EFFECTS OF LAMB FEEDING WITH A DE-STONED OLIVE POMACE ON SOME MEAT QUALITY TRAITS.

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Background

The utilization of agricultural by-products as nutrient sources for animal feeding may provide many benefits under the economic and environmental standpoint. Among these by-products, in Mediterranean areas olive cakes have been widely tested for lamb production (Accardi et al., 1979; Leto, 1984; Belibasakis, 1985; Dattilo et al., 1995; Omar et al., 1995; Liotta et al., 2001; Zumbo et al., 2001). However, despite its great availability especially in Apulia that is an Italian leader in the olive oil industry, its use has been limited because of its controversial nutritive value due to the high lignin content (Molina Alcaide and Nefzaoui, 1996; Hadjipanayiotou, 1999). In this trial we evaluated the use of a new type of by-product, i.e. an olive pomace made of virgin olive pulp produced by the stone removal from olives (Amirante et al., 2002). The extra virgin oil contained in the olive pulp exerts a high antioxidant activity due to the presence of poliphenolic compounds, tocopherols and squalene (Conte et al., 2002). Olive pomace also presents the advantage of containing less NDF in comparison to the traditional olive cake obtained from pressing along with a lower percentage of ADL (26% on the D.M. basis), since stone removal is carried out after drupe crushing; therefore, stone crumbs are totally absent in the olive pomace. Furthermore, this olive pomace contains a good amount of lipid, among which particular importance is held by the monounsaturated and unsaturated fatty acids which, if transferred to meat, may improve its dietetic properties. Recently, many studies have rediscovered the beneficial role played by MUFA since, besides exerting an hypocholesterolemic effect, these fatty acids do not negatively affect meat lipid stability as PUFAs do (Secchiari et al., 2002).

Objectives

The aim of this study was to evaluate meat colour features, tenderness and the chemical and fatty acid composition in lambs fed on a concentrate pelleted diet containing 20% of olive pomace.

Methods

The experiment was carried out during May-July 2002 at the University farm located in Bari (Apulia, Southern Italy, 41 °N). Sixteen male Comisana lambs, weaned at about 50 days of age, were divided into two homogeneous groups of 8 subjects each and fed *ad libitum* for 6 weeks on either a concentrate pelleted diet (control group) or on a diet containing 20% olive pomace. Diets were planned in order to contain approximately the same amount on dry matter of protein (16.5%), fat (5.0%) and crude fiber (10.5%). The productive performances, slaughtering and sectioning data of these lambs have been described elsewhere (Ragni et al., 2003). Lambs were slaughtered after fasting for 12 hours. Following 24 hours of refrigeration at 4 °C, the carcasses were split into two halves and from the right one the *Longissimus lumborum* (LL) muscle and the *Semimembranosus* (SM) muscle were isolated. From each animal, the LL samples were cut into two halves, one of which was used to perform chemical analysis (ASPA, 1996) and the fatty acid profile, while the other was submitted to meat colour and tenderness assessments. Lipids were extracted according to the 2:1 chloroform-methanol method described by Folch et al. (1957), whereas the acidic profile was assessed using a Chromopack CP 9000 gas chromatograph. On both LL and SM muscle samples, meat colour was estimated by the Hunter Lab system using a colourmeter (illuminant D 65), which measures the values of Lightness (L), Redness (a) and Yellowness (b) by making 5 readings for each sample consisting of an approximately 2.5 cm thick slice of meat. Tenderness was measured using a Warner Bratzler shear device applied to an Instron 5544 and expressed as the cutting force required to shear perpendicularly to the direction of the fibres one half inch diameter cylinders of raw meat, taking three measurements for each muscle for each animal. Peak force was expressed as kg/cm^2, while peak elongation as cm (ASPA, 1996). The indexes of atherogenicity and thrombogenicity were calculated accordingly to Ulbricht and Southgate (1991). The PCL/PCE (plasma cholesterol lowering/plasma cholesterol elevating) ratio was also determined (Reiser and Shorland, 1990). Data were analysed for variance using the GLM procedure (SAS, 1991).

Results and Discussions

Due to health problems which were not correlated to the feeding treatment, one subject of the control group was excluded from statistical analysis. As for the chemical composition of *Longissimus lumborum* meat samples, no significant differences aroused between treatments, although the olive pomace diet slightly increased the protein content of meat (19.25 *vs* 18.70) and lowered fat (3.50 *vs* 3.93; Table 1). Meat yielded by lambs fed on the olive pomace diet globally showed better dietetic properties compared to the control group as evidenced by a markedly higher amount of monounsaturated and unsaturated fatty acids ($P<0.05$; Table 2), along with a lower incidence of saturated ones ($P<0.05$). As a consequence, a lower index of thrombogenicity in meat was obtained from the olive pomace group ($P<0.05$). With regards to the PUFA content of meat, no significant differences emerged between the two treatments, neither for the ω6 nor the ω3 fractions. However, feeding with the olive pomace diet improved the ω6/ω3 ratio lowering it to 5.87, that is closer to recommended value of 4 (Enser et al., 1996). It has been well documented that a high content of unsaturated fatty acids in meat may lead to lipid oxidation with effects on colour, texture, flavour and the nutritive value of meat (Ponnampalam et al., 2001). As a matter of fact, previous reports have associated antioxidants such as vitamin E to diets integrated with olive cakes in order to prevent meat lipid oxidation (Lanza et al., 2000a; Lanza et al., 2000b; Zumbo et al., 2001). In this trial we found that the olive pomace diet did not worsen meat colour. In particular, in the LL muscle the yellowness index (b) was significantly lower following feeding with the olive pomace diet ($P<0.05$; Table 3). The results concerning meat texture showed that the olive pomace diet markedly lowered peak elongation both for the LL as well as for the SM muscles ($P<0.05$; Table 4), thus improving meat tenderness on the whole.

Conclusions

The integration of a de-stoned olive virgin pulp at 20% in the diet of growing lambs may be an interesting feeding strategy since it improved the dietetic properties of meat by an increase of the total amount of monounsaturated and unsaturated fatty acids along with an improvement of the thrombogenicity index. Moreover, also some physical characteristics such as meat colour and tenderness were also improved.

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Table 2 - Fatty acid composition of Longissimus lumborum (%).

	Control	Olive pomace	SED
Samples (n.)	7	8	(DF= 13)
$C_{6:0}$	0.37	0.30	0.265
$C_{8:0}$	0.10	0.09	0.120
$C_{10:0}$	0.54	0.46	0.206
$C_{12:0}$	0.64	0.62	0.237
$C_{14:0}$	5.64	5.55	1.435
$C_{14:1}$	0.16	0.19	0.059
$C_{15:0}$	0.54	0.64	0.140
$C_{15:1}$	0.16	0.19	0.119
$C_{16r:0}$	0.10	0.07	0.102
$C_{16:0}$	24.34	24.17	2.064
$C_{16:1}$	1.97	2.89	0.942
$C_{17:0}$	1.17	1.22	0.186
$C_{17:1}$	0.43B	0.74A	0.160
$C_{18:0}$	15.03a	11.94b	2.374
$C_{18:1\ \omega\text{-}9trans}$	7.57	9.35	2.606
$C_{18:1\ \omega\text{-}9cis}$	30.36	29.73	2.585
$C_{18:1\ \omega\text{-}7}$	1.20b	1.62a	0.392
$C_{18:2\ \omega\text{-}6cis}$	6.24	5.76	1.364
$C_{18:3\ \omega\text{-}6}$	0.11	0.19	0.110
$C_{18:3\ \omega\text{-}3}$	0.39	0.55	0.501
$C_{20:0}$	0.23	0.37	0.463
$C_{20:1\ \omega\text{-}9}$	0.38	0.27	0.176
$C_{18:2\ coniug\ cis}$	0.28	0.20	0.198
$C_{18:2\ coniug\ trans}$	0.07	0.12	0.099
$C_{20:2\ \omega\text{-}6}$	0.21	0.76	0.643
$C_{20:3\ \omega\text{-}6}$	0.13	0.09	0.089
$C_{20:3\ \omega\text{-}3}$	0.13	0.11	0.069
$C_{20:4\ \omega\text{-}6}$	0.14	0.12	0.084
$C_{22:0}$	0.03	0.01	0.057
$C_{20:4\ \omega\text{-}3}$	0.08	0.10	0.061
$C_{22:1\ \omega\text{-}9}$	0.71	0.65	0.625
$C_{20:5\ \omega\text{-}3}$	0.14	0.29	0.246
$C_{21:5\ \omega\text{-}6}$	0.07	0.12	0.083
$C_{24:0}$	0.11	0.11	0.129
$C_{24:1\ \omega\text{-}9}$	0.03	0.06	0.064
$C_{22:5\ \omega\text{-}6}$	0.03	0.11	0.089
$C_{22:5\ \omega\text{-}3}$	0.08	0.11	0.141
$C_{22:6\ \omega\text{-}3}$	0.04	0.07	0.074
Saturated	48.86a	45.57b	2.831
Monounsaturated	42.97b	45.70a	2.238
Polyunsaturated	8.17	8.72	1.639
Unsaturated	51.14b	54.42a	2.831
Polyunsaturated ω-6	6.87	7.04	1.296
Polyunsaturated ω-3	0.94	1.36	0.477
ω-6/ω-3 ratio	7.63	5.87	2.122
Unsaturated/Saturated	1.05b	1.20a	0.131
Atherogenicity index	0.94	0.87	0.182
Thrombogenicity index	1.62a	1.38b	0.200
Saturated/ Polyunsaturated	6.13	5.53	1.487
PCL/PCE	0.97	1.06	0.179

A, B: P<0.01; a, b: P<0.05.

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Table 1 - Chemical composition of Longissimus lumborum (%).

	Control	Olive pomace	SED
Samples (n.)	7	8	(DF= 13)
Moisture	75.63	75.37	1.065
Protein	18.70	19.25	0.776
Fat	3.93	3.50	0.942
Ash	1.31	1.32	0.212
N - free extract	0.42	0.56	0.374

Table 3 - Meat colour.

	Control	Olive pomace	SED
Samples (n.)	7	8	(DF= 13)
Longissimus lumborum			
L (Lightness)	39.70	37.95	4.338
a (Redness)	8.72	7.87	0.853
b (Yellowness)	8.51a	6.41b	1.470
Semimembranosus			
L (Lightness)	39.93	38.89	3.442
a (Redness)	8.56	8.86	0.797
b (Yellowness)	7.88	7.79	0.778

a, b: P<0.05.

Table 4 - Meat tenderness.

	Control	Olive pomace	SED
Samples (n.)	7	8	(DF= 13)
Longissimus lumborum			
Peak force (kg/cm^2)	5.18	4.44	1.905
Peak elongation (cm)	2.43a	2.13b	0.241
Semimembranosus			
Peak force (kg/cm^2)	5.38	3.93	1.630
Peak elongation (cm)	2.39a	2.09b	0.226

a, b: P<0.05.