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Classification and composition of the carcass of pre-ruminant kid goats of the Granadina breed

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SUMMARY - To establish the principal relationships existing between carcass classification and composition in pre-ruminant kid goats of the Granadina breed, 36 kids were divided into nine groups each of which was fed from birth until to months of age on different milk replacers. At two months of age all animals were slaughtered. The differences in the composition of the milk replacers used gave rise to different rates of food intake and different growth rates and to carcasses with differed in both chemical and tissue composition. The parameters of composition and classification, together with the variables energy intake, growth rate and carcass weight, were analysed by multivariate factorial analysis. The results of the analysis indicated that three, to a certain extent independent, factors, need to be taken into account when considering carcasses from animals of this type. The first of these is energy intake, which is the principal factor determining tissue composition. The second is the subcutaneous fat status of the carcass, which, in turn, is determined mainly by the carcass size, and the third is the carcass conformation which only in part, is dependent on the carcass weight.

Key words: Kid goats, carcass, composition, classification.

RESUME - *"Classification et composition de la carcasse de chevreaux pré-ruminants de race Granadina". Pour établir les principaux rapports entre la classification et la composition des carcasses des chevreaux pré-ruminants de la race Granadina, 36 animaux de cette race ont été nourris avec différents laits de remplacement depuis la naissance jusqu'à deux mois, âge auquel ils étaient abattus. Les différentes compositions des laits de remplacement ont fait apparaître des différences concernant la croissance et la composition tissulaire et chimique des carcasses. La classification et la composition des carcasses ainsi que les données concernant l'ingestion d'énergie, le poids des carcasses et la vitesse de croissance ont été analysées par analyse multivariante. Les résultats de cette analyse montrent que 3 facteurs, dans une certaine mesure indépendants, doivent être pris en compte pour caractériser les carcasses de ce type d'animal. Premièrement, l'ingestion d'énergie est le principal facteur influençant la composition tissulaire de la carcasse. En deuxième lieu, le niveau de gras de couverture, dépend essentiellement de la taille de la carcasse. En troisième lieu, la conformation de la carcasse qui dépend partiellement de son poids.*

Most-clés : *Chevreaux, carcasse, composition, classification.*

Introduction

The carcasses systems of classification intend to determine their quality by means of certain qualitative characteristics assuming to be related, to a greater or lesser extend, to their composition. As far as goats are concerned carcass classification presents certain difficulties because the peculiar growth and development characteristics of these animals give rise to very lean carcasses. These animals have very scarce fat deposits specially in respect to subcutaneous fat. The problem is accentuated when the carcasses in question are from young animals, whose low age means that fat deposits are even more scarce. With the aim of carrying out the goat carcass classification in a more correct way, a specific standard system was finally proposed (Colomer-Rocher *et al.*, 1987). It would be useful, therefore, to determine what relationships exist between the standard classification of particular goat carcasses and their composition.

In relation to the kid goat, one important information is available about the relationship between nutrition, growth and carcass composition (Mowlem, 1982; Morand-Fehr *et al.*, 1982; Singh *et al.*, 1982; Bas *et al.*, 1987a,b). In respect to what happens in the kid goats of the Granadina breed, the most important aspect of food composition determining its growth and corporal development has also been identified (Falagan, 1986; Sanz *et al.*, 1987, 1990).

According to all these and with the aim of establishing the relationships existing between kid goat of the Granadina breed carcass standard classification and composition, thirty-six animals of this breed were fed on nine different milk replacers. In this way, enough number of carcasses with also, enough carcass composition differences were obtained. Then, and based on the data of these carcasses standard classification and composition, the proposed study was carried out.

Material and methods

Thirty-six male kid goats of the Granadina breed were divided into nine groups each of which was fed on a different milk replacer. The milk replacers differed according to their fat and protein composition. These differences in protein and fat composition gave rise to different growth rates and different body composition in the animals of the different groups. Each animal was allowed *ad libitum* access to the diet assigned to it from 9 am to 6 pm. During this period the feed was maintained at 39 ± 2°C and adequately mixed by means of a device designed specially for this purpose (Ruiz *et al.*, 1990). Appropriate balance trials were conducted to determine the metabolizable energy content of the different milk replacers and from these values the mean daily energy intake of each animal was calculated (kJ/kg$^{0.75}$). Live weights of all animals were recorded twice weekly which allowed the growth rates to be determined (g/day).

All animals were slaughtered when they were two months old and at that time they were weighed and their carcasses classified according to the system of classification devised especially for caprine carcasses (Colomer-Rocher *et al.*, 1987). The colour of both the lean and fat was estimated. The length of the carcass (K), taken as the linear distance between the points of insertion of tail and neck, was measured. The carcass width (G) was also measured as the rump width at its widest point, at the level of the trochanters. After jointing the left half of the carcass, the tissue composition of the leg cut was determined by dissection (percentage of muscle, of covering and intermuscular fat and of bone). The right half of the carcass was homogenized and its chemical composition determined (percentage dry matter, fat, fat-free extract, protein and ash). Dry matter content was determined by lyophilization, nitrogen was analysed in order to calculate the protein content, by the Kjeldahl method, the fat content by extraction with chloroform/methanol (2/1) and ash by mineralisation in an electric furnace at 550°C. Finally the relationships existing between the weight of the carcass and its length and between the carcass length and width were calculated as these were considered to be useful indices of conformation. The colour of the lean and the fat was, in all cases, pink and cream, respectively. The fat status, judged by the subcutaneous fat, was evaluated taking into account the classes or categories indicated in the standard classification system (Colomer-Rocher *et al.*, 1987). However, when the status was judged to be low, within any particular class, then it was assigned a negative symbol, while a positive symbol was assigned to the value if the status was considered to be high. The evaluation of the fat status with respect to kidney fat was performed in a similar manner. For purposes of statistical analysis the classifications were converted into quantitative values. Thus classification of 1^-, 1 and 1^+ were given the values 1, 2 and 3, respectively, classifications 2^-, 2 and 2^+, were given the values 4, 5 and 6, respectively and classifications 3^-, 3 and 3^+, were given the values 7, 8 and 9, respectively.

At the end of the trials, in addition to values for the rates of metabolizable energy intake, growth rates and carcass weights, data were also available on carcass classification, carcass tissue composition derived from the leg cut and on the chemical composition of the whole carcass. In order to establish the relationships between these parameters, multivariate analysis, factor analysis, was carried out (SAS, 1987). For statistical analyses the animals were considered to be experimental units and the different parameters were the variables to be analysed. The algorithm used was PRO FACTOR. The covariance matrix and Varimax rotation method was chosen. The colour classifications for the lean and fat were not taken into account since, for all animals, these were identical.

Results and discussion

Table 1 shows the mean values and standard errors of the different parameters studied as well as their ranges. Table 2 shows the results of the factor analysis. According to Chatfield and Collins (1980) the idea of factor analysis is to derive new variables called factors, which will hopefully, give us a better understanding of relationships between the data. By means of this, we ask if the total variables are made up of a single underlying general factor or of several more limited factors measuring different attributes, even they are not independent since each factor is defined by all variables, but in special by means of some of them. The results of the factor analysis carried out here show that the first three derived factors explain 99.75% of the total variance. Considering within each factor those variables whose scoring coefficients result equal or higher than 0.5 it is possible to say that: the first factor, F_1, accounting for 65.75% of the total variance, demonstrates how the metabolizable energy intake is highly influential in determining fat deposition at tissue level. The second factor, F_2, which explains 24.89% of the total variance, appears to indicate how subcutaneous fat status is essentially related to growth rate and carcass weight and also, though to a lesser extent, to food intake. Finally, the third factor, F_3, which only accounts for 9.11% of the total variance, indicated as the carcass conformation is essentially related to its chemical composition and also, to a lesser extent, to kidney fat level. Perhaps the most important result in this sense, is to indicate that the conformation indices are independent enough of the tissue composition values.

As a result of the differences in the nutrient composition of the milk replacers used and the differences in intake of nutrients arising as a result of the differences in diets, a series of carcasses were obtained which were sufficiently different to allow analysis of the relationships existing between the parameters studied. The results of the statistical analyses performed highlight exactly what relationships do exist. The first factor, which, as mentioned above, alone explained most of the total variance, appears to be chiefly defined by the level of food intake, indicating how this variable is the one which principally determines the tissue composition. The tissue composition determines, to a great extent, the eating quality of the carcass. It should be pointed out that the low voluntary food intake of pre-ruminant animals in general, and of kids in particular, explains why, in these animals, body composition during the first stage of growth (30-35 days of age) depends more on the body weight than on the level of food intake (Walker, 1986; Sanz *et al.*, 1990). In older animals, differences in energy intake can produce differences in body composition (Lara, 1991), which, from the results presented here, would appear to be due essentially to differences in tissue composition. The second factor, which also explains a considerable amount of the total variance, was determined, in large part, by the growth rate, or carcass weight, achieved. In other words, this factor represents the size of the animal, which in turn is related to the indices of subcutaneous and cover fat and, to a lesser extent, to the food intake. Thus, the subcutaneous fat status, which is important since it contributes to the carcass quality, seems to depend overall, on the size or weight of the carcass. The food intake influences carcass quality only to the extent that, irrespective of the initial size of the animal, it determines growth rate. Finally, the third factor appears mainly to represent the carcass conformation, which in turn is related to the chemical composition of the carcass as well as to the fat status at kidney level. In addition, the results indicate that carcass size is to a certain extent important in determining carcass chemical composition and levels of kidney fat but that the effects of growth rate and food intake were no significant.

Conclusions

The first conclusion that it is possible to draw is about the close relation existing between the carcass standard classification and composition of pre-ruminant kid goats of the Granadina breed. At the same time and in accordance with the results achieved, we can conclude by stressing that when analyzing carcasses of pre-ruminant kid goats, three, fairly independent, factors should be considered. Both the energy intakes achieved during the rearing period and the carcass size reached are important. The third point to be considered is that carcass conformation in only partly dependent on carcass size. Thus, in order to obtain carcasses of an adequate quality, this type of animal should be fed a milk replacer which will give a high energy intake and, furthermore, the initial weight or birth weight of the animals chosen should not be below the mean weight of the breed in question.

Table 1. Values for the different experimental results

	Metabolizable energy intakes (MEI) and growth rates (GR)		
	X ± SD		Range
MEI (kJ/kg$^{0.75}$. day)	778	16	621 - 1009
GR (g/day)	86.0	3.9	36.4 - 134.0
	Fattening index and conformation values		
	X ± SD		Range
Subcutaneous fat	5.9	0.1	2 - 9
Kidney fat	4.1	0.3	1 - 9
W/K†	83.0	16.3	52.2 - 123.7
K/G††	3.35	0.06	2.52 - 4.02
	Weight (kg) and chemical composition (%) of the carcasses		
	X ± SD		Range
Weight	3.9	0.1	2.0 - 5.7
Fat	31.0	0.9	22.1 - 41.0
FFE†††	68.1	0.9	58.1 - 77.9
FFEP††††	78.3	0.3	74.0 - 82.9
FFEA†††††	21.3	0.3	18.9 - 24.9
	Leg cut tissue composition (%)		
	X ± SD		Range
Muscle	65.0	0.2	63.3 - 67.2
Cover fat	4.1	0.1	2.9 - 5.4
Intermuscular fat	5.7	0.2	4.1 - 7.5
Total fat	9.7	0.2	7.6 - 12.5
Bone	23.2	0.1	21.4 - 24.3

†W/K: Carcass weight/Carcass lenght
††K/G: Carcass lenght/Carcass width
†††FFE: Fat-free extract
††††FFEP: Fat-free extract protein
†††††FFEA: Fat-free extract ash

Table 2. Factor analysis results. Scoring coefficients values

	F_1	F_2	F_3
MEI†	0.838	0.471	0.277
Total fat*	0.632	0.326	0.195
Intermuscular fat*	0.626	0.170	0.274
Muscle*	-0.540	-0.129	-0.096
Bone*	-0.359	-0.399	-0.190
Cover fat*	0.392	0.555	-0.016
Subcutaneous fat	0.355	0.584	0.340
Carcass weight	0.379	0.791	0.423
Growth rate	0.511	0.867	0.146
K/G††	-0.186	0.304	-0.687
Dry matter#	0.480	0.144	0.513
Kidney fat	0.404	0.131	0.584
FFEP†††, #	-0.064	0.205	0.606
Carcass fat#	0.333	0.204	0.698
W/K††††	0.304	0.388	0.816
FFEA†††††, #	-0.075	-0.549	-0.083

Total variance explained: 99.75%; by each factor: F_1: 65.75%, F_2: 24.89%, F_3: 9.11%
†MEI: Metabolizable energy intake
††K/G: Carcass lenght/carcass width
†††FFEP: Fat-free extract protein
††††W/K: Carcass weight/carcass length
†††††FFEA: Fat-free extract ash
*Leg tissue composition values
#Carcass chemical composition values

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