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# Meat fatty acids profile of kid goats from Serpentina breed

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**Abstract.** The paper refers to the fatty acids (FA) profile of intramuscular fat in three muscle sites: *longissimus dorsi* (LD), leg, shoulder and the FA profile of perirenal fat (PRF). Kid goats were raised on three farms with distinct feeding management (1, 2 and 3) and slaughtered in December, at 10-12 kg live weight. From farm 3, intramuscular fat and PRF FA profile of kid goats slaughtered in April were compared to those from December. All goats grazed natural pastures and only goats and kids raised on farms 1 and 2 were supplemented. The saturated fatty acids (S) content was higher in PRF while the intramuscular fat of the different muscle samples showed a similar concentration of polyunsaturated fatty acids (P). Meat from kids raised on farm 3 and slaughtered in December was richer in conjugated linoleic acids, C18:2 cis9,trans11 (CLA) and in n-3 polyunsaturated fatty acids, with a dietetic advantage due to a lower n-6/n-3 fatty acids ratio. This result shows the advantage of a feeding system based only on pasture. Spring raised kids showed the same advantages in the FA profile: n-6/n-3 fatty acids ratio decreased from 2.25 to 1.60 and CLA increased from 0.45 to 0.66%, suggesting the higher quality of pastures during spring. A discriminant analysis using the FA profile of intramuscular fat of LD allowed the identification of the different feeding systems.

**Keywords.** Feeding system – Pasture – Kid goats – Fatty acid profile – Meat fat.

## **Profil en acides gras de la viande de chevreaux de race Serpentina**

**Résumé.** Cet article concerne le profil en acides gras (AG) du gras intramusculaire de trois muscles, *Longissimus dorsi* (LD), gigot, épaule, et le profil en AG du gras périrénal (GPR). Les chevreaux, issus de trois élevages (1, 2 et 3) en adoptant une conduite alimentaire différente, furent abattus au mois de décembre, à un poids vif de 10-12 kg. Dans l'élevage 3, nous avons comparé le profil en AG du gras intramusculaire et du GPR des chevreaux abattus en avril et celui des chevreaux abattus en décembre. Toutes les chèvres ont été élevées sur pâturage naturel et seuls les chèvres et les chevreaux des élevages 1 et 2 ont reçu de la complémentation. Le niveau d'acides gras saturés (S) était plus élevé dans le GPR tandis que le gras intramusculaire des échantillons des différents muscles a présenté une concentration semblable en acides gras polyinsaturés (P). La viande des chevreaux de l'élevage 3 abattus en décembre était plus riche en acides linoléiques conjugués, C18 :2 cis9, trans11 (CLA) et en n-3-AG polyinsaturés, avec un avantage sur le plan diététique compte tenu du rapport acides gras n-6/n-3 plus bas. Ce résultat montre qu'un système d'alimentation basé sur le pâturage est plus avantageux. Les chevreaux élevés au printemps ont présenté les mêmes avantages pour ce qui est du profil en AG : le rapport acides gras n-6/n-3 a baissé, passant de 2,25 à 1,60 et les CLA ont augmenté, passant de 0,45 à 0,66%, ce qui montre la qualité supérieure des pâturages au printemps. Une analyse discriminante utilisant le profil en AG du gras intramusculaire du LD a permis de différencier les trois systèmes d'alimentation.

**Mots-clés.** Système d'alimentation – Pâturage – Chevreaux – Profil en acides gras – Graisse intramusculaire.

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## **I – Introduction**

Kids goats from Serpentina breed are exclusively reared under extensive production systems and the meat is obtained from young unweaned animals. Since most consumers are concerned with healthy diets, their commercial valorisation should rely on strategies related to the production system, emphasizing their nutritional and sensorial characteristics, namely the ratio between n-6 and n-3 polyunsaturated fatty acids and the conjugated linoleic acid, namely

cis9,trans11-C18:2 (CLA), content in meat. Furthermore, Banskalieva *et al.* (2000) refer that goat meat is richer in polyunsaturated fatty acids (e.g., C18:2, C18:3 and C20:4) than beef and sheep meat. These authors also refer that, during the pre-ruminant stage, fatty acids profile of meat reflects that of the milk consumed while Nudda *et al.* (2005) reported a positive correlation between the CLA content in goat milk and in suckling kid *longissimus dorsi* (LD) intramuscular fat. Jambrenghi *et al.* (2007) studied the effect of goat production system on the concentration of CLA in meat obtained from suckling kids and found a higher total CLA concentration on those reared by grazing goats.

## II – Material and methods

Fat and meat samples from "Serpentina" breed kids of three farms with distinct feeding systems were evaluated for fatty acids composition. All goats grazed "natural" pastures under holm oak trees but were subjected to different planes of supplementation during lactation. In Farm 1, goats were supplemented with dehydrated alfalfa and concentrate; Farm 2 goats were supplemented only with a concentrate. Goats from Farm 3 were not supplemented. All kids stayed indoors all day and nursed in the evening when their dams returned from grazing. Kids from Farm 1 were supplemented since day 30 after birth; kids from Farm 2 were supplemented since day 15 after birth; kids from Farm 3 were not supplemented. Seven kids from each farm were slaughtered on December at 10-12 kg live weight (LW) and fatty acids (FA) profile of intramuscular fat of meat samples from *longissimus dorsi* (LD), leg (Lg) and shoulder (Sh) as well as perirenal fat (PRF) samples were determined. On April, seven kids from Farm 3 were slaughtered at the same LW, to evaluate the effect of rearing season.

Lipids from muscle and fat samples were extracted (Folch *et al.*, 1957) and fatty acid methyl esters were prepared by base catalysed transesterification as described by Christie (1994). Determination and identification was performed as described by Bessa *et al.* (2005).

Data on the 4 types of samples (LD, Lg, Sh, PRF) were studied by analysis of variance. The effect of rearing season was evaluated on farm 3 LD samples from the two slaughter dates. A stepwise-forward canonical discriminant analysis was performed considering the 3 farms and LD fatty acids profile in order to determine the variables that best discriminated the different feeding systems.

## III – Results and discussion

Fatty acids profiles (as % of total fatty acids) were compared by farm and type of sample (LD, Lg, Sh and PRF). Saturated fatty acids (C12:0+C14:0+C16:0+C18:0) (S) concentration of PRF (57.0%) was significantly higher than that determined for the meat samples, averaging 38.8% overall. The concentration of polyunsaturated fatty acids (C18:2n6+C18:3n3) (P) was similar for all the meat samples (mean 7.7%), and significantly greater than the value obtained for PRF samples (1.5%).

Considering LD samples and kids reared in winter (Table 1), S fatty acids concentration was similar for all kids and P fatty acids was higher for Farm 1 kids. However, the meat from farm 3 kids was significantly richer in CLA, 0.45% vs 0.34 (Farm 1) and 0.38% (Farm 2), a surplus considering that CLA are recognized from its anticarcinogenic properties (Ip *et al.*, 1994). The major FA in the intramuscular fat were C18:1cis9, C16:0 and C18:0.

It is well known that a higher concentration of long chain saturated FA raises plasma cholesterol, while mono-unsaturated and polyunsaturated FA concentrations will decrease it (Grundy and Denke, 1990). Thus, P/S and n-6/n-3 polyunsaturated FA ratios are accepted as dietetic indicators for meat quality (Department of Health, 1994). Sanz Sampelayo *et al.* (2006) reported values of 0.44 and 2.89 for P/S and n-6/n-3, respectively, obtained in intramuscular fat of the leg in suckling kids slaughtered at 9.5 kg LW. Banskalieva *et al.* (2000) also suggest that the ratio (C18:0+C18:1)/C16:0 can be used to describe the potential health effects of different

types of lipids. Values reported for this index may range from 2.06, for kids slaughtered at 11 kg LW (Todaro *et al.*, 2004), to 3.39, for kids slaughtered at 5 kg LW (Todaro *et al.*, 2002). The indexes for the functional indicators referred above, in LD samples from kids raised in Farms 1, 2 and 3 were respectively (Table 1): (i) 0.25; 0.16 and 0.16 for P/S; (ii) 3.75, 2.62 and 2.25 for n-6/n-3; and (iii) 2.22; 2.62 and 2.59 for (C18:0+C18:1)/C16:0 ratios. Values for Farm 1 for n-6/n-3 and (C18:0+C18:1)/C16:0 ratios were significantly different from those of the other two farms. As to an index of meat softness, considered as the ratio between (C16:1+C18:1) and (C16:0+C18:0), Todaro *et al.* (2002) report values of 1.11 and 0.93 according to slaughter age in Girgentana suckling kids, respectively at 25 and 35 days. The values observed were significantly higher for farm 3 kids (1.17 vs 0.91 and 1.01 for Farms 1 and 2, respectively) but all values indicated high quality for the meat obtained.

**Table 1. Meat fatty acids content and functional indicators in LD samples of kids reared in winter**

	Farm 1	Farm 2	Farm 3
S (%)	40.1	40.8	38.1
P (%)	9.7 <sup>b</sup>	6.4 <sup>a</sup>	5.9 <sup>a</sup>
CLA (%)	0.34 <sup>a</sup>	0.38 <sup>a</sup>	0.45 <sup>b</sup>
C18:1cis9 (%)	30.4 <sup>a</sup>	35.0 <sup>b</sup>	37.8 <sup>b</sup>
C16:0 (%)	21.3	20.5	21.0
C18:0 (%)	13.6	15.4	12.8
P/S	0.25	0.16	0.16
n-6/n-3	3.75 <sup>b</sup>	2.62 <sup>a</sup>	2.25 <sup>a</sup>
(C18:0+C18:1)/C16:0	2.22 <sup>a</sup>	2.62 <sup>b</sup>	2.59 <sup>b</sup>
Softness index	0.91 <sup>a</sup>	1.01 <sup>a</sup>	1.17 <sup>b</sup>

Note: values in the same row with different letters differ significantly ( $P < 0.05$ ); S=Σ C12:0, C14:0, C16:0, C18:0; P= Σ C18:2n6+C18:3n3.

The effect of rearing season in farm 3 showed that the FA profile from kids raised in spring presented higher CLA (0.66 vs 0.45%) and n-3 family fatty acids concentration (6.76 vs 3.98%), namely C18:3n-3 (2.01 vs 0.89%), C20:5n-3 (EPA) (1.71 vs 0.99%) and lower n-6/n-3 ratio (1.60 vs 2.25) than those reared in the fall.

A panel of trained consumers tested LD samples from the 3 farms, according to the procedure described by Bessa *et al.* (2005), and could not find differences on the meat quality parameters tested: (i) tenderness; (ii) succulence; and (iii) flavour.

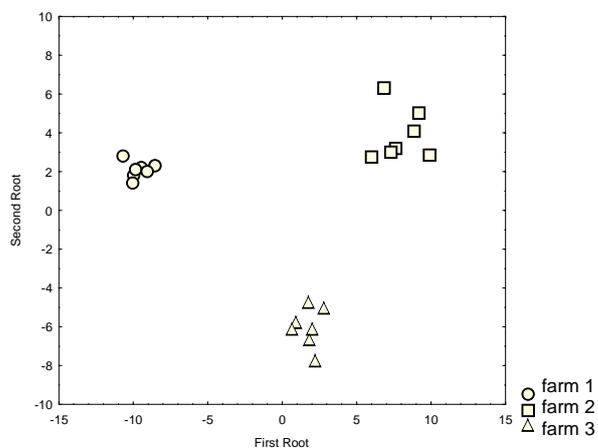
Results from the discriminant analysis resulted in two significant uncorrelated linear combinations of 13 FA which clearly discriminated the three feeding systems (Fig. 1). The first root accounted for 73.9% of the total variation. The highest scores were observed for C18:1cis9 and C18:2n6 for the 1<sup>st</sup> root and C12:0 and C16:0 for the 2<sup>nd</sup> root, while C14:0 contributed equally for both roots.

Samples from Farm 1 were located towards the left, those from Farm 3 in the middle and Farm 2 on the right. Furthermore, the second root placed Farms 1 and 2 on the upper half of the plot while Farm 3 was clearly discriminated below the other two. This is related to the fact that in those feeding systems (Farms 1 and 2) both goats and kids received a supplementation. All samples were 100% correctly allocated to their groups.

## IV – Conclusions

The results obtained show that, in general, the production of Serpentina kid meat has a good dietetic quality. Furthermore, the feeding system based only on pasturage has increased nutritional advantages, due to higher CLA and lower n-6/n-3 ratio, which is emphasized on the

spring rearing season. The discriminant analysis resulted in the identification of the most relevant FA in the intramuscular fat profile of LD, clearly allowing the distinction of the 3 feeding systems.



**Fig. 1. Spatial distribution of fatty acids profile from kid goats from the three farms, in the plane defined by two discriminant functions.**

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