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THE USE OF GRAPE PULP, GRAPE SEED MEAL AND BARLEY STRAW IN LAMB FATTENING DIETS[1]

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SUMMARY

Two lamb fattening trials were conducted to study the feasibility of fattening Chios lambs to a slaughter live weight of 35—40 kg and to evaluate the contribution of grape pulp, grape seed meal and barley straw as roughage sources in lamb fattening rations.

In the first trial, 80 Chios lambs weaned at 45 days of age were used. They were randomized into four groups. One group was fed a pelleted concentrate ration based on barley, while the remaining three groups were fed rations containing 40% of either grape pulp, grape seed meal or molassed grape seed meal.

Daily liveweight gains did not differ significantly among treatments. There were, however, significant differences in feed conversion efficiency. The values obtained were 5.4, 6.8, 7.5 and 7.4 kg of feed per kg live weight gain for the concentrate, grape pulp, grape seed meal and molassed grape seed meal rations respectively. There were significant differences in dressed carcass weight ($p < 0.01$), but no differences were found in the killing out percentage between the treatments.

In the second trial 60 Chios lambs weaned at approximately 70 days of age, were randomized among 3 treatments in which the pelleted concentrate ration was compared with either a pelleted ration containing 40% ground barley straw or a mixture of nonpelleted concentrate and chopped straw.

There were no significant differences between treatments in terms of overall daily live weight gains of lambs. The food conversion efficiency values in this trial were 6.0, 8.5 and 7.0 for the concentrate and straw diets respectively. Killing out percentage was significantly lower for the pelleted ration based on straw ($p < 0.01$).

INTRODUCTION

There is an increasing need to utilize agricultural by-products in ruminant feeding. This is particularly true in view of the increasing cost of cereal and protein sources as well as the shortage of processed roughages for inclusion in complete ruminant feeds. Grape pulp and grape seed meal are by-products of the wine industry. They are available separately in the dried milled form after the extraction of oil from the grape seeds. A further by-product, grape mark, is a physical mixture of grape seed and grape pulp. The chemical composition

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and digestibility of grape pulp and grape seed meal would appear to depend to some extent on the variety of grapes from which they are obtained as well as the extent to which the seeds are separated from the pulp. The crude fibre content of grape pulp varies from 16 to 18%, and that of grape seed meal from 30 to 35%. Recent *in vitro* digestibility values obtained by O' Shea (1972) were 28.6% and 17.7% dry matter digestibility (DMD) for grape pulp and grape seed meal respectively. These values are considerably lower than that of barley straw which has on average a DMD value of 40 to 45%.

The objectives of the present study were :

(1) To compare and evaluate a high level of inclusion (40%) of grape pulp, grape seed meal and molassed grape seed meal with that of ground or chopped barley straw as roughage sources in complete (pelleted) lamb fattening rations.

(2) To assess the growth rate and carcass potential of Chios lambs.

MATERIALS AND METHODS

Animals : Two lamb fattening trials, involving 140 purebred Chios lambs, were carried out. The lambs were weaned abruptly from their dams. They were housed and group-fed in lean-to sheds equipped with concrete floors and saw-dust as bedding. An *ad libitum* supply of fresh water was available. Fasted live-weights were obtained for all lambs at the commencement of each trial. They were subsequently weighed at weekly intervals and were fattened to a slaughter live weight of 35 to 40 kg. Fasted live weights were again obtained at the termination of the trials and all male lambs, excluding a few required for breeding purposes were slaughtered. Measurements were made of gut-fill, killing out % and a carcass appraisal at slaughter.

Feeds : The composition and analysis % of the feeds used in both experiments is given in Table 1. Each diet was pelleted with the exception of diet F. In the case of the latter the concentrate portion of the diet was offered in the mash

TABLE 1

Composition (%) and analysis (%) of the diets (Trial 1 and 2)

	DIET					
Ingredients (%) :	A	B	C	D	E	F††
Crushed Barley	82.5	46.5	45.0	45.0	36.5	36.5
Soya bean meal	15.0	11.0	12.5	12.5	21.0	21.0
Grape pulp	—	40.0	—	—	—	—
Grape seed meal	—	—	40.0	30.0	—	—
Molasses	—	—	—	10.0	—	—
Ground straw	—	—	—	—	40.0	—
Min.-Vit. suppl.†	2.5	2.5	2.5	2.5	2.5	2.5
Analysis (%) :						
Dry matter	88.35	87.85	89.70	89.50	91.90	89.24
DMD†††	86.83	66.38	69.94	64.85	71.14	—
Crude protein	14.2	13.9	14.1	13.7	13.9	13.9
Ash	7.40	7.37	11.52	7.58	9.26	7.10

† Dicalcium phosphate, 2.0% ; iodised salt, 0.5% ; cobalt carbonate, 35 g/ton ; vitamin A 3,250,000 IU/ton ; vitamin D_3 330,000 IU/ton ; and vitamin E 1,530 IU/ton.

†† Diet F was fed in mash form, mixed with chopped straw in the ratio of 60:40. All other diets were pelleted.

††† DMD = Dry matter digestibility coefficient (%).

form in the ratio of 60 parts concentrate to 40 parts of finely chopped (3—4 cm) straw. The objective here was to evaluate a more simple form of feeding a concentrate-straw mixture which would not involve grinding the straw and pelleting of the complete feed. All the diets were isonitrogenous but varied in metabolisable energy (ME), depending on the roughage source. In all cases the diets were offered *ad libitum* and group daily intakes were recorded for each treatment.

Trial 1. Eighty Chios lambs, 40 males and 40 females weighing 16 to 18 kg live weight, which corresponded to a weaning age of 40 to 47 days, were used in this trial. They were divided according to sex and type of birth (singles or twins) into four groups. The trial was laid out in a completely random design with a 4X2X2 factorial arrangement of the treatments. The four treatment rations evaluated in this trial were the concentrate diet and the diets containing the grape pulp, grape seed meal and molassed grape seed meal (rations A, B, C and D).

Trial 2. Sixty Chios lambs, 30 males and 30 females were used in this trial. The average weaning weight of these lambs was 19 kg which corresponded to a weaning age of 60 to 70 days. They were randomized into three groups and were fed the concentrate diet and the diets containing the straw (rations A, E and F). The data of both trials were analysed by covariance using the initial live weight of the lambs as a covariate.

RESULTS

Performance data in terms of live weight gain, feed intakes and feed efficiency for the lambs in both trials is given in Tables 2 and 3. There were no significant differences between the live weight gains of the lambs on any of the treatments in both trials. The overall daily live weight gains of the lambs in both trials are low and reflected the fact that 50% of the lambs in each treatment were female. The mean daily gains of the male lambs in Trial 1 were 0.255, 0.253, 0.227 and 0.220 kg compared with 0.191, 0.179, 0.167 and 0.192 kg for the female lambs in treatments A, B, C and D respectively. No significant differences in growth rate were found between single and twin lambs in any of the treatments.

The intakes of diets based on the different roughage sources were higher than those for the concentrate treatments. In all cases feed efficiency was poorer for the roughage concentrate diets. It will be noted from the footnote in Table 3 that not all of the chopped straw offered was consumed. Even though the concentrate and chopped straw were offered in the ratio 60 : 40 the net straw consumption was approximately 25% of total DM intake. This inevitably increased the overall protein concentration of diet F even though protein intake was not affected.

TABLE 2

Mean live weight gains, feed intakes and feed conversion efficiency of lambs fed on four different pelleted diets. (Trial 1).

	Diet				
	A	B	C	D	SE*
Initial weight (kg)	15.5	15.7	15.4	15.3	0.342
Final weight (kg)	37.2	36.8	36.7	36.8	1.070
Days on trial	101	103	112	107	6.191
Weight gain (kg/day)	0.223	0.216	0.197	0.207	0.011
Feed intake (kg/day)	1.140	1.380	1.420	1.480	—
Feed conversion (kg/kg gain) ..	5.35	6.51	7.53	7.43	

* Standard error of difference between two treatment-diet means.

TABLE 3

Mean live weight gains, feed intakes and feed conversion efficiency of lambs fed on three different diets.

(Trial 2).

	Diet			
	A	E	F*	SE
Initial weight (kg)	19.2	19.4	19.5	0.736
Final weight (kg)	37.0	37.4	37.4	0.672
Days on trial	93	85	91	5.541
Weight gain (kg/day)	0.213	0.219	0.204	0.011
Feed intake (kg/day)	1.110	1.800	1.025	—
Feed conversion (kg/kg gain)	5.97	8.55	7.00	—

In the case of diet F the value given refers to the concentrate only, the intake of straw was 0.335 kg/lamb/day.

TABLE 4

Slaughter data of male lambs

	Diet					
	A	B	C	D	E	SE
Final weight (kg) ..	38.4	37.6	37.5	37.7	38.4	0.240
Fasted weight (kg).. ..	36.5	34.9	34.0	34.6	35.8	0.221
Carcass weight (kg) ..	18.4	17.2	16.3	16.6	16.7	0.192
Total gut fill (kg) † ..	5.5	6.4	7.1	7.1	7.0	0.216
Killing out % ††	50.4	49.3	48.0	48.1	46.5	0.368

† The residual gut fill as measured at slaughter plus the difference between final and fasted live weights.

†† Carcass weight as a percentage of fasted live weight.

Table 4 presents information on the dressed carcass weights, gut fill and killing out %. The dressed carcass weights of the lambs fed on the roughage concentrate diets were in all cases significantly lower than those of the lambs on the control group. Significant differences were also found between the carcass weight of the lambs fed on the grape pulp (diet B) and lambs fed on the other roughage concentrate diets. Highly significant differences were also found in the gut-fill content between the lambs fed on diet A or B and the lambs fed on the other roughage concentrate diets. In the case of killing out percentage highly significant differences were found only between the lambs fed on the concentrate diet and those fed on the diet containing 40% straw. Even though no carcass data was obtained at the commencement of the trial, it is reasonable to assume that there were differences in carcass yields paralleling differences in dressed carcass weights.

DISCUSSION

The early weaning of lambs at approximately 6 to 8 weeks of age and their subsequent indoor fattening is now being widely practised in many European countries. This is particularly true where out of season or early lamb production is being practised. In Mediterranean countries, and in particular Cyprus, sheep are kept as dual purpose animals. The male lambs are reared with their dams and slaughtered between 50 to 70 days of age. This corresponds to a live weight of approximately 15 kg. Economic considerations, especially the growing shortage of meat, dictate the desirability of fattening lambs to a higher slaughter live weight. The possibility of fattening Chios lambs is particularly attractive since this breed of sheep combines high prolificacy and good milk yields.

The performance of the male Chios lambs in the present lamb fattening trials, in terms of growth rate, dressed carcass and duration of the fattening period were quite good. Despite the somewhat lower live weight gains, the results obtained compare favourably with those of other workers using meat breeds of sheep (Owen, Davies, Miller and Ridgman, 1967; Andrews, Kay and Orskov, 1969; Lawlor and Crowley, 1971). The somewhat lower growth rate of the Chios lambs was partly due to the energy content of the rations and to a possibly lower potential growth rate of Chios lambs.

The inclusion of processed roughage sources such as ground oat-hulls, straw or ammoniated rice-hulls in pelleted complete diets for fattening lambs has been investigated by Owen *et al.*, (1967); Andrews *et al.*, (1969) and Lawlor and Crowley, (1971). While there is some inconsistency in the results obtained by these workers, it would appear that good performance in terms of feed intake and growth rate are obtained when the ground roughage source is included at levels upto 40%. Little information is available on the use of dried grape residue at high levels in complete diets for ruminants. In terms of protein content both grape pulp and grape seed meal are superior to either ground oat-hulls or straw. Grape pulp and grape seed meal contain 10 to 12% CP whereas oat-hulls and straw contain only 3 to 4%.

On the other hand the digestibility and energy content of dried grape residues is low. The "*in-vitro*" DMD values obtained by O' Shea (1972) for grape pulp and grape seed meal indicate the digestibility to be about half that of ground straw. These "*in-vitro*" DMD values for grape residues support the starch equivalent (SE) values of 19 to 23 suggested by Maymone and Petrucci (1945) and Maymone and Salerno (1945). Despite the apparent low metabolizable energy values (ME), of dried grape residues, the results of the present studies indicate that they can be used to advantage in lamb fattening rations.

The inclusion of the different roughage sources in the rations resulted in substantial increases in feed intake, due presumably to the ruminant's tendency to eat to a constant energy intake. The intake increases in diets, B, C and D containing the dried grape residues were 21, 25 and 30% respectively over that of the concentrate diet. Molassing the grape seed meal (diet D) resulted in a small increase in intake and performance. An extremely high increase in intake (62%) was obtained from diet E, which contained the ground straw. The increased intakes of the roughage concentrate diets were reflected in increased gut-fills and correspondingly lower killing out percentages. The overall performance of the lambs fed on the straw diets was surprisingly poor and can only be attributed to the straw used being of very poor quality.

The economic feasibility of using dried grape residues in ruminant feeds, depends of course on price relationship with existing costs of other sources of energy and in particular barley. The results of the present trials clearly indicated that these roughage sources can be used to advantage in complete pelleted diets for fattening lambs. It may well be that the optimum levels of inclusion should be lower. Further studies are needed with varying levels of inclusion of dried grape residues, together with pre-slaughter groups, to enable an accurate economic appraisal of the value of these agricultural by-products.

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