32	0.87	2.62	3.32	4.42	3.34	1.24s
CLA 9,11	1.39	1.51	1.98	1.71	0.39S	1.92	1.98	1.87	1.75	0.34

(1): within breed, S or C= stocking rate or concentrate type main effect significance P≤0.05;
s or c = stocking rate or concentrate type main effect significance P<0.10.

CLAs are the result of ruminal biohydrogenation of linoleic and linolenic acid, thus the variation of their proportion in meat lipids of suckling animals likely depended on the composition of the milk they consumed, mainly due to diverse herbage intake of ewes grazing in different stocking conditions (Raes *et al*., 2004).

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