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Effect of Molasses Distillers Condensed Soluble on Nutrients Digestibility, Performance and Some Blood Biological Parameters in Lambs

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

Original Research Article

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ABSTRACT

An experiment was conducted to determine the effects of dietary molasses distillers condensed soluble (MDCS) on nutrients digestibility, performance, carcass traits and some blood biological parameters in Lori male lambs. A total of 24 male lambs (aged 8 months, 31.16±1.10 kg) were randomly assigned to each of 4 dietary treatments with 6 replicate. The experimental animals were daily offered a basal diet with 0, 5, 10 and 15 percentage of MDCS/Kg DM of total ration, which were mixed with wheat straw and alfalfa hay. The results of the study indicated that the digestibility of neutral detergent fiber (NDF) and acid detergent fiber (ADF) of alfalfa hay were increased ($P<0.05$) by using the MDCS. The in-vivo apparent digestibility of dry matter (DM), organic matter (OM), crude protein (CP) and NDF of experimental diets were increased ($P<0.05$) by incorporation of MDCS at the level of 15%. There were no significant differences among treatments in average daily gain (ADG), dry matter intake (DMI), carcass characteristics and feed conversion ratio (FCR). Serum metabolites and liver enzymes were also not affected due to incorporation of MDCS in the diets. In conclusion, MDCS can be used as a source of protein and energy for ruminants, which can be mixed with hay or concentrate and could safely be used as a feed ingredient up to 15% to the male lamb's diet without any detrimental effects.

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1. INTRODUCTION

Molasses is a typical alcoholic distillate in Iran. The molasses distillers condensed soluble (MDCS) is a molasses–based fuel ethanol by-product. It is a mineral–rich liquid, yeast and fermentation of soluble components which, is produced after distillation and alcohol production. Its production depends on geographical location, cost and availability of these matters [1, 2]. It is reasonable to take advantage of the large amounts of MDCS being produced. The price of MDCS is one fourth (1/4) of corn seed in Iran.The MDCS have a substantial value as animal feedstuff by removing the water. As the recovered by-product of MDCS has a low pH (=4), it is advantageous to raise or even neutralize the pH. This pH adjustment can be achieved by adding sodium hydroxide, ammonia or any other feed grade alkali [3, 4]. Neutralization with ammonia is desirable, because the nitrogen can serve as a protein source in the animal feed [4, 6]. Corn distiller's soluble or molasses distillers condensed soluble are relatively high in CP (15 to 25%), which makes the product an attractive supplement for low-quality forages. Low-quality forages and by-pass residues are abundant, valuable feed resources for ruminant animals [7]. Improved cellulose digestion by addition of either Citrus condensed molasses soluble or corn distiller's soluble has been reported [5, 8]. However, little is known about optimum levels distillers' by-product in low-quality forage-based diets and subsequent effects on ruminal fermentation and digestion. No research has been carried out regarding the effect of MDCS as a dietary component on the performance of animals. Sadr and Moeini [9] reported that the different levels of MDCS did not influence the ADG, feed intake and feed conversion ratio (FCR) in broilers. Veyskarami et al. [10] indicated that MDCS as a cheap source of protein and energy mixed with hay and safely used as a feed ingredient in fattening lambs ration without any clinical signs. Meanwhile, it is mentioned some problems with preparation and storage of alfalfa hay mixed with MDCS. There is very limited research evaluating the use of MDCS in animal diet. The objective of this study was to determine the chemical composition of MDCS and to evaluate the effect of different levels of MDCS supplementation on digestibility, growth performance and blood biochemical parameters in Lori lambs.

2. MATERIALS AND METHODS

2.1 Animals and Experimental Treatments

A total of 24 male Lori lambs (8 month age, 31.16±1.10 kg) were used in 112 days at animal station of the Jihad center research of Lorestan province. A completely randomized design was performed with 4 treatments (6 lambs in each group). The treatments were 0, 5, 10 and 15 percent of MDCS (Kg/DM) of total ration mixed with alfalfa hay (Table 2). The MDCS were obtained from an alcohol fuels production factory located in west of Iran. The chemical compositions of diet and MDCS were analyzed according to AOAC [11] and Van Soest et al [12].The minerals were measured using the flame atomic absorption spectrophotometer (AAS). The gross energy was calculated by calorimetric bomb (Pars, model 2000) and ME was estimated according to Menke et al. [13] and Makkar [14]. The apparent digestibility, blood biochemical parameters, growth and some carcass characteristics were performed during the experiment. Experimental fattening period was 105 days in length, allowing 14 days as adaptation period to the treatments diets. At the end of fattening period, nine lambs (three lambs from each group) were randomly housed in individual stanchion pens (0.9×1.2 m) to estimate the effect of MDCS levels on apparent nutrients digestibility. The lambs were

fed at 08:00 and 17:00 and were allowed free access to water and salt blocks. Feed refusals, feces and urine excreted by each animal were recorded daily over 7 days and sub-sampled for further analysis. Blood samples were taken in sterile non-heparinized vacutainer tubes from each lamb via jugular vein-puncture on day 1 and at the end of experiment. Blood samples were centrifuged for 15 min at 2000 rpm. Serum was aliquoted in different fractions and stored at −20ºC until further laboratory analysis. Subsequently serum samples were subjected for analyzing the glucose, creatinine, triglycerides, cholesterol and liver's enzymes (ALP, AST and ALT). Glucose was estimated using glucose oxidase [6, 15]. Urea was measured according to method of Berthelot [6], creatinine through Jaffe method, and triglycerides and total cholesterol by lipoprotein lipase method using Pars Azmun kits (Tehran, Iran). The effect of MDCS on treated lamb's health was investigated by monitoring the color and weight of liver and kidneys. Evaluations of carcass parameters of lambs were followed by slaughtering of 3 lambs from two groups (control and 15% MDCS) at the end of experiment. The carcass was divided into individual components and weighed separately as internal organs (liver, heart, lungs, kidneys and spleen), slaughter weight and proportion of cuts.

2.2 Statistical Analysis

Data were analyzed as a complete randomized design using MIXED procedure of SAS software [16] for both experiments. Multiple comparisons among means were performed with the Duncan multiple range method. The model included MDCS level and period as fixed effects, and lamb as a random effect. Daily weight gain was analyzed as a repeated measurement using GLM procedure of SAS software [16].

3. RESULTS AND DISCUSSION

The chemical compositions of the MDCS are given in Table 1. The MDCS was relatively high in CP (21 to 22%; DM basis), which makes it an attractive supplement for low-quality forages. Because of molasses content and procedures on distillers soluble, the ash content of MDCS was high (21%) which is one of the reasons of its limitations in daily ration.

Table 1. Nutrient Composition of MDCS

Nutrient composition	MDCS
DM %	67.0
ME (Mcal/kg)	3.10
CP (gr/Kg/DM)	197.9
NDF(gr/Kg/DM)	176.9
EE(g/Kg/DM)	28.9
Minerals;	
Ca (gr/Kg/DM)	3.90
P (gr/Kg/DM)	4.76
k (gr/Kg/DM)	12.87
S(gr/Kg/DM)	2.21
Na (gr/Kg/DM)	6.98
FE (mg/Kg/DM)	98.0
Cu (mg/Kg/DM)	9.90
Zn(mg/Kg/DM)	43.98
Se (mg/Kg/DM)	0.98

Based on the data from Table 3, the MDCS treatments had positive effect on nutrient digestibility. Animals fed on the diet containing 15% MDCS revealed higher (P<0.05) digestibility of DM than those animals fed control diet. We also observed an increase in vivo DM digestibility following incorporation of 15% MDCS to the diets. In other study, the addition of MDCS increased CP and CF digestibility of feedstuffs with low protein [8, 17]. Gilbery et al. [18] also reported that applying corn condensed distillation soluble (CCDS) up to 15%, caused an increase in DM digestibility of forage. Hunt et al. [19] indicated that silage digestibility increased when prepared with different levels of condensed distillation soluble.

Table 2. Components, Ingredients and Nutrient Composition of Diets

	Control	5% MDCS	10% MDCS	%15MDCS
Components (%)				
Alfalfa hay	20	20	20	20
Wheat straw	17	17	17	17
Wheat barn	15	15	15	15
Barley	48	43	38	33
MCDS	0	5	10	15
Nutrient composition:				
CP(g/kgDM)	152	157	159	162
ME(Mcal/kg)	3.22	3.21	3.21	3.20

Table 3. Mean (±SD) Nutrients Digestibility *(%)*

	Control	% 5MDCS	%15MDCS
Dry matter (DM)	57.6 ± 1.2^{b}	59.6 ± 1.1^{b}	66.1 ± 1.2^{a}
Organic Matter	59.5 ± 1.1^{b}	59.8 ± 1.4^{b}	68.9 ± 1.1^{a}
Crude Protein	66.05 ± 1.5^{b}	68.05 ± 1.2^{b}	73.5 ± 1.5^{a}
Ether Extract	98.27 ± 0.39	-	99.21 ± 0.19
NDF	49.11 ± 1.6^{b}	50.17 ± 17^{b}	55.5 ± 1.6^{a}
ADF	48.08 ± 1.7^{b}	50.01 ± 1.2^{b}	57.8 ± 1.6^{a}

The OM digestibility of treated diets with MDCS were higher (P<0.05) than that of control. An increase in OM digestibility of diet with 15% MDCS has been achieved during experiment. These results are in good agreement with the reports of Stemme et al. [15] that MDCS increased OM digestibility. Incorporation of MDCS to the diets also enhanced (P<0.05) CP digestibility. Archibeque et al. [20] reported that addition of CCDS up to 15% to silage-based diets with low protein content caused an increase (P<0.05) in CP digestibility of forage (34% in the base feed and 57.3% in the base feed with 15% CCDS. Similarly, fiber digestion was higher (P<0.05) by adding MCDS to the diets at 15% level replacement. An increase in fiber digestibility of low protein rations due to addition of MDCS has been also reported by Kamalzadeh [8] and Veyskarami et al. [10]. An increment in NDF and ADF digestibility of diets also has been reported by Archibeque et al. [20]. The EE and GE digestibility of diets were not influenced significantly due to treatments. This by-product in low-quality forage-based diets had subsequent effects on ruminal fermentation and digestion.

The changes of body weights of lambs are presented in Table 4. Average daily gain (ADG), final body weight and feed conversion ratio (FCR) of fattening lambs were not influenced by addition of MDCS to the diets. There was no additional ADG, growth performance of lambs and different FCR due to incorporation of corn and sorghum distiller's by products [2] or corn distiller's grains with soluble [21]. The blood metabolites of lambs during the fattening period are presented in Table 5. Blood glucose, cholesterol, triglycerides, urea, creatinine and albumin concentrations were not altered following addition of MDCS to the diets (P>0.05). The serum concentrations of minerals sodium, potassium, calcium, phosphorus and iron did not differ between treatments (P>0.05). The liver's enzymes (AST, ALT and ALP) were also not influenced by MDCS and were at the normal levels in all lambs. The slaughter and carcass characteristics of the lambs of control and 15% MDCS are summarized in Table 6. The proportion of wholesale cuts and organs of lambs fed on diets containing MDCS were similar to those of control (P>0.05).the dressing percentage in controls were lower than mdcs treatments (P<0.05). The percentage of fat-tail in controls were lower than in MDCS treated lambs (P>0.05). The liver weights as well as color of livers and kidneys of treated lambs were normal when compared with controls. The results of this study showed that incorporation of MDCS did not affect carcass weight and some carcass percentage of fattening lambs.

Table 4. Mean (±SD) Weight and Growth Traits of Lambs

	Control	5% MDCS	10% MDCS	%15MDCS	SE
Initial weight(Kg)	31.8 ± 1.2	32.1 ± 1.1	32.1 ± 1.3	32.0 ± 1.4	0.38
Final weight(Kg)	46.8 ± 1.5	47.0 ± 1.4	47.3 ± 1.1	46.5 ± 1.5	0.42
ADG(g/Day)	132.9	133.8	134.1	129.9	0.19
Feed intake(g/Day)	1537	1534	1539	1538	16.2
FCR	11.49	11.38	11.42	11.69	0.08

Table 5. Mean Blood Metabolites of Treatments (End of experiment)

	Control	5% MDCS	10% MDCS	%15MDCS
Urea (mg/dl)	39.2	35.1	34.1	32.0
Total protein(mg/dl)	6.8	7.0	7.1	6.5
Glucose(mg/dl)	66.9	63.6	65.5	59.5
Triglycerides (mg/dl)	1537	1534	1539	1538
Cholesterol (mg/dl)	9.34	9.42	9.50	9.82
AST (mmol/l)	89.4	87.3	88.1	88.2
ALT (mmol/l)	13.7	14.3	15.3	15.0
ALP (mmol/l)	528.2	528.2	528.6	530.1

Table 6. Mean (±SD) Carcass Characteristics and Proportional Yield of Lambs

Traits	Control	15% MDCS
Slaughter weight	46.35 ± 0.13	47.04 ± 0.44
Warm Carcass Weight (WCW)	24.84 ± 0.99	24.22 ± 0.34
Cold carcass weight	23.82 ± 0.61	24.28 ± 0.36
Carcass percentage	52.39 ± 1.62	52.46 ± 0.92
Fillet Muscle Cutting Plane [cm^2]	16.11 ± 0.14	16.62 ± 0.41
Proportion of cuts and organs (%)		
Neck	6.2 ± 0.5	5.8 ± 0.7
Hands	15.5 ± 0.31	15.90 ± 1.13
Legs	29.31 ± 0.40	28.82 ± 0.83
Chest	12.01 ± 0.42	12.52 ± 0.63
Head	5.56 ± 0.02	5.29 ± 0.05
Spleen	0.27 ± 0.06	0.25 ± 0.26
Liver	1.51 ± 0.03	1.39 ± 0.09
Lungs	0.95 ± 0.08	0.98 ± 0.15
Kidney	0.27 ± 0.01	0.28 ± 0.06
Internal fat	1.46 ± 0.22	1.31 ± 0.05
Fat –Tail	8.30 ± 0.61[b]	9.45 ± 0.21 [a]

In each row, means with different superscript letters differ significantly (P<0.05)

4. CONCLUSIONS

The digestibility of DM, OM and NDF were increased by adding MDCS at the level of 15%. The MDCS can safely be mixed with hay or concentrate and could be used as a feed ingredient up to 15% to the fattening lamb's diet without any detrimental effects. However, further study needs to find optimum levels of MDCS in daily ruminant's rations.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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