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Effect of using fermented straw with urea, molasses and malic acid in different proportions on the performance and carcass characteristics of male Arabi lambs

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Abstract:*The study aimed to know the effect of adding urea, molasses, and malic acid to straw, fermenting it and replacing it with concentrated feed at rates of (10, 20, 30, and 40%) on some productive traits live weights, total and daily weight gain, feed intake and feed efficiency and carcass characteristics such as hot carcass, dressing percentage ratio, major joints (neck, shoulder, rib, loin, leg and fat-tail) as well as internal organs and inedible organs. The results were superior to the second treatment (10%) of fermented straw over the rest of the groups in characteristics live weights, total and daily weight gain, feed intake and feed efficiency and carcass characteristics live weights, total and daily weight increases, dressing percentage ratio, feed efficiency, hot carcass weight, clearance ratio and in some weights of joints.*

I. INTRODUCTION

Straw is considered one of the agricultural wastes of small cereal crops such as wheat and barley, and it is characterized by being a coarse, low-quality fodder, with a high percentage of cellulose-butylene; In view of the importance of providing coarse fodder with concentrated fodder in the diets of ruminant animals to prevent the formation of a doughy mass and hard to digest as well as the physiological aspects of these animals, the importance of using straw that is available in very large quantities in diameter as rough fodder in the diets of ruminants despite its low nutritional value. In order to increase the intake many treatments must be done to improve its nutritional value and raise its digestion coefficient ([1], [2]).

To improve the use of agricultural crop residues for ruminants, the ruminant environment needs to be enhanced through microbial fermentation. Because the important factors that limit the bacterial decomposition in the rumen are higher levels of lignin, and its low content of nitrogen, vitamins and minerals. To improve the coefficient of digestion and to increase the intake, it must be treated by various methods, including physical, chemical and biological ([3], [4]).The interest in using urea to improve the nutritional value of the roughage because its source at non-protein nitrogen and works on the fibrous part, which breaks the chemical bonds between lignin and hemicellulose For hemicellulose, all these reactions occur due to the expansion of the fibers and facilitating access of the cellulose enzyme to the feed material, which improves digestion ([5]).

Molasses is considered as one of the energy-rich food additives for poor quality roughage, It works to improve its flavor, taste, and palatability, and then increase its consumption, as molasses provides the energy needed for the growth and activity of microorganisms in the animal's rumen, especially those that decompose cellulose, and then the nutritional value of the feed will improve ([6]). Organic acids are used to improve fermentation properties, which can lower the pH and delay the growth of harmful bacteria, thereby ensuring a good environment. Malic acid can be used for low-quality foodstuffs and materials as a way to improve their nutritional value and chemical composition ([7], [8], [9]). The aim of experiment that the use of urea, molasses, and malic acid together led to an increase in the intake of fermented straw in different proportion in feeding Arabi lambs.

II. MATERIALS AND METHODS

Barley straw was purchased from local markets and 91.5 kg was spread on a large piece of nylon with a thickness of approximately 10 cm. 40 liters of water was brought and dissolved in it (0.5 kg of malic acid + 3 kg of urea + 5 kg of molasses) and the materials were stirred in a circular motion until completely dissolved, and spray the solution directly on the straw with a sprayer, with continuous stirring of the straw during spraying, so that the solution reaches completely to all parts of the straw in order to ensure homogeneity of the treatment. The treated straw was then placed directly into 50 kg nylon bags and properly sealed to prevent the release of the resulting ammonia. From the decomposition of urea, and left for 21 days at room temperature, after that the bags were opened and the treated straw was spread on nylon in the air with stirring for the purpose of not leaving any unwanted smell, and then mixed with the concentrated feed to be to fed the lambs in the proportions mentioned in the study.

This study was conducted in the animal field of the College of Agriculture, University of Basrah, Karma site, for the period from 1/4/2021 to 1/7/2021, distributed over 20 lambs (5) treatments and (4) lambs for each treatment, which includes the use of fermented straw and its replacement with concentrated feed, as follows:

1. (T1) 100% concentrated feed. (Control) (barley 53%, wheat barn 36%, soybean meal 8%, mineral-vitamin premix 2%, salt 1%).
2. (T2) concentrate feed 90% + fermented straw 10%.
3. (T3) concentrate feed 80% + fermented straw 20%.
4. (T4) concentrate feed 70% + fermented straw 30%.
5. (T5) concentrate feed 60% + fermented straw 40%.

The lambs were placed in semi-shaded pens of equal size (2 x 2.5 m^2) that were equipped with plastic feeders and water throughout the experiment period. The diet was given twice a day at seven in the morning and four in the afternoon at a rate of (3%) of the live body weight, Lamb weight gain, feed intake, and feed efficiency were calculated. The feeding phase continued with experimental diets over a period of (90) days. Chemical composition as indicated in Table (l).

Table 1. Ingredients of basal diets and chemical composition

Chemical composition	T1	T2	T3	T4	T5
Dry matter	88.28	88.82	89.36	89.90	90.44
Crude protein	14.02	13.63	13.24	12.85	12.46
Ether extract	2.86	2.70	2,554	2.40	2.24
Crude fiber	7.38	9.27	11.17	13.07	14.97
Ash	3.63	3.93	4.23	4.53	4.84
Soluble carbohydrates	67.59	65.53	63.47	61.41	59.35

Metabolicenergy MJrettamyrdgk/	12.40	12.11	11.82	11.53	11.25

Following the experiment, the animals were fasted 18 hours before being slaughtered. The weight of the animal, the weight of the hot carcass, the percentage of dressing, the main joints (neck, shoulder, rib, loin, leg and fat-tail) and inedible organs (head, skin and feet) were recorded.

The data were analyzed as a complete randomized experimental design to study the replacement of fermented straw with concentrated on the studied traits, and the significant differences between the means ($P < 0.05$) were compared with the statistical program ([10]) according to the following mathematical model:

YijK=u+Ai+eij

YijK = viewing value for any studied strait.

u = overall mean.

Ai = effect of treatment.

eij = effect of experimental error, which is randomly and normally distributed with mean equal to zero and variance σ^2 e.

III. RESULTS AND DISCUSSION

1.3 Initial and final live weight and average daily gain

Table (2) shows a significant ($P < 0.05$) superiority of T2 treatment in final weight, total weight gain, and average daily gain, which were 38.80, 15.63 kg, and 173 g, respectively, compared to the rest of the treatments. It was significantly superior ($P < 0.05$) Treatments T1, T3 and T4 compared to T5 treatment, T1 treatment recorded 36.22, 13.04 kg and 145 g, respectively, T3 treatment recorded 36.10, 12.89 kg and 143 g, respectively, T4 treatment recorded 35.57, 12.35 kg and 137 g respectively, T5 treatment recorded 33.90 and 10.80 kg and 120 g, respectively. There were no significant differences between the control treatment and the T3 and T4 treatment. Fermented straw of up to 30% could be used with concentrated ration. Economically, the cost of the ration will be lower, increasing the farmer's profit.

This increase in the final weight and the daily and total weight gain of T2 treatment may be due to the change in the chemical composition of the fermented straw and an improvement in the nutritional value due to the breaking of the ester bonds and the swelling of cellulosic crystals, which helped in the penetration of fiber-degrading enzymes into the plant cell wall and thus improving its effectiveness and efficiency ([1],[11]) and the use of urea led to an increase in crude protein content and digestibility through better rumen fermentation, in addition to available energy (molasses energy) in improving the rumen environment and increasing microbial protein synthesis. ([12]) and the effect of malic acid in improving rumen ecology and increasing the activity of microorganisms in the rumen and increasing microbial protein ([13], [14]).

These results are consistent with [2], [5], [11], [15],[16], [17],[18],[19]when using different percentages of urea as an energy source in sheep diets in improving terminal weights and daily and total weight gain.

Table 2. Final live body weight, total weight gain (kg) and average daily gain (g/day) for various experimental treatments (Mean± standard error)

Treatments	Initial Weight (kg)	Final Live Weight (kg)	Body Weight gain (kg)	Average Daily Gain (g/d)
T1	23.17±0.29	36.22± 0.57 *b*	13.04± 0.29 *b*	145± 3 *b*
T2	23.16±0.16	38.80± 0.61 *a*	15.63± 0.47 *a*	173± 5 *a*
T3	23.20±0.43	36.10± 0.43 *b*	12.89± 0.75 *b*	143± 8 *b*
T4	23.22±0.11	35.57± 0.16 *b*	12.35± 0.17 *b*	137± 1 *b*
T5	23.10±0.39	33.90± 0.73 *c*	10.80± 0.43 *c*	120± 4 *c*

*Different letters vertically differ significantly at the 5% level.

2.3 Average feed consumption and average feed conversion efficiency

Table (3) shows an increase in the average feed consumption in T2 and T3, recording 25.36 and 24.30 kg/month/head, respectively, compared to the other of the treatments. T1, T4, and T5 recorded 23.91, 23.73, and 23.59 kg/month/head, respectively. An improvement was also seen in the average feed conversion efficiency for T2, which recorded 4.86 kg of feed/kg of weight gain compared to the rest of the treatments. T1, T3 and T4 had 5.49, 5.66 and 5.77 kg of feed/kg of weight gain compared to T5 with 6.55 feed/kg of weight gain. The remarkable improvement in the amount of feed consumption for the two treatments, T2 and the T3, may be due to the treated straw (molasses, urea and malic acid) as one of the additives, as it worked to improve the flavor, taste and palatability of roughage feed and then increase its consumption, through the availability of the energy necessary for the growth and activity of microorganisms in the animal's rumen in particular. Those that hydrolyze cellulose and then will improve the nutritional value of the feed and increase the feed intake, led to the improvement of environmental conditions inside the rumen ([6],[20]).

These results are in agreement[1], [11],[15],[16],[17],[18],[19] when they used in different proportions in sheep diets to increase feed consumption and improve feed conversion efficiency.

Table 3. Feed consumption (kg/month/head) and feed conversion efficiency (kg feed/kg weight) for the various experimental treatments.

Treatments	Average feed consumption	Average feed conversion efficiency
T1	23.91	5.49
T2	25.36	4.86
T3	24.30	5.66
T4	23.73	5.77
T5	23.59	6.55

3.3 Hot carcass weight, dressing percentage and inedible organs

Table (4) shows a significant superiority ($P < 0.05$) for T2 in the average weight of the warm carcass relative to other treatments and recorded 16.84 kg. T1, T3 and T4 treatments were recorded 15.50, 15.40 and 15.16 kg, respectively, compared to the T5 treatment of 13.55 kg. The improvement of the hot carcass weight of the second treatment may be due to the improvement of the live weights of the lambs of the treatment T2 compared to the rest of the treatments (Table 2). No significant differences ($P < 0.05$) were observed in carcass weights for T1, T3 and T4 treatments. The results were consistent with [15],[18], [19],[21],[22]when they using different ratios of urea sheep diets to increasing the weight of the hot carcass.

Table 4. Weight of hot carcasses, dressing percentage and weight of inedible organs of different experimental treatments (Mean± standard error)

Treatments	Hot carcass (kg)	Dressing percentage (%)	Inedible organs (g)		
			Head	Feet	Skin
T1	15.50± 0.57 *b*	42.79± 0.28 *a*	2121±50	885±31	4458±415
T2	16.84± 0.15 *a*	43.44± 0.95 *a*	2216±60	908±37	4471± 221
T3	15.40± 0.12 *b*	42.70± 0.82 *a*	2100±94	892±41	4205±191
T4	15.16± 0.28 *b*	42.61± 0.68 *a*	2082±36	815±20	4833±301
T5	13.55±0.61*bc*	39.92± 1.00 *b*	2251±67	879±14	4765±334

*Different letters vertically differ significantly at the 5% level.

Table (4) also shows that there are significant differences ($P < 0.05$) in the dressing percentage, as T1, T2, T3 and T4 treatment excelled, recording 42.79, 43.44, 42.70, and 42.61 %, respectively, compared to T5 treatment, which recorded 39.92%. The reason for the superiority of the second treatment in the percentage of inoculations may be due to the efficient use of the diet that contained treated straw and concentrated fodder, which led to an increase in live weights and an increase in carcass weight, and thus an improvement in the dressing percentage. The results agree with [18],[19], [22].

Table (4) showed that there were no significant differences ($P < 0.05$) between the treatments in the weights of slaughter waste (head, feet and skin), and arithmetic differences appeared between the treatments. The absence of significant differences in the weights of slaughter by-products (head, feet and skin) may be attributed to the fact that these organs are early-maturing organs and are not affected by the contents of the diet used ([23],[24]). Results are consistent with [16], [25], [26].

4.3 Weight at the Carcass joints

From Table (5), there were significant differences ($P < 0.05$) for the second treatment in the weights of the joints (shoulders, loin and leg) and recorded 5272, 1621 and 5795 g, respectively, compared to the rest of the treatments, and the rest of the treatments recorded significant and non-significant differences in the weights of the joints (shoulders, loin and leg) among the treatments, and there were no significant differences between the treatments in the rest of the other joints weights (neck, ribs, and fat-tail). The fifth group arrived at the bottom values. The reason for the superiority of the second treatment in some of the weights of the joints may be due to the increase in the feed intake, which led to an increase in live weight, an increase in carcass weight, and an increase in the weights of the joints. Results are consistent with those of [15],[16],[18], [22].

Table 5. Weight of the carcass joints (g) for the different experimental treatments (Mean± standard error)

Treatment	Neck	Shoulder	Rib	Loin	Leg	Fat-tail
T1	911±10	4876± 57*ab*	1736±90	1335± 51*b*	5220±*b*61	1422±34
T2	905±15	5272± 44*a*	1782±71	1621± 27*a*	5795± 30 *a*	1467±19
T3	892±16	4857± 54*ab*	1570±45	1562± 38 *a*	5032±29 *b*	1490±25
T4	892±4	4712± 68*bc*	1686±95	1253± 26 *b*	5178±77 *b*	1441±39
T5	862±24	4315± 36 *c*	1655±88	1128± 48*b*	4217± 24 *c*	1373±28

* Different letters vertically differ significantly at the 5% level.

IV. CONCLUSION

We conclude from the results of this study that the use of straw added to urea, molasses and malic acid and its replacement with concentrated feed at a rate of 10% improves the growth of animals and feed consumption, which improves the characteristics of carcasses. Also, we could use fermented straw up to 30% with the concentrated ration. From an economic point of view, the cost of the ration will be less, thus increasing the farmer's profit.

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