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EFFECTS OF SUPPLEMENTING MOLASSES VIA DRINKING WATER ON LAMBS PERFORMANCE AND CARCASS CHARACTERISTICS

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Abstract

Fifteen Turkish Karayaka lambs of similar live weights (LW) 36±4.62 kg were placed in three groups of 5 each and fed similar diets. The drinking water of the T1 and T2 groups was supplemented with molasses (Mo) at 50 and 100ml/5Lwater/lamb, respectively, while Mo was not provided to the control group lambs (C). Three lambs per group were slaughtered to study carcass characteristics. Daily total DMI in C, T1, and T2 were almost the same at 1.75, 171, and 1.77 kg/d, respectively. Final and daily LW gains were not affected (P>0.05) by Mo supplementation although T2 and T1 lambs had numerically higher LWs at 4.8 and 1.6 kg, respectively. Differences were not observed (P>0.05) between treatments in shrinkage, rib eye area, fat thickness, and dressing percentage based on LW and empty BW. Adding Mo resulted in an increase in slaughter weight by 5.6 and 8.6 kg in T1 and T2, respectively compared to C. Similarly, lambs in the T1 group yielded a numerically higher (P>0.05) dressing percentage based on body weight (51.71%) than those in C (49.31%). There was no effect (P>0.05) of Mo on all wholesale cuts and offal organs except shoulder cuts and lungs trachea which were lower (P<0.05) in the treated groups compared to C. Lambs in C had numerically higher lean percentages than the Mo-supplemented groups though fat value was lower. The Mo supplementation numerically increased lambs LBW due to higher body fat at the expense of lean mass.

Keywords: Molasses, Drinking water, Performance, Carcass traits, Lambs.

تأثير إضافة المولاس عن طريق مياه الشرب على أداء الحملان وصفات الذبيحة

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الخلاصة

تم توزيع 15 حملاً من سلالة كرياكة التركية الى ثلاث مجاميع متساوية بواقع (5 حملان/ مجموعة) وبمعدل وزن الجسم 36 كغم، حيث تم تغذيتها على عليقة متماثلة. تم إضافة المولاس في T1 وT2 بمعدل 50 و100 مل/ 5 لتر ماء/ حمل على التوالي. أما الحملان في مجموعة (C) بدون إضافة المولاس. تم ذبح ثلاث حملان/ مجموعة وذلك لغرض دراسة صفات الذبيحة. تبين DMI اليومي للمجموعات C و T1 وT2 متقاربة (1.75 و171 و1.77 كغم/ يوم) على التوالي. كذلك لم يتأثر الوزن النهائي والزيادة اليومية (P>0.05) باضافة المولاس. على الرغم من أن الحملان في T2 وT1 كان وزنها أعلى حسابياً بمقدار 4.8 و1.6 كغم على التوالي قياساً لمجموعة (C). كما لم يتم ملاحظة فروقات (P>0.05) بين المعاملات في الانكماش، مساحة العظلة العينية، سمك الدهون ونسبة التصافي محسوباً على وزن الجسم الحي والفارغ. أظهرت النتائج بأن اضافة المولاس أدت إلى زيادة حسابية في وزن الذبح بمقدار 5.6 و8.6 كغم في (T1 وT2 على التوالي) مقارنة بمجموعة (C). وعلى نفس المنوال، أنتجت الحملان في المعاملة T1 نسبة التصافي أعلى حسابياً (P>0.05) استناداً الى وزن الجسم (51.711٪) من تلك الموجودة في المجموعة C (49.31٪). كما لم يتبين اي تأثير للمولاس على جميع القطع والأعضاء الداخلية باستثناء الكتف والرئتين والقصبة الهوائية التي كانت أقل في المجموعات المعاملة قياساً لمجموعة C. تبين ان النسبة المئوية للحوم الحملان في مجموعة C أعلى (57.29٪) مقارنة بمجموعات المعاملة لكن نسبة الدهن أقل (21.56٪). ان اضافة المولاس ادت إلى زيادة الوزن حسابياً من خلال زيادة الدهون في الجسم على حساب كتلة اللحم.

كلمات مفتاحية: المولاس، مياه الشرب، اداء الانتاج، صفات الذبيحة، الحملان.

Introduction

Sheep are an integral component of Iraq's rural economy because of their capacity to adapt in harsh environments and incur little capital costs. Cereal straw is widely used as a main feedstuff for sheep throughout the year (2). Straw, a nutritionally valuable roughage with low digestion and intake, high fiber content, and rumen fill, is crucial for controlling voluntary intakes especially when harvested at higher plant maturity. The imbalance in nutrients made available by rumen fermentative digestion is the first constraint to their better utilization. As animals fed solely on straw have negative energy balance energy and nitrogen supplements are used to improve their nutritional status. Low-quality diets lack energy, amino acids, and glucose precursors, limiting gluconeogenesis and acetate utilization (7). Therefore, adding both energy and protein supplements is important to maintain animal production.

Soluble carbohydrates or non-structural carbohydrates (NSCs) from molasses can increase energy, nitrogen utilization, and ruminal outflow rates. NSCs have also been found to elevate the molar proportion of rumen volatile fatty acids (VFA) such as propionate. Besides enhancing the supply of amino acids from microbial protein synthesis, they boost gluconeogenesis, thereby ensuring more efficient utilization of acetate when animals are fed low-quality forages (9 and 10). Consequently, using agro-industrial by-products such as molasses (that are rich of energy) for ruminant feed is a cost-effective and environmentally friendly solution to reduce waste discharge and waste management costs (16, 26 and 34). This approach has gained importance including in the interoperability of plant and animal production (15).

Feeding molasses to ruminant animals takes various forms and proportions. Molasses is used as a binding agent to stick feed ingredients with additional minerals for sheep in order to distribute them uniformly (17). Molasses is also fed directly after dilution with water and poured over fodder in the manger or trough. Moreover, molasses has partially replaced cereals (28 and 30), or oral drench (13). It is stated that supplementing molasses via oral drench in sheep did not depress rumen fermentation or blood metabolites (13). In an evaluation of nutritional influence on animal performance, (22) reported that lambs fed high energy diets had greater feed conversion ratios, live weights (LW), and dressing percentages compared to lower energy diet animals. Moreover, molasses-fed calves showed lower dressing percentage, less excessive fat, and higher edible meat (31). Thus, the use of carcass as a parameter is essential to determine the animal’s efficiency in converting feed to meat production (4 and 18). Lamb carcass parameters are affected by factors such as feeding system, and slaughter and carcass weights (4, 5 and 44). Thus, understanding the influence of nutrition and stage of maturity on lamb growth performance may offer better means to achieve effective feed conversion into meat production by the growing lambs with optimum fat content and minimum bone composition (5 and 27).

Crude glycerol supplemented via drinking water to lambs resulted in a numerically lower feed intake and LW increase (32). However, crude glycerol is costlier compared to molasses. Moreover, to best of our knowledge no studies have been conducted in Iraq on the effects of molasses supplementation via drinking water on lamb performance and carcass characteristics. Therefore, this investigation evaluates the influence of supplementing molasses at 50 and 100 ml/5L/lambs per day on lamb performance and carcass characteristics.

Materials and Methods

This study was conducted at the Grdarasha farm of the Agricultural Engineering Science College, Salahaddin University, Erbil using 15 male Turkish Karayaka lambs with similar body weights (LW) of 36±4.62 kg. The lambs were allocated randomly by LW to one of three dietary treatments (Table 1). The supplemented molasses (5L/lamb per day) was dissolved daily in drinking water.

Table 1: Dietary treatment*.

Code	Treatment
Control	**No molasses added**
T1	**50ml molasses/5Lwater/lamb**
T2	**100ml molasses/5Lwater/lamb**

*Molasses HAT VET (Antakya-Hatay, Turkiye) Ltd.

The animals were kept in groups over a period of 80 days and fed a diet of forage and concentrate at 8 am and 4 pm daily. Their LW was recorded fortnightly (at 1 pm) to assess their performance. The forage was wheat straw and the concentrate was mush feed from a commercial feed mill company (MegaFarm, Erbil-Iraq). The diets were similar across all dietary treatments except for the molasses supplementation dissolved in drinking water.

At the end of the study period, three lambs from each group (2 having minimum and maximum final LW, and the third with intermediate LW, with their average LWs almost similar to that of the five lambs in each group) were slaughtered. All three lambs were slaughtered according to the Islamic method at a slaughterhouse as described by (4 and 5). The throat and major blood vessels in the neck were severed, and the animals were skinned immediately after they were eviscerated. Following that the carcass and non-carcass components, as well as the hot carcass parts such as kidney, kidney fat, edible offal comprising testes, spleen, liver, heart, lungs, and trachea were weighed. The attached cardiac fat was removed and weighed. Finally, the gastro-intestinal tracts were weighed, emptied of their content, and washed prior to weighing to determine empty body weight by subtracting the weight of the gut content from the slaughter weight.

The carcasses of the lambs were chilled at 4˚C for 24 h to determine their cold carcass weight. The attached fat from the kidneys and pelvic areas were removed and weighed. The carcasses were divided into two along the vertebral column with an electric saw. Prior to weighing the left side was cut into nine cuts. The area of the longissimus dorsi muscle (at the 12th rib) was determined with a Placom digital planimeter (KP-92 N, KOIZUMI-Sokki, Japan). Fat thickness perpendicularly over the midpoint of the L-dorsi muscle were measured using a digital caliper.

The statistical program GLM (general linear model) within SAS (35) was employed for data analysis and to determine the effect of different levels of molasses on the studied traits. The differences between the sub classes of each factor were tested using the Duncan multiple range tests (12).

Results and Discussion

Daily dry matter intake throughout the 80-day study period for the C, T1, and T2 groups was almost similar at 1.75, 171, and 1.77 kg/d, respectively. The addition of molasses (up to 20%) had no effect on the lambs' dry matter intake (16) and on the dietary treatments (final LW and daily LW gain; P>0.05) (Table 2), although the T2 lambs had numerically higher final LW (4.8 kg) and DLWG compared to the C group. Similarly, lambs in T1 had more LW (1.4 kg) and DLWG compared to the C group, indicating that supplemented molasses especially for T2 resulted in higher LW. This can benefit farmers economically. The positive effect of molasses on the performance of ruminant animals has been attributed to the higher feed digestibility (16) and palatability (29).

Earlier studies report that the inclusion of 205% molasses in Afar sheep diets increased organic matter digestibility and final LW gain compared to a no molasses diet. The improvement in lambs LW via molasses supplementation in this study were not accompanied by any adverse effects on the animals' overall health. All lambs were healthy and there was no sign of sickness such as isolation from flocks, abnormal eating habits, and diarrhea. However, the inclusion of soybean molasses into the feed of lambs did not alter performance parameters such as DMI, final LW, and ADWG (33). This discrepancy in the effect of molasses on animal performance could be attributed to the method of supplementation of molasses. Based on the results of this study, the supplementation of molasses via drinking water showed superior results compared to inclusion in diets.

Table 2: Effect of molasses supplementation via drinking water on Karayaka lamb performance.

Parameters	C	T1	T2	Significance
Initial live weight, kg	36.00±5.30	36.02±3.12	36.00±6.03	0.995
Final live weight, kg	54.20±5.57	55.80±4.26	59.00±7.34	0.242
DLWG, kg/d	0.23±0.074	0.26±0.045	0.29±0.050	0.158

*C=control (no molasses supplementation); T1 and T2 = 50ml and 100ml/5L/lamb molasses supplementation, respectively.

Both slaughter body weight and hot carcass weight in T2 and T1 were numerically higher than C lambs and did not reach significance (P>0.05) (Table 3). The inclusion of molasses treatment had the highest final LW, slaughter body weight, and hot carcass weight while the control group lambs had the lowest weights. This could be attributable to the differences in the final LWs in T2 and T1. Both (11 and 16) stated that a higher carcass weight was linked to the higher final LW. In this study, rib eye area was not affected by dietary treatment (P>0.05). Similarly, there was no effect (P>0.05) of molasses supplementation on both shrinkage percentage and fat thickness. Dressing percentage (based on LW) of lambs in T1 and T2 groups were numerically higher (P>0.05) with mean values of 51.711 and 49.785%, respectively compared to the control (49.305%). In addition, there was no difference in dressing percentage (based on empty body weight) amongst lambs treated with molasses and control (Table 3).

Likewise, there were no significant differences in dressing percentage when sugarcane condensed molasses solubles were offered to sheep and cattle (8, 21 and 45). Hence, the changes in dressing percentage could have resulted from the changes in final LWs of the lambs supplemented with molasses as (16 and 28). For instance, lambs in the control group had the lowest final LW and dressing percentage. An increase in slaughter weight resulted in an increase in fat percentage (43). Besides, body fat increase was accompanied with a rise in dressing percentage (6, 41 and 42). (38) reported that lambs with higher slaughter weights also had higher dressing percentages, meaning that heavier carcasses were fatter than lighter ones, although subcutaneous fat content in this study was almost the same amongst C and treated animals. According to (33), the lack of molasses effect on subcutaneous fat of feedlot lambs has been linked to two possible factors. Firstly, the animals were slaughtered in a commercial slaughterhouse; thus the evaluation may have been compromised by traditional skinning methods (39), with excessive subcutaneous fat left in the leather. Secondly, acetate is regarded as the main substrate for subcutaneous fat synthesis (37), and the roughage offered in this study contained the same amount of wheat straw and total DMI as mentioned above in all dietary treatments. This possibly prevented any changes in the produced rumen content of the acetate acid and in subcutaneous fat.

Table 3: Effect of supplementing molasse on the carcass characteristics of Karayaka lambs*.

Characteristics	C	T1	T2
Slaughter wt.	54.00 ±4.163	55.67±3.712	58.67 ±5.783
Hot carcass wt.	26.60±1.946	28.76±1.768	29.29±3.339
Chilled carcass wt.	26.34±1.889	28.53±1.785	29.13±3.274
Shrinkage %	0.98 ±0.180	0.82 ±0.148	0.54 ±0.151
Rib eye area (cm2)	16.27±1.757	15.97±1.410	15.90 ±1.400
Fat thickness (mm)	3.03 ±0.246	3.04 ±0.021	3.24 ±0.403
Dressing %/ live wt.	49.31±1.011	51.71±0.623	49.79±0.749
Dressing %/ empty body wt.	54.70±1.519	56.70±0.761	55.35±1.182

*C= control (no molasses supplementation); T1 and T2 = 50ml and 100ml/5L/lamb molasses supplementation, respectively.

There was no effect (P>0.05) of molasses on all wholesale cut parameters as a percentage of chilled carcass weight except for shoulder cuts which were higher (P<0.05) in the control groups compared to T1 and T2 (Table 4). Correspondingly, molasses distillers condensed solubles did not affect the proportion of wholesale cuts of fattening lambs compared with control (25). Moreover, lambs in the control group had significantly higher shoulder and numerically lower fat tail than the molasses-treated groups, their proportions of shoulder cuts decreased, while fat tail percentage increased with higher slaughter weight. Similarly, offering a diet with 10% molasses resulted in a higher percentage of lambs' fat-tail compared to other groups. In another study, (3) observed that with higher slaughter weights, the percentage of shoulder decreased while that of fat tail increased significantly. These differences reflect the influence of fat deposition.

Table 4: Effect of supplementing molasses on wholesale cuts from Karayaka lamb carcasses as a percentage of chilled carcass weight*.

Cuts	C	T1	T2
Left side of the carcass	12.93 ±0.926	14.25 ±1.162	14.25 ±1.652
Legs %	26.49 ±0.895	25.50 ±0.488	25.45 ±0.268
Loin %	9.75 ±0.329	9.81 ±0.595	9.56 ±0.389
Neck %	7.19 ±0.066	7.31 ±0.475	7.69 ±0.222
Shoulder %	19.17 ±0.619a	16.50 ±0.533b	16.01 ±0.500b
Fore shank %	3.06 ±0.095	3.19 ±0.206	3.49 ±0.130
Breast %	8.01 ±0.182	9.73 ±1.279	9.77 ±0.660
Rack %	6.34 ±0.229	6.29 ±0.599	6.78 ±0.293
Flank %	1.92 ±0.131	2.24 ±0.258	2.06 ±0.193
Fat tail %	18.08 ±0.813	19.44 ±1.639	19.20 ±1.415

*C=control (no molasses supplementation); T1 and T2 = 50ml and 100ml/5L/lamb molasses supplementation, respectively.

*Means with different letters within each row differ significantly (P≤0.05) according to Duncan's test.

Supplementation of molasses had no significant (P>0.05) effect on rack tissue such lean, fat, bone, lean fat ratio, and lean bone ratio (Table 5). However, the lean percentage of lambs in the control group was numerically higher than for the treatment groups in rack cuts. On the other hand, fat proportion numerically increased with increasing levels of molasses. In addition, it was obvious that the lean-to-fat ratio (2.699±0.232) was greater in lambs slaughtered at 54 kg than at 55.67 and 58.67 kg. Likewise, it was reported that carcass lean/fat ratios decreased with higher slaughter weights (4, 19 and 44). Therefore, the numerically higher lean proportion in C lambs, and higher fat proportion in the molasses-supplemented lambs in this study could be attributed to two factors. Firstly, molasses via gluconeogenesis produce glucose, converting it to pyruvic acid and then to acetyl CoA resulting in de novo fat synthesis and increased rack-fat proportions (24). The second factor is that the fat content of the carcass rack cuts increased with higher slaughter weights from 54.00, 55.67 to 58.67 kg (Table 5). It well-recognized that fat is a late-growing body tissue. Consequently, proportions in the carcass are greatly changed with the progress of growth (3). Furthermore, (6) reported that lambs with fatter carcasses have higher dressing percentages. Consequently, carcass containing less fat may have lower dressing percentages.

The proportion of bone in rack cuts was numerically higher in T1 compared to the T2 and control groups. There was a reduction in the bone proportion of rack cuts in lambs slaughtered at different LW. Those slaughtered at 54 kg had lower back bone cuts than those at 58.67 kg. It is accepted that bone is an early maturity carcass component. Hence, it may result in slower growth rates during post-natal life which may decrease with higher body weight (20 and 23). Moreover, it was reported that as slaughter weight increases it mainly caused a rise in fat and a reduction in bone proportion of carcasses (1, 14, 27 and 36).

Table 5: Effect of supplementing molasse on the physical components of the rack parameters (%)*.

Rack Parts	C	T1	T2
Lean	57.29±0.342	52.69±0.545	53.15±2.309
Fat	21.56±1.959	23.49±2.695	26.61±3.193
Bone	21.15±1.830	23.82±3.158	20.24±0.944
Lean: Fat Ratio	2.70±0.232	2.31±0.276	2.09±0.381
Lean: Bone Ratio	2.75±0.252	2.29±0.302	2.63±0.053

*C= control (no molasses supplementation); T1 and T2 = 50ml and 100ml/5L/lamb molasses supplementation, respectively.

*Means with different letters within each row differ significantly (P≤0.05) according to Duncan's test.

There was no difference (P>0.05) among lambs in all groups for offal organs as a percentage of chilled carcass weight. The exception were lungs and trachea which registered higher percentages (P<0.05) in the control over the treated groups (T1 and T2) (Table 6). (25) also found that the proportion of organs of lambs fed on molasses diets were similar to those of control. Moreover, similar results concerning carcass characteristics were reported by (40) on Lori fattening lambs using 15% MCDS treatment. Fat is the most variable tissue in the carcass, and it fluctuates not only in total amount but also in distribution among the various deposits which alters substantially during growth. In addition, in meat animals, both the proportion and location of fat in the body are vital (22). In this study, fat percentages in kidneys, pelvic, and heart increased numerically with higher levels of molasses due to increased slaughter weights. This implies that the proportion of these organs' fat percentage were higher in T2 than other groups. Similarly, (3) reported that heart fat percentage increased significantly with increasing slaughter weight. However, (25) found that lambs fed diets containing molasses distillers condensed solubles had lower internal fat than those in the control groups.

Table 6: The effect of supplementing molasses on offal organs as a percentage of slaughter weight*.

Offal organs	C	T1	T2
Liver	1.53 ±0.124	1.53 ±0.054	1.52 ±0.092
Kidney	0.25 ±0.008	0.26 ±0.011	0.26 ±0.009
Lungs trachea	1.61 ±0.057 ^{a}	1.30 ±0.083 ^{b}	1.44 ±0.059^{ab}
Heart	0.40 ±0.053	0.41 ±0.050	0.40 ±0.003
Spleen	0.21 ±0.029	0.20 ±0.057	0.23 ±0.030
Testes	0.65 ±0.142	0.55 ±0.115	0.58 ±0.089
Full digestive tract	17.04 ±0.279	16.84±0.564	16.56 ±0.294
Gut wt.	9.82 ±1.226	8.79 ±0.155	10.04 ±0.572
Empty digestive tract	7.23 ±1.225	8.05 ±0.623	7.03 ±0.520
Empty body wt.	90.18±1.226	91.21 ±0.155	89.96 ±0.572
Kidney and pelvic fat	0.21 ±0.098	0.30 ±0.186	0.31 ±0.102
Heart fat	0.11 ±0.036	0.15 ±0.024	0.24 ±0.061

*C= control (no molasses supplementation); T1 and T2 = 50ml and 100ml/5L/lamb molasses supplementation, respectively.

*Means with different letters within each row differ significantly (P≤0.05) according to Duncan's test.

Conclusions

Molasses supplementation via drinking water in this study had no significant effect on animal performance although it resulted in a numerical increase in both final and daily LWs. In addition, the carcass characteristics of the Karayaka lambs, wholesale cuts, physical components of the rack parameters, and offal organs were not significantly affected by the molasses augmentation. However, with the higher levels of molasses, the slaughter weight of lambs numerically increased by 5.6 and 8.6 kg in the T1 and T2 groups, respectively compared to C-group lambs. In addition, lean percentage decreased while fat percentage increased numerically in the rack cuts with higher molasses inputs.

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Author Contributions:

Both authors contributed in methodology, writing—original draft preparation, review, and editing. They have read and agreed to the published version of the manuscript.

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The data supporting the findings of this research is available upon resendable request from the corresponding author.

Conflicts of Interest:

The authors declare no conflict of interest.

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