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Effect of rearing system on the growth rate and meat quality of young goats

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SUMMARY – Two groups of 12 male Alpine goat kids were raised from birth to slaughter either single suckling their dams (group N, natural) or artificially reared with a whey-based milk replacer from an automatic self-feeder (group A, artificial). Kids were slaughtered in two batches when they reached a weight of 12.5-15.5 kg, at 39 (N) and 43 (A) days of age. The cold carcass weights were 7.01 and 6.75 kg respectively. There were no significant differences in the carcass and *L. thoracis* muscle dimensions, kidney fat or flank colour between groups. In contrast, meat colour differed: L 48.8 vs 53.0, $P < 0.01$; b* 4.7 vs 6.2, $P < 0.05$, in N and A respectively. The percentage of separable kidney fat and ether extract in the meat were slightly, but not significantly, higher in group A. The consumer acceptance of the meat from both groups, assessed by a domestic consumer test, was good, with a slight, but non significant, preference for the product from the naturally suckled kids.

Key words: Goats, milk feeding system, carcass quality, meat quality.

RESUME – *"Effet du système d'élevage sur la vitesse de croissance et la qualité de la viande des chevreaux". Deux groupes de 12 chevreaux mâles de race Alpine ont été élevés de la naissance à l'abattage, un premier groupe étant alimenté sous la mère (1 chevreau par chèvre; groupe N), un second groupe recevant un lait de remplacement à base de lactosérum distribué par un allaiteur automatique (groupe A). Les chevreaux ont été abattus au poids de 12,5-15,5 kg, à 39 (N) et 43 (A) jours. Les poids de carcasse froide étaient de 7,01 et 6,75 kg respectivement. Il n'y avait pas de différence significative entre les deux groupes pour la taille des carcasses et du muscle* L. thoracis*, la graisse de rognon et la couleur des flancs. En revanche, la couleur de la viande était différente : L 48,8 vs 53,0, $P < 0,01$; b* 4,7 vs 6,2, $P < 0,05$ pour N et A respectivement. Le pourcentage de gras de rognon séparable et de matières grasses dans la viande était légèrement supérieur dans le groupe A, quoique de façon non significative. L'acceptation des viandes par les consommateurs, estimée par un test à la maison, a été bonne pour les deux groupes, avec une préférence légère, mais non significative, pour les produits issus des chevreaux allaités naturellement.*

Mots-clés : *Caprins, système d'alimentation lactée, qualité de la carcasse, qualité de la viande.*

Introduction

In dairy goat systems, the artificial rearing of kids has developed in recent years to increase the volume of marketable milk and reduce the cost of feeding milk. Systems for using milk replacers and their effects on performance and nutrient utilisation for growth in kids has been widely studied (Havrevoll *et al.*, 1991; Sahlu *et al.*, 1992; Sanz Sampelayo *et al.*, 1997). Morand-Fehr *et al.* (1991) reviewed and discussed the influence of milk feeding on the quality of young goat carcasses. Sauvant *et al.* (1979), Potchoiba *et al.* (1990), Zygoyiannis *et al.* (1992) and Rojas *et al.* (1994) studied the relationship between milk feeding systems and chemical composition of goat kid tissues.

Little is known about the effects of milk feeding systems on the sensory characteristics and consumer acceptance of goat meat from milk-fed kids, which is a traditional product from the dairy goat systems in southern European countries.

In this paper the effect of two rearing strategies on growth performance, carcass and meat characteristics and meat acceptance of 6 week old unweaned kids was investigated. The experiment took place on a commercial farm as part of a goat farming development project in Alpine areas, supported by the Regional Agricultural Development Agency (ERSA) in Friuli-Venezia Giulia.

Material and methods

Animals and rearing systems

Two groups of 12 male Alpine goat kids were raised from birth to slaughter either single suckling their dams (group N, natural) or artificially reared with a commercial milk replacer from an automatic self-feeder (group A, artificial), after 2-4 days of individual training to teat-feeding by hand feeding from a bottle. The milk replacer, based on cheese whey, concentrated whey protein, bovine tallow, lard and coconut oil, contained 18.5% dry matter (DM), 23.5% DM fat and 23% DM protein. All the animals were housed on permanent litter in a purpose-built barn; group N kids had free access to the concentrate (N*6.25: 21.6% DM; crude fibre: 7.3% DM) and hay offered to their dams. The suckled dams were also machine milked once daily for cheese production. The self-fed kids were kept separate in a pen in the same barn. No mortalities were recorded during the trial.

Growth rate

The kids were weighed weekly, from birth to slaughter. The daily growth rate was calculated from the linear regression coefficient of live weight (LW) on age.

Carcass characteristics

Kids were slaughtered in two batches when they reached a weight of between 12.5 and 15.5 kg, to obtain the same carcass weight between groups. On the day of slaughter, the animals were weighed live, slaughtered, skinned and eviscerated. After overnight storage at +4°C, kidney fat and flank colour (of the *Rectus abdominis* muscle) were assessed visually (Colomer-Rocher *et al.*, 1987) and carcass measurements (Fisher and De Boer, 1994) were taken. The pH (penetrating glass electrode), colour (L, a*, b*, Minolta CM-2002 spectrocolorimeter) and section dimensions (nearest mm) of the *Longissimus thoracis* muscle were measured.

Meat composition

Samples of *L. thoracis* muscle were taken for analysis of dry matter, ash, ether extract (Soxhlet) and crude protein (N*6.25, Kjeldahl) concentrations.

In-house consumer acceptance test

A consumer preference test was organised by distributing carcass quarters from both kid types to 115 consumers belonging to 32 families formed from at least 3 members more than 16 years old. The families were selected because they normally consumed goat kid meat at Easter. In the triangular test, each family group received 2 quarters from one kid (the left and right fore or hind quarter) and a third quarter from a kid from the other group (fore quarter weight: 1.78 kg, sd 0.14 kg; hind quarter, 1.38 kg, sd 0.11 kg). 16 families received 2 joints from group A animals and a third from group N (2A families) while the other 16 families received 2 group N joints and one group A joint (2N families). The joints were vacuum packed 24 h after slaughter, refridgerated for 6 days before freezing at –20°C, and distributed frozen to the families. The families, which did not know the identity of the joints, were required to cook (oven roasted, usual family recipe) and consume the joints within one month of distribution (over the Easter period). The cook was asked to assess odour during cooking and each family member to assess flavour, texture, juiciness and overall liking, using a 100 mm unmarked hedonic line scale from "dislike extremely" to "like extremely". The assessments were converted to a score (mm) by measuring to the nearest mm from the anchor point "extremely dislike" on the left to the assessor's mark on the line scale.

Three initial scores were obtained from each consumer for each attribute, as follows:

2A family: A_{min}, A_{max} and N, respectively for the 2 joints from the same animal and the other kid.
2N family: N_{min}, N_{max} and A, as above.

These initial scores were used to calculate the following final scores, for a consumer in a 2A family:

$A = \text{mean}(A_{min}, A_{max})$ and N if $A_{max} + (A_{max}-A_{min}) < N < A_{min} - (A_{max} - A_{min})$

or

$M = \text{mean}(A, N)$

If the difference between sample N and the mean of the 2A samples was less than the difference between the 2A samples, the consumer was considered to have expressed the same acceptance level for both types of meat. The same procedure was adopted for the scores from the 2N families. The final scores thus obtained were analysed with a paired t-test.

Results and discussion

The average rate of growth of the kids was good in comparison with other milk-fed kids of the same breed and type (Morand-Fehr *et al.*, 1986; Manfredini *et al.*, 1988; Terzano *et al.*, 1988; Andrighetto *et al.*, 1994). Group N kids grew faster (255 g/d) than those in group A (220 g/d). At an average age of 39 (N) and 43 (A) days, the kids weighed 14.15 and 13.44 kg respectively (Table 1). The full gut weight accounted for a large part (77%) of the difference in LW between groups at slaughter so the difference in carcass weight was not significant: the cold carcasses weighed 7.01 and 6.75 kg in kids from groups N and A respectively. As a consequence, the killing out % of group A kids was 0.5% points higher than that for group N. These results, which were expected on the basis of a previous trial (Peresson *et al.*, 1997), were due to the consumption of some fibrous feed by the kids reared under their dams.

Table 1. Effect of rearing system on performance and slaughter characteristics of Alpine kids

		Rearing system		Pooled s.d.
		Artificial	Natural	
Liveweight at birth	kg	4.22	4.21	0.541
Age at slaughter	days	43[a]	39[b]	3.8
Liveweight gain	g/day	220[b]	255[a]	25
Liveweight at slaughter	kg	13.44[b]	14.15[a]	0.759
Filled digestive tract	kg	2.13[b]	2.68[a]	0.268
Hot carcass weight	kg	6.88	7.16	0.520
Cold carcass weight (CCW)	kg	6.75	7.01	0.513
Killing out percentage	%	51.1	50.6	1.66
Losses during chilling	%	1.9	2.1	0.34

[a,b]$P < 0.05$.

There were no significant differences in the carcass and *L. thoracis* muscle dimensions, kidney fat, flank and fat colour (cream) between groups (Table 2). It is likely that the energy intake of the two groups was similar, because in these conditions, the fatness of young goat carcasses raised with milk replacer is very close to that obtained from kids consuming goat milk (Morand-Fehr *et al.*, 1991).

The pH measurements are a reliable and sensitive indicator of the rate and extent of *post-mortem* glycolysis. Both meat colour and texture may be influenced by pH. If sufficient glycogen is initially present, the pH values for the *L. thoracis* muscle normally declines to a final level of 5.4-5.7 in mutton, beef and pork (Ouali, 1991). The muscle pH 24 h after slaughter was 0.1 points lower in group A than in group N; in any case, both mean values (5.59 and 5.69) appeared to be consistent for animals having low pre-slaughter stress.

The average colour data for the *L. thoracis* muscle were comparable to those recorded in Alpine goat kids fed a similar diet (Borghese *et al.*, 1990). The meat from the group A kids was lighter and yellower than that from group N, which was redder, although the differences were not significant. This

result could have been due to a greater quantity of pigment in the muscle, as a consequence of the greater physical activity allowed to the group N kids. It cannot, however, be excluded that the slightly higher pH tended to render the meat from group N kids a more purple colour (MacDougal and Jones, 1981), as the hue value indicated (hue 21.2 vs 15.3; $P < 0.05$ in groups A and N respectively).

Table 2. Effect of rearing system on carcass characteristics

	Rearing system		Pooled s.d.
	Artificial	Natural	
Measurements of the carcass and the *Longissimus thoracis* (L.t.) muscle			
Carcass length (mm)	497	503	12.2
Circumference of buttock (mm)	401	407	8.4
Width of buttock (mm)	133	136	5.0
Chest depth (mm)	195	195	5.1
L.t. muscle depth (mm)	20	21	2.2
L.t. muscle width (mm)	40	39	4.5
Kidney knob and channel fat (% CCW)	2.1	1.8	0.64
Visual carcass classification			
Fatness† (points)	2.23	2.10	0.56
Flank colour assessment†† (points)	1.08	1.25	0.37
pH and colour of the L.t. muscle			
pH	5.59[b]	5.69[a]	0.077
Colour			
L	53.0[a]	48.8[b]	2.25
a*	15.9	16.7	1.42
b*	6.2[a]	4.7[b]	1.36
Hue†††	21.2[a]	15.3[b]	3.70
Chroma††††	17.0	17.4	1.53

[a,b]Different letters in the same line indicate significant differences at $P < 0.05$.
†KKCF scores: 1 = little; 2 = medium; 3 = excessive.
††Flank colour scores: 1 = pale muscle; 2 = pink muscle; 3 = red muscle.
†††Hue = arctan (b*/a*), angle in degrees.
††††Chroma = $(a^{*2} + b^{*2})^{1/2}$.

The marbling fat appeared to be of less importance in determining the difference in colour between groups, as suggested by the similar chroma value (17.0 vs 17.4, n.s., in groups A and N respectively) and the muscle fat content. In fact, as reported in Table 3, the ether extract concentration of the muscle tissue was only slightly and not significantly higher in group A, in agreement with the results obtained for the separated pelvic fat.

Table 3. Effect of milk feeding system on *longissimus thoracis* muscle composition (% of fresh tissue)

Rearing system	DM (%)	Ash (%)	N x 6.25 (%)	Ether extract (%)
Artificial	23.36	1.16	20.54	1.27
Natural	23.34	1.17	20.81	1.14
Pooled s.d.	0.459	0.033	0.366	0.249

Of the 115 consumers involved in the survey, 60 gave different "general liking" scores for the two meat types, with 25 consumers prefering meat from artificially reared animals and 35 prefering meat

from the suckled kids. Of these latter, 27 consumers reported their prefered meat to have more flavour. The mean consumer score for the kid-meat attributes are reported in Table 4. The acceptance of both types of meat was good, with a slight but non-significant preference for the meat from the naturally suckled kids. The similarity of the mean scores for the different attributes may have been due to the type of questionnaire used, as it is known that individual subjects tend to give the various attributes scores close to the general liking score - an effect known as a "halo".

Table 4. Mean consumer scores for the different attributes of meat from kids reared with different feeding systems

Attribute†	Rearing system		Pooled s.d.
	Artificial	Natural	
No. of judgements	32	32	–
Odour	73	73	16.9
No. of judgements	115	115	–
Flavour	72	74	20.5
Texture	72	75	20.2
Juiciness	72	75	20.8
Overall liking	72	75	20.9

†Hedonic line scales: 0 = "dislike extremely" to 100 = "like extremely".

Conclusions

The two rearing systems produced kids which were similar in terms of liveweight gain and carcass traits. Notwithstanding some differences in meat colour, the meat quality was deemed to be very acceptable, independently of the feeding system adopted.

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References

Andrighetto, I., Bailoni, L., Zancan, M. and Dalvit, P. (1994). Effect of concentration of cold acidified milk replacers, breed and rearing season on the performance of goat kids. *Small Ruminant Res.*, 13: 223-229.

Borghese, A., Terzano, G.M. and Bartocci, S. (1990). Kid production in intensive rearing. 6. Carcass and meat characteristics in Saanen and Alpine kids at 35 and 50 days of age. *Zoot. Nutr. Anim.,* 16: 167-178.

Colomer-Rocher, F., Morand-Feher, P. and Kirton, A.H. (1987). Standard methods and procedures for goat carcass evalutation, jointing and tissue separation. *Livest. Prod. Sci.*, 17: 149-159.

Fisher, A.V. and de Boer, H. (1994). The EAAP standard method of sheep carcass assessment. Carcass measurements and dissection procedures. Report of the EAAP Working Group on Carcass Evalutation, in cooperation with the CIHEAM Instituto Agronomico Mediterraneo of Zaragoza and the CEC Directorate General for Agriculture in Brussels. *Livest. Prod. Sci.*, 38: 149-159.

Havrevoll, O., Hadjipanayiotou, M., Sanz Sampelayo, M.R., Nitsan, Z. and Schmidely, P. (1991). Milk feeding systems of young goats. In: *Goat Nutrition*, Morand-Fehr, P. (ed.). Pudoc, Wageningen. *EAAP*, 46: 259-270.

MacDougal, D.B. and Jones, S.J. (1981). Translucency and colour defects of dark-cutting meat and their detection. In: *The Problem of Dark-cutting in Beef,* Hood, D.E. and Tarrane, P.V. (eds). Martinus Nijhoff Publishers, The Hague.

Manfredini, M., Massari, M., Cavani, C. and Falaschini, A.F. (1988). Carcass characteristics of male Alpine kids slaughtered at different weights. *Small Ruminant Res.*, 1: 49-58.

Morand-Fehr, P., Bas, P., Schmidely, P. and Hervieu, J. (1986). Qualité des produits chez les ovins et les caprins. In: *Proc. 10 Journées de la Recherche Ovine et Caprine*, ITOVIC-SPEOC (eds), Paris, 1986, pp. 236-247.

Morand-Fehr, P., Havrevoll, O., Bas, P., Colomer-Rocher, F., Falagan, A., Sanz-Sampelayo, M.R., Sauvant, D. and Treacher, T.T. (1991). Influence of feeding and rearing methods on the quality of young goat carcas. In: *Goat Nutrition*, Morand-Fehr, P. (ed.). Pudoc, Wageningen. *EAAP*, 46: 292-303.

Ouali, A. (1991). Sensory quality of meat as affected by muscle biochemistry and modern technologies. In: *Developments in Animal and Veterinary Sciences 25. Animal Biotechnology and the Quality of Meat Production,* Fiems, L.O., Cottyn, B.G. and Demeyer, D.I. (eds), Meller (Belgium), 7-9 November 1990. Elsewier, Amsterdam, pp. 85-105.

Peresson, C., Piasentier, E. and Furlan, D. (1997). Comparison of kid rearing systems: Results of on-farm demonstration trials in Friuli-Venezia Giulia. *L'Allevatore di Ovini e Caprini*, 11: 1-4.

Potchoiba, M.J., Lu, C.D., Pinkerton, F. and Sahlu, T. (1990). Effects of all-milk diet on weight gain, organ development, carcass characteristics and tissue composition, including fatty acids and cholesterol contents, of growing male goats. *Small Ruminant Res*., 3: 583-592.

Rojas, A., Lopez-Bote, C., Rota, A., Martin, L., Rodriguez, P.L. and Tovar, J.J. (1994) . Fatty acid composition of Verata goat kids fed either goat milk or commercial milk replacer. *Small Ruminant Res.*, 14: 61-66.

Sahlu, T., Carneiro, H., El Shaer, H.M. and Fernandez, J.M. (1992). Production performances and physiological responses of Angora goat kids fed acidified milk replacer. *J. Dairy Sci.*, 75: 1643-1650.

Sanz Sampelayo, M.R., Ruiz Mariscal, I., Gil Extremera, F. and Boza, J. (1997). The effects of different concentrations of protein and fat in milk replacers on protein utilisation in kid goats. *Anim. Sci.*, 64: 485-492.

Sauvant, D., Bas, P. and Morand-Fehr, P. (1979). Production of heavy kids. 2. Effect of amount of milk taken and of weaning on performance and composition of adipose tissue. *Ann. Zootech.,* 28: 73-92.

Terzano, G.M., Bartocci, S. and Borghese, A. (1988). Kid production in intensive rearing. 4. Growth performance and slaughter data for Saanen and Alpine kids at 35 and 50 days of age. *Zoot. Nutr. Anim.*, 15: 495-501.

Zygoyiannis, D., Kufidis, D., Katsaounis, N. and Phillips, P. (1992). Fatty acid composition of carcass fat of indigenous (*Capra prisca*) suckled Greek kids and milk of their does. *Small Ruminant Res*., 8: 83-95.