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Original Article

Impact of Molasses Supplementation in Drinking Water on Lamb Performance and Biochemical Parameters

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ABSTRACT

Utilizing agro-industrial by-products like molasses in ruminant feed offers a cost-effective and sustainable way to reduce waste discharge and management costs. This approach enhances resource efficiency while supporting environmentally responsible livestock production. Hence, this study was aimed to assess molasses supplementation to drinking water during fattening period on lamb's performance and some blood biochemical parameters. Fifteen Karayaka Turkish breed lamb were randomly (based on their live weight; weighing an average of 36.00 ± 4.62 kg) allocated to one of three treatment groups (five lambs for each treatment). Lambs feeding were as group and the study lasted 61 days. The offered diet was a standard (Total Mixed Ration) concentrate and wheat straw at ratio of 70:30, and similar amongst all treatments. While, the molasses supplementation via drinking water was varied (at a level of 0, 50, 100 ml/5L/lambs) among control and treated groups T1 and T2 respectively. Molasses supplementation had no effect ($P>0.05$) on the performance of experimental lambs (weekly live weigh and weight gain). Although, lambs in T2 group had numerically greater live weight (above 2 kg) at the end of the study (week8) compared to lambs control group. Blood serum metabolites such glucose, total protein, creatine, total cholesterol were not affected ($P>0.05$) by drinking molasses. Except, triglyceride in lambs T2 group were elevated ($P<0.05$) in comparison with the control groups. Blood serum minerals (Na, K, and Cl) and liver enzymes (GOP, GOT, and ALP) were not significantly ($P>0.05$) changed by molasses in T1 and T2 compared to C lambs. In conclusion, molasses supplementation via drinking increased (numerically) production (2 kg live weight), without having any detrimental effect on lamb's health. This would yield a better economic outcome.

Keywords: Molasses, water, lamb, performance, serum metabolites.

1 Introduction

Molasses is the final effluent remaining (when sucrose is no longer easily obtained for simple crystallization) after sugar extraction for producing white sugar via three steps (such evaporation, crystallization and centrifugation) of juices from sugar cane or sugar beets. As a result, molasses has a viscous consistency with dark brown-colored. Moreover, some nutrients, such as soluble carbohydrates, vitamins, and minerals, are rich in molasses [1]. However, molasses can be deficient in kind of vitamins and minerals such as vitamin C and phosphorus content [2]. In developing countries, small ruminants regarded as a vital livestock to socio-economic of smallholders. Although, insufficient nutrition is considered as a one critical concern and challenges affecting the ruminant livestock industry [3]. Molasses supplementation in the form of a block or a liquid feed is often recommended for straw-fed ruminants [4]. Many researchers have examined the effect of supplementing straw with molasses to sheep as an energy source [5,6]. They demonstrated that molasses inclusion may enhance rumen functions, digestion, and straw intake, nutrient digestibly, and live weight. Although, excessive levels of dietary supplements may cause microbial activity, rumen digestibility, and straw intake to be suppressed [5,4]. Moreover, the increase of water palatability via molasses inclusion in calves has been used a technique to increase intake, consequencing an improvement in animal health and production. As a positive correlation between water and concentrate intakes was reported [7,8]. However, there is lack information related to using molasses in drinking water as a means to improve lamb's performance.

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Supplementing concentrates with low-quality roughage (such as straw) enhances feed intake and digestibility, but it is unsuitable for small-scale livestock production due to inconsistent supplies and expensive pricing. Liquid coproducts (such molasses and crude glycerol) as alternative feed energy sources of supplements are needed for smallholder farmers [9]. By which small scale farmers better could have better means to enhance livestock production and profitability. Recently, the addition of molasses in the drinking water of Holstein-Friesian calves has been used to enhance animal performance and results showed an increase in daily live weight gain with a positive benefit to animal's health [8].In addition, using liquid coproducts (such crude glycerol) as alternative feeds and energy source (after being dissolved drinking water and offered to lambs) have shown a positive effect on lambs performance and there was no negative health consequences on lambs [10]. To the best our knowledge, dissolving molasses in drinking water and offered to lambs by which studying its impact on lamb's performance and blood metabolites have not yet been reported. We hypothesized that a molasses supplementation via drinking water would improve animal performance in lambs. Therefore, the present study was sought to evaluate the consequences of supplementing molasses at 50 and 100 ml/5l of water/lambs per day on lamb's performance and blood serum parameters.

2 Materials and Methods

2.1 Location, Animals, and Experimental Diets

The study was launched at Grdarash Research Centre - University of Salahaddin-Erbil, Agricultural Engineering Sciences College, from October - 2023 to January – 2024 (over a period of 61 days with adaptation period of 11 days). Karayaka Turkish breed male lambs with an initial mean body weight of 36± 4.62 kg. All lambs were used after being identified and treated to control internal and external parasites at the. The diets were isonitrogenous and isocaloric, and similar across all dietary treatments. The difference was only molasses supplementation. The diet was total mixed ration TMR) of concentrate and roughage. The TMR was daily manually mixed) at a ratio of 70:30 (DM basis) to give live weight gain (0.250 kg/d) [11]. The roughage was wheat straw, while the concentrate (mash concentrate). Which was secured from commercial feed mill (MegaFarm, livestock diet manufacture, Erbil, Iraq).

The composition of experimental diet (%) was including (soya bean meals (12.3), maize grain (20), wheat flour (25), wheat barn (29), wheat (9.5), urea (0.5), limestone (0.03), sodium bicarbonate (0.5), Salt (0.3), toxin binder (0.1), premix (2.5). Feed samples (straw and concentrate) were analysed at commercial feed laboratory (Afnan, Erbil, Iraq).) for DM (905,901 g/kg), Ash (57,63), CP (30,160), EE (13,30), and NDF (750,125) contents (g/kg DM) respectively. The metabolisable energy (ME) as a TMR for diet was 11.7 MJ/kg DM.

2.2 Treatments, routine, weight determination

Fifteen lambs (based on their body live weight (LW) were randomly assigned to one of three experimental groups (5 lambs per each groups). The experimental dietary treatments were as follows; control (C), no molasses (HAT VET, Antakya-Hatay, Turkiye- LOT no; HV 202311) supplementation. While, T1 and T2 were supplemented with 50 and 100 ml of molasses (daily dissolved in 5 litters of drinking water for each lambs in treated group) respectively. The lambs were kept in a well-ventilated shed (in groups), on wood shavings floor. Animals also had free accessed to water. Lambs in each dietary treatment groups were fed twice a day at (08:00 and 18:30 h). The remaining feed were weighed (every Saturday and Tuesday in a week) to determine feed intake in each groups. The lambs body LW were measured fortnightly, on Sundays at 11:00, using a digital weigh.

2.3 Collecting Blood Sample for Analysis

The collection of blood sample (via the jugular venipuncture) were carried out twice (at week 0 and 8 at 15:00h) throughout the experiment. Subsequently, blood put into plastic tubes (Becton Dickinson Vacutainer Systems, Plymouth, UK). Then, blood serum was harvested, following overnight blood being left in a refrigerator to coagulate, through centrifugation at 1000 g for 15 minutes [10]. The supernatant (serum) was then aliquot into 2 ml bijou tubes and stored at – 20 ºC for subsequent blood serum metabolite parameters such as total cholesterol, total protein, triglyceride, glucose, creatine, GOT (Glutamate Oxaloacetate Transaminase), GPT (Glutamate Pyruvate Transaminase), ALP (Alkaline Phosphatase), and minerals analysis such Na, K, and Cl. All samples were analysed via commercial laboratory (Med-Line laboratory for disease diagnosis, Erbil, Iraq).

2.4 Statistical Analysis

The MIXED procedure of SAS (SAS Inst. Inc., Cary, NC) were employed to perform statistical analysis. The experimental design was ANOVA as a 3x1 (one-way). The regression analysis was employed to calculate DLWG [10]. The means of treatment were calculated through the LSMEANS option. The significance was identified as $P < 0.05$ and trends as $0.05 \leq P \leq 0.10$.

3 Results and Discussion

3.1 Animal Performance Evaluation

According to Van Soest [12], feeding intake are affected by metabolic requirements and can impact body weight. Although, statistical analysis of daily dry mater intake DDMI in current study was not employed due to group feeding. Across all dietary treatment groups DDMI as followings; 1.67 (C), 1.65 (M1), and 1.70 (M2) kg/day. Indicating, lambs DDMI (kg/d) were more or less the same among dietary treatment. Similarly, the DMI was not differ in lambs when molasses was included diet up to the 20% [6]. Adding molasses to poor quality diet has been used as a mean to improve feed intake and palatability [13]. As, bacteria in the rumen rapidly degrade the carbohydrates in molasses, molasses provides a rapid release of energy, making it ideal for balancing other feeds in sheep fattening and could be used as energy source. This implying that the diet in current study was high quality. Hence, this confirming that molasses may be better to use with poor quality feed.

Across all dietary treatments of this study, the mean of ADLWG was 0.253±0.012 kg/d. This is close anticipated value (0.250

kg/d) by AFRC [11]. Similarly, Qoja and Hussein [10] reported that predicted ADLWG based on AFRC [11] was similar to the experimented results (0.251 kg/d). This confirms the validity of this prediction in lambs. There was no difference (P>0.05) amongst dietary treatment groups in both weekly live weight and ADLWG (Table 1). Although, at week 8, lambs in T2 groups had numerically higher (2.18 kg live weight) compared to C and T1 groups, and weekly live weight later groups were almost the same. These results are agreed with the results of serval authors [6,14,15,16]. Later, reported that inclusion of molasses up to 20% in diet fed to lambs resulted a numerical increase (2 kg live weight) compared to control groups. Besides, the positive effect of supplementing molasses on lambs live weight and ADWG have been linked to an enhancement in feed digestibility and feed intake resulted from molasses supplementation. As, discussed above DDMI in T2 was higher compared to C. Hence, the improvement in live weight at week 8 could be linked to the improvement in feed palatability caused by supplementing molasses. Osman et al. [17] reported that the improvement in final live weigh in goats when molasses supplemented was related to an enhancement in palatability produced by molasses. Adding molasses to livestock animals has been extensively uses as a mean to improve feed palatability [13].

Table 1: Weekly body live weight (kg) and daily live weight gain (kg/d) (DLWG) of lambs being supplemented with molasses via drinking water[1].

Time	C	T1	T2	Significance
Day 0	36.00±5.30	36.02±3.12	36.00±6.03	0.995
Day 0-18	40.16±5.11	38.40±3.36	39.72±6.55	0.857
Day 18- 32	42.94±4.80	42.44±3.52	42.70±6.38	0.988
Day 32-46	47.54±5.13	46.48±4.18	47.66±7.27	0.937
Day 46-60	50.08±4.89	50.22±4.19	52.26±6.64	0.775
DLWG, kg/d	0.240±0.06	0.260±0.05	0.272±0.02	0.533

[1]C= control (no molasses), T1= 50ml/5L/lamb molasses, T2= 100 ml/5L/lamb molasses.

3.2 Blood Serum Metabolites

Blood serum biochemical parameters such glucose, total protein, creating, total cholesterol, and triglyceride have been used to assess the side effects of supplementing of molasses to sheep and goat [14,16,18]. In current study, there weren't stated any negative impacts on body functions and production, and all blood serum parameters were within normal range [10,19]. In addition, supplementing molasses to lambs had no significant impact on blood serum glucose, total protein, creatine, total cholesterol (Table 2). Similarly, in sheep and goat, supplementation of molasses had no significant influence in blood serum metabolite parameters [14,16]. Though, at week 8, the highest (P=0.045) triglyceride were found in T2 group and the lowest triglyceride was in control group, with T1 group being intermediate. Triglycerides were employed to measure the energy status of the animals. Molasses metabolism in the liver can stimulate triglyceride synthesis, altering serum triglyceride concentrations [20]. This may clarify that triglyceride levels were significantly higher (P<0.05) in the T2 group than in C group.

Table 2: Effects of molasses supplementation (at week 0 and 8) via drinking water on blood serum metabolite parameters in lambs[1].

Parameters	C	T1	T2	Significance[2]
Glucose, µU/ml				
wk 0	45.64±15.44	52.60±5.29	49.12±4.74	0.550
wk 8	83.37±4.87	84.51±8.09	78.89±9.36	0.494
Total Protein, mg/dl				
wk 0	6.42±0.42	6.26±0.59	6.99±1.07	0.303
wk 8	4.17±0.16	4.37±0.5	4.37±0.43	0.646
Creatine, mg/dl				
wk 0	0.94±0.07	0.96±0.13	0.91±0.09	0.708
wk 8	0.99±0.10	1.00±0.12	1.02±0.06	0.862
Cholesterol, mg/dL				
wk 0	29.13±4.64	34.06±4.5	34.91±3.17	0.099
wk 8	54.57±11.6	53.00±8.9	48.57±4.61	0.556
Triglycride, g/dL				
wk 0	19.68±4.9	25.20±8.58	20.80±5.54	0.398
wk 8	17.60±4.51b	24.20±6.06ab	32.00±11.58a	0.045

[1]C= control (no molasses), T1= 50ml/5L/lamb molasses s, T2= 100 ml/5L/lamb molasses. [2] Means within a same row with different superscripts are differ significantly at P<0.05.

3.3 Blood Serum Mineral Concentrations

Molasses are considered rich in minerals and high proportion of sodium and potassium can be noted in beet molasses [2]. The adverse impact (such as diarrhea and low diet intake) of high level inclusion of molasses in chick's diet has been linked to potassium content in molasses [21]. In this study, the level of studied mineral was within normal range [19], and no symptoms of diarrhea were noted on animal during the study period. Blood serum minerals such Na, K, and Cl concentrations were not affected (P>0.05) by molasses (Table 3). This results are in lined with Moeini et al. [14].

Table 3: Blood serum minerals concentrations in lambs supplemented without or with molasses via drinking water[1].

Minerals[2]	C	T1	T2	Significance
Sodium (Na), mmol/dl				
wk 0	153.18±17.38	156.80±6.7	159.68±27.15	0.865
wk 8	141.60±13.54	135.46±7.98	139.32±8.35	0.644
Potassium (K), mmol/dl				
wk 0	7.97±1.39	8.86±0.74	8.10±1.51	0.502
wk 8	5.80±0.91	5.89±0.46	6.42±0.99	0.464
Chloride (Cl), mmol/dl				
wk 0	103.34±7.54	102.40±6.73	111.80±4.92	0.078
wk 8	106.40±6.02	103.40±6.66	102.00±3.32	0.461

[1]C= control (no molasses supplementation), T1= (50ml/5L/lamb molasses supplementation), T2= (100 ml/5L/lamb molasses supplementation.
[2] Sodium (Na), Potassium (K), and Chloride (Cl).

3.4 Blood Serum Liver Enzyme Activity

Blood serum liver enzyme activity such as GPT, GOT, and ALP were not significantly different (P>0.05) between C and T1 and T2 groups (Table 4). In addition, all serum liver enzyme parameters were within normal range [19]. This implying that supplementation of molasses throughout the study period were not adversely affected cellular metabolism and liver function of lambs. All experimental lambs were under normal health condition. Similar results have been observed by Moeini et al. [14] in lambs and Osman et al. [17] in lambs.

Table 4: Effect of molasses supplementation on liver enzymes[1].

Liver enzymes	C	T1	T2	Significance
GOT, mmol/l				
wk 0	81.32±14.7	81.68±8.67	89.02±6.44	0.451
wk 8	96.28±10.17	95.10±12.36	98.38±12.73	0.907
GPT, mmol/l				
wk 0	13.62±4.23	18.64±3.69	17.70±4.07	0.151
wk 8	22.62±2.64	16.92±1.62	21.02±7.51	0.183
ALP, mmol/l				
wk 0	340.80±113.83	379.00±151.45	303.20±133.07	0.678
wk 8	1113.20±367.88	1137.80±367.88	822.60±286.26	0.277

[1]C= control (no molasses), T1= 50ml/5L/lamb molasses, T2= 100 ml/5L/lamb molasses.

Conclusion

Results achieved from current study showed that supplementing 100 ml/5L water/ lambs resulted in arise (numerically- above 2 kg) live weight in comparison with control lambs. Blood serum parameters, mineral concentrations, and liver enzymes were not affected by dietary treatments. Based on results from current study supplemented molasses up to 100 ml of molasses/5L water/ lambs daily can be used to improve lambs live body weight without having any adverse effect of lamb's health and production.

Contribution of Authors

The planning, design, launching, and conducting of this study were done by both Abdulqader A. Hussein and Dler A. O. Sherwany. Data analysis was performed by Abdulqader. Both authors were contributed in revision process and final manuscript submission was confirmed by both.

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Conflict Interest Statement

The authors declare they have no conflicts of interest.

Data Availability Statement

The data of this study is available

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