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Effect of Replacing Dietary Maize with Graded Amounts of Cane-molasses on Lamb Performance

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THE EFFECT on lamb performance of including different levels of cane molasses in rations for fattening Ossimi lambs was studied.

Three experimental rations were used in this experiment. Ration A served as control and contained no molasses, while in rations B and C, molasses were included at levels of 14 and 28% in the DM.

The results showed that there were no significant differences in growth rates or feed efficiency between lambs given the three experimental rations. Lambs given the highest level of molasses, however, grew slower and utilized their diets less efficiently than groups given 0% or 14% molasses.

Apparent digestibilities of DM, OM, CF, N and EE, decreased with increasing level of molasses in the diet. The magnitude of this reduction was higher for lambs maintained on the highest level of molasses. It was also more pronounced for CF, N and EE digestibilities.

The level of molasses appears to have no significant effect on dressing percentage and slaughter data.

The results are discussed in relation to digestion and metabolism of diets containing molasses both in the rumen and post ruminaly.

It was concluded that molasses can successfuly be included in diets for fattening fat-tailed sheep up to at least 14% in the ration DM.

Sugar-cane molasses represent a valuable by-product of sugar-cane industry because of its high content of available carbohydrates. The use of molasses as an energy supplement to animal feeds is likely to increase with the new expansion in sugar production from sugar beet in the area north of Delta.

Although many experiments have been directed to study the use of cane-molasses in rations for dairy and fattening cattle (Clark *et al.* ,1973; Losada *et al.*, 1973 and Huektas *et al.*, 1975). little information is available on the use of molasses in diets for fattening fat-tailed lambs.

The present experiment was, therefore, carried out to study the effect on lamb performance of including different levels of cane-molasses in rations for fattening Ossimi lambs.

Material and Methods

Animals

Nineteen male Ossimi lambs of about 3-4 months of age (16 kg live weight) were used in this study. They were distributed according to their body weights to three groups and within groups assigned at random to receive one of three experimental rations. Groups 1 and 2 contained 6 lambs each while group 3 contained 7 lambs. Another six male lambs of about 40 kg live weight on average, were involved in digestibility trials (2 per treatment) to determine the effect of level of molasses on apparent digestibility of nutrients.

Diets

Three experimental rations were formulated to supply the energy and protein allowances recommended by Tommi (1963) for growing and fattening lambs. Ration A served as control and consisted mainly of Co-op feed mixture*, wheat bran and ground maize. In rations B and C, half (50%) and all (100%) of dietary maize was replaced iso-calorically with cane molasses on the assumption that the SV of molasses is half of that of maize (Abou Raya, 1976). Clover hay was used as the sole source of roughage and offered to the experimental animals at the rate of 400 g/day.

Molasses was included in the diets by simple mixing with wheat bran, ground maize and the Co-op feed just before feeding. The level of molasses in diets B and C represents about 14 and 26% on dry matter basis. All diets were supplemented with vitamin and mineral mixtures. The composition of the three experimental diets is presented in Table 1. The lambs were individually fed and the diets were offered to the animals in two equal portions at 08.00 and 16.00. The experiment lasted for 147 days during which live weights and food intakes were recorded at weekly intervals. The first 15 days of the experiment were considered as preliminary period.

At the end of the experiment, all animals were slaughtered after being fasted for 15 hr. Weights of carcasses, pelts, heads, legs, ribs (*9th*, *10th* and *11th*), hearts, lungs, kidneys, spleens,

Co-op feed mixture contained; cotton seed cake (64%), rice bean (20%), wheat bran (10%), molasses (3%), limestone (2%) and sodium chloride (1%).

TABLE 1. Composition of the three experimental rations containing graded amounts of molasses in place of dietary maize.

Ingredients:	Ration A	Ration B	Ration C
	(g / kg dry matter)		
Wheat bran	170.2	160.6	152.1
Co-op feed	308.6	291.2	275.7
Ground maize	174.0	82.1	———
Molasses	———	138.3	262.0
Clover hay	347.2	327.8	310.2
Chemical composition,% DM basis:			
Dry matter	90.5	88.3	86.3
Crude protein	17.0	15.4	14.0
Crude fiber	15.7	14.7	13.8
Ether Extract	4.1	3.6	3.1
Ash	10.8	12.2	13.4
Soluble carbohydrates(NFE)	52.4	54.1	55.7

livers, four compartments of the stomach, small and large intestines (full and empty) were recorded. The weights of each of these parts as percentages of body weights were also calculated. Dressing percentage was calculated as the ratio between hot carcass weight including the tail relative to fasting live weight.

Chemical analysis

Representative samples of dietary ingredients were analyzed for dry matter (DM), Ash, nitrogen (N), Ether extract (EE) and crude fibers (CF) according to the O.A.A.C. (1970). Soluble carbohydrates were determined by difference (NFE).

Statistical analysis

Data for daily live weight gain, gross efficiency (g gain/100 g SV or TDN eaten) and carcass characteristics were subjected to analysis of variance for unequal numbers according to Snedecor and Cochran (1967).

Results

All animals (except one) remained healthy and completed the experiment. One lamb receiving diet B died during the trial. Post-mortem examination showed that pulpy kidney was the main cause of death, which was not related to treatment. The fact that no death losses occurred in the group of lambs given the highest level of molasses (diet C) may further support the above conclusion. All animals consumed their diets with no palatability problems.

Lamb performance

Mean values with their standard error (SE) for daily live weight gains, gross efficiencies and food intakes are presented in Table 2.

Table 2. Mean performance of Ossimi lambs given diets containing graded amounts of cane-molasses in place of dietary maize.

Item	Treatment (A) 0% molasses	(B) 14% molasses*	(C) 26% molasses*
Initial body weight(kg)	16.0±2.2	15.9±2.4	17.5±2.1
Final " " "	35.1±3	36.7±3.3	34.1±2.8
Daily live weight gain(g)	145±15	147±16.4	126±12.9
Food intakes(gDM/head/day)	1041.3	1103.3	1165.4
TDN** (kg)	699	699	699
SV** (kg)	582	582	582
Gross efficiency***			
TDN	20.7	21.0	18.0
SV	24.9	25.3	21.7

* As percentage of dietary maize(on DM basis).

**Calculated on the basis of the values published in Abou-Raya(1967).

*** g gain/100 g SV. or TDN. intake.

Analysis of variance showed no significant differences in daily gains or gross efficiencies between the three groups of lambs. However, lambs given the highest level of molasses (26%) grew at a slower rate and were less efficient in their diets into live weight in comparison with the groups of lambs given either 0% or 14% molasses.

Apparent digestibility of nutrients

Mean values for apparent digestibility of DM, OM, N, EE, CF and soluble carbohydrates are presented in Table 3. The replacement of maize with molasses in diets for growing lambs appears to depress apparent digestibility of all nutrients. The magnitude of this depression was highest for lambs maintained on the highest level of molasses. The most pronounced reduction in apparent digestibility was that of CF, N and EE. Only the reduction in CF and nitrogen digestibilities will be considered in the general discussion because of their greater contribution to the diet in comparison with ether extract.

TABLE 3. Mean values for apparent digestibility of nutrients of lambs given graded amounts of molasses in place of dietary maize.

	Ration A 0% molasses	Ration B 14% molasses	Ration C 26% molasses
Apparent digestibility %			
Dry matter(DM)	70.4	62.9	56.8
Organic matter(OM)	72.4	62.7	58.0
Nitrogen (N)	67.6	58.5	42.4
Ether Extract(EE)	85.6	57.9	57.5
Crude Fibers(CF)	53.9	38.8	29.7
Soluble carbohydrates	76.1	73.0	69.5

Carcass characteristics and slaughter data

Mean values with their SE for dressing percentages and slaughter data are presented in Tables 4 and 5.

Table 4: Mean values with their SE* for dressing percentage and slaughter data of Ossimi lambs given graded amounts of cane-molasses in place of dietary maize.

Criteria	Treatment		
	A	B	C
Dressing percentage	51.2±1.5	53.7±1.6	50.8±1.4
Carcass+tail weight(kg)	17.8±2.8	18.7±3.1	15.5±2.6
Tail weight(kg)	1.4±0.45	1.5±0.50	1.6±0.42
" " as% of B.W.	4.1	4.3	4.7
Head weight(kg)	2.0±0.20	2.1±0.22	2.1±0.18
" " as% of B.W.	6.0	6.0	6.0
Legs weight(kg)	0.75±0.04	0.76±0.05	0.74±0.04
" " as% of B.W.	2.2	2.2	2.2
Fleece weight(kg)	0.59±0.09	0.58±0.10	0.66±0.09
" " as% of B.W.	1.7	1.7	2.0
Pelt weight (kg)	1.75±0.24	2.04±0.26	1.97±0.22
" " as% of B.W.	5.1	5.9	5.9
Ribs weight(kg)	0.93±0.10	0.94±0.11	0.85±0.09
" " as% of B.W.	2.7	2.7	2.6
Heart weight(kg)	0.20±0.01	0.20±0.01	0.16±0.01
" " as% of B.W.	0.6	0.6	0.5
Liver weight (kg)	0.59±0.05	0.56±0.05	0.55±0.05
" " as%of B.W.	1.7	1.6	1.7
Lungs weight(kg)	0.51±0.03	0.45±0.04	0.45±0.03
" " as% of B.W.	1.5	1.3	1.4
Kidney weight(kg)	0.23±0.03	0.28±0.04	0.20±0.03
" " as% of B.W.	0.7	0.8	0.6
Spleen weight(kg)	0.062±0.01	0.063±0.01	0.053±0.01
" " as% of B.W.	0.2	0.2	0.2

* S.E.- Standard Error.

Statistical analysis showed that the replacement of maize with different levels of molasses had no significant effect on dressing percentage or other slaughter data. However, lambs given the medium level of molasses appear to have slightly higher dressing percentage than the other two groups of lambs. Also lambs given the

Table 5. Mean weight and their S.E. for the stomach, small and large intestines of lambs given graded amounts of cane molasses in place of dietary maize.

Criteria	Treatments A	B	C
Weight of four compartments of the stomach.			
1. Full(kg)	4.3±0.42	3.7±0.46	4.5±0.39
" as% of B.W.	12.4	10.7	13.5
2. Empty (kg)	1.03±0.07	1.02±0.07	1.01±0.06
" as% of B.W.	3.0	3.0	3.0
Weight of the small intestine.			
1. Full (kg)	1.2±0.10	1.2±0.11	1.1±0.09
" as% of B.W.	3.5	3.5	3.3
2. Empty (kg)	0.79±0.09	0.86±0.11	0.66±0.09
" as% of B.W.	2.3	2.5	2.0
Weight of large intestine.			
1. Full (kg)	1.73±0.20	1.64±0.22	1.51±0.18
" as% of B.W.	5.0	4.7	4.5
2. Empty (kg)	0.85±0.10	0.84±0.22	0.75±0.08
as% of B.W.	2.5	2.4	2.3

highest level of molasses had the lowest dressing percentage values. They had however, the highest tail weight either in absolute terms or expressed as a percentage of body weight.

The inclusion of cane-molasses up to the levels used in this experiment had no significant effect on the weights of the different parts of the digestive tract. Similar trend was recorded when these parts were related to live weight.

Discussion

The present results showed that cane-molasses can be included in lamb diets up to 26% of the DM with no palatability problems

encountered. The quantities of molasses consumed/lamb/day were about 152g and 305g on the low and high levels of molasses respectively. These results were on agreement with those of Jordan and Hanke (1958), who reported that lambs can consume up to 500g molasses/head/day with no acceptability problems.

Lamb performance

The growth trial showed that lambs given the low level of molasses (14% in the DM) performed nearly similar to the control group in terms of daily gains and gross efficiency (Table 2). However, those given the high level of molasses (26% in the DM), grew at a slower rate and utilized their diets less efficiently than the other two groups of lambs. These results suggested that, when included in the diets up to 14% in the DM, molasses appear to have no adverse effects on lamb performance. Merion *et al.* (1965) and Zorrilla and Merino (1972), found that lambs performed satisfactorily on diets containing 10 to 20% molasses. When the level of molasses was increased from 20 to 30 or 40% in the diet, lamb performance depressed greatly.

Nutrients digestibility

The results of the digestibility trials showed that apparent digestibility of most nutrients decreased as the level of molasses increased from 0 to 14 or 26% in the DM (Table 3). This reduction was most pronounced for CF and N digestibilities. To explain the reason (s) for the reduced digestibility with molasses, it is reasonable to assume that both the physical form and the type of carbohydrate have been altered when maize was replaced by molasses. Both factors may have altered the type of rumen fermentation. Orskov *et al.* (1974), showed that feeding whole barley grains to early weaned lambs was superior in terms of nutrients digestibilities to ground grains. The rumen pH was considerably higher with whole than with ground grains (6.4 vs 5.4). Similar situation may have occurred in the present study, by feeding molasses in place of maize. Thus molasses may have been fermented more rapidly than maize, leading to an early fall in rumen pH. The reduced rumen pH may have inhibited the activity of cellulytic bacteria thus reducing DM, OM, and CF digestibilities (see Orskov *et*

al., 1974). Martin and Wing (1966), found that increasing the level of molasses from 6 to 18% in rations for fattening steers depressed digestibilities of DM, cellulose and energy.

The type of dietary carbohydrates, has been also found to affect the pattern of rumen fermentation. Marty and Sutherland (1970), Marty and Henderickx (1973) and Orskov (1975), reported that the inclusion of high levels of glucose or sucrose in the diets tend to enhance a butyric acid type of fermentation. Diets with high levels of starch usually characterized with high propionic acid type of fermentation. The former type of fermentation is likely to be similar to that of molasses containing diets. The production of butyric acid may have altered the ratio of 2.25 to 3.0 of non-glucogenic to glucogenic metabolites entering intermediary metabolism and needed for optimum energy utilization in case of growth and fattening as suggested by Orskov (1975).

It is also possible that a secondary type of fermentation may have occurred in the rumen with molasses leading to the conversion of VFA's to CO_2 and methane, thus reducing energy availability to the animal (Rowe *et al.*, 1979).

Nitrogen digestibility decreased with increasing level of molasses in the diet. If it is assumed that varying quantities of molasses have escaped rumen fermentation, it will only be formented in the have escaped rumen fermentation, it will only be fermented in the intestine (Dollar and Porter 1957, Huber *et al.*, 1961; Siddons, 1968; and Orskov *et al.*, 1972).

Fermentation of molasses in the lower tract may have increased faecal nitrogen (Orskov and Foot, 1969), thus leading to an under estimation in nitrogen digestibility. Along with the possible effects of molasses on rumen metabolism may be sufficient to explain the reduced lamb performance on the high level of molasses.

The present results showed that the levels of molasses used in this experiment had no significance effect on dressing percentage or other slaughter data. These results were possibly expected since such data are usually more affected by differences in levels of feeding, protein and energy levels (see Soliman, 1971).

Finally, it may be concluded that molasses can be successfully used in lamb diets up to at least 14% in the DM, with no adverse effects on lamb performance. Work in progress is being undertaken as examine the possibility of using either buffers or NPN sources or both diets containing high levels of molasses.

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تأثير احلال المولاس محل الذرة على اداء الحملان

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اجريت تجارب ـ شملت الدراسة على استخدام مستويات مختلفة من المولاس وتاثيرها على الصفات الانتاجية فى اغذية الحملان

استخدم ثلاث علائق تجريبية الاولى كانت للمقارنة وتحتوى على مولاس بينما الثانية والثالثة تحتوى على ١٤ ، ٢٦٪ مولاس من المادة الجافة على التوالى . وقد اوضحت النتائج عدم وجود اختلافات معنوية بالنسبة لمعدلات النمو او كفاءةالتحويل الغذائى بين المجاميع التجريبية المختلة . الا ان الحملان المغذاه على مستوى المولاس المرتفع قد نمت اقل واستفادت من غذائها بكفاءة اقل من المجاميع صفر ١ و ١٤٪ مولاس .

معاملات الهضم الظاهرية للمادة الجافة والمادة العضوية والالياف الخام والنيتروجين والدهن كانت تقل بزيادة مستوى المولاس فى الغذاء وكانت اكثر مكونات الغذاء تاثيرا الالياف والنيتروجين والدهن .

وقد وجد ان مستوى المولاس لم يكن له تأثير معنوى على نسبة التصافى وبعض القياسات الاخرى التى اخذت على الحيوان قبل وبعد الذبح .

وقد نوقشت النتائج على اساس هضم وتمثيل العلائق المحتوية على مولاس فى كل من الكرش وباقى القناة الهضمية .

وقد استنتج انه من الممكن اضافة المولاس فى علائق تسمين الحملان الاوسيمى بنسبة ١٤٪ على الاقل من المادة الجافة .