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Impact of Feeding Biologically Treated Wheat Straw on the Production Performance of Goats in North Sinai

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Abstract: The present study was conducted to evaluate the effect of feeding biologically treated wheat straw on milk and growth performance of goats in North Sinai. This study was divided into four parts: 1) preparation of the rations. 2) metabolism trails throughout 12 mature male goats to assess the effect of biological treated wheat straw on the digestibility, nitrogen balance and some rumen and blood parameters. Animals were randomly divided into four feeding groups: D1: untreated wheat straw (UWS) + CFM, D2: [UWS+ 3% molasses plus 3% urea] (MUWS) + CFM, D3: MUWS treated with ZAD solution + CFM, D4: D2 + CFM added with 20g/h/d of ZADO powder. 3) production performance of female goats throughout 45 female goats were randomly divided into three equal groups to fed the best diets of second part (D2, D3 and D4) for 6 months. 4) growth trail throughout 24 growing male kids were randomly divided into three feeding groups to fed the same previous rations in the third part. The results showed that ZAD treatment improved chemical composition of wheat straw throughout increased CP and decreased CF and fiber fraction content. There was significant ($P<0.05$) differences in roughages and total dry matter intake between D3 and other groups.The highest value of total dry matter intake was in D3 and the lowest value was in D1. Diet 3 (D3) showed the highest digestion coefficients for all nutrient. The same trend was observed for the nutritive value as TDN and DCP. There was significant ($p<0.05$) differences in nitrogen balance between D3 and other groups.The highest value of nitrogen balance was in D3 and the lowest value was in D1. Also, D3 showed the highest milk production and the lowest feed cost followed by D4.This diet (D3) had also the best growth performance and the highest economic efficiency than D2 and D4. From the previous data, it can be conclude that using wheat straw treated chemically with (3% urea and 3% molasses) then biologically with (ZAD solution, 1L/Ton) in lactating and growing goats diets seem to be economically good.

Key words: Straw · Biological treatment · Digestibility · Feeding value · Goats · Growth performance

INTRODUCTION

In Egypt, about 21.6 million ton of agriculture residues are produced annually [1]. These residues such as wheat straw contain considerable quantities of cellulose and hemicelluloses. But, the availability of these components is controlled by lignin-carbohydrate complex, which limit the digestion of cellulose and hemicelluloses. Also, the major limitation of using these agricultural residues as feed are low palatability, digestibility, protein and high fiber contents [2]. Many attempts have been done to increase the digestibility and utilization of the agricultural residues, one of them is the biological treatment in order to degrade lingo-cellulose into lignin, cellulose and hemicelluloses and improve crude portion content, digestibility, nutritive value and feed intake [3]. Goats in North Sinai represent the most dominant livestock and play an important role in the social life and economic status of Bedouins [4].

The objective of this study was to study the effect of feeding biologically treated wheat straw on milk and growth performance of goats in North Sinai.

MATERIALS AND METHODS

The present study was carried out in Abu El-Feta research station, El Arish, North Sinai which affiliated for Desert Research Center, Ministry of Agricultural, Egypt.

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This study included two experiments. First one is a milk production and the second is meat production experiment. Metabolism trials were carried out to evaluate the experimental diets. Preparation of wheat straw: wheat straw was chopped to 1-3 cm length (UWS) and either untreated (UWS) or treated with 3% urea + 3% molasses (MUWS) only or biologically treated with 1L/ton ZAD solution (patent no: 22155). ZAD is a biotechnical solution product mad from natural sources to elevate the level of cellulases enzyme from anaerobic bacteria in the molecular biology lap, Animal production department, Ain Shams University according to the procedure of Gado [5] and contained some of specific enzymes such as cellulase (8.2 μ/gm),hemicellulases (6.2 μ/gm),amylase (64.4 μ/gm) and protease (12.3 μ/gm). Metabolism trails were carried out for 28 days (21 days as preliminary period and 7 days as collection period) using 12 mature male goats with 43.83 kg average live body weight. Animals were divided into four feeding groups (3 in each) and fed one of the following diets

D1: untreated wheat straw (UWS) + CFM, D2: wheat straw treated with 3% molasses + 3% urea (MUWS) + CFM, D3: (MUWS) treated with 1L/ton ZAD solution + CFM, D4: D2 + CFM added with 20g/h/d of ZADO powder (patent no: 22155 contained similar enzymes of ZAD plus specific bacteria and *Sacchromyces cerevisia* yeast.).The amount of CFM were used to meet 50% from the maintenance requirement for all group, while the roughage were fed *ad lip*. During the collection period feed intake was determined daily and total feces weight and urine volume were recorded daily and sampled. At the end of digestibility trails, rumen samples by stomach tube and blood samples from the jugular vein were taken at zero time (just before feeding) then 3hr. and 6hr. after feeding to determined pH, NH3-N and TVFA,s, total protein (TP) and urea concentration.

Experimental 1: Forty five female shami goats after 7 days of parturition (aged 1.5-2.5 years and weighed 31.75 kg in average) were randomly divided into three equal groups (15 each). Each group fed one of the best three diets according to the results of the metabolism trails previously done (D2, D3 and D4) for 6 months experimental period. Animal in all groups were weighed at the beginning and then biweekly till the end of lactation period and rations offered were adjusted according to body weight change of goats to meet the maintenance requirements from CFM at 8.00 am and 2.00 pm according to Kearal [6], while roughages were offered *ad lib.* to meet the milk production requirements. Milk yield was recorded once every week where at random 5 Does from each group were hand milked at 7.00 am.Whereas the kids were separated from their mother at 7.00 pm of the day prior to the day of measuring. Milk samples were taken at `milking time and analyzed for fat, protein, lactose, total solids and urea.

Experimental 2: Twenty four growing male kids (aged 4 months and 13.99 average body weights) were randomly divided into three feeding groups (8 each) and fed the same previous diets of the milk production experiment for 180 days growing trail. Each group of kids was hosed in separated pen and received CFM at 8.00 am and 2.00 pm to cover 100% maintains requirements, while roughage offered *ad lib*. Refusal (if any) was collected just before offering the next rations, feed intake were recorded daily for all animals. Water was available at all the time.

Animals were weighed at the beginning and then a teach week to record the change of weight for each animal and then daily weight gain was calculated. Feed cost was calculated based on the market price in year 2007.

Chemical Analysis: Samples of feed, urine and feces were analyzed according to A.O.A.C. [7]. Fiber fraction constituents: neutral detergent fibers (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined according to Goering and Van Soest [8]. Hemicelluloses and cellulose were calculated by difference. Ammonia nitrogen (NH_3-N) and total volatile fatty acids (TVFA's) of rumen liquor were determined according to A.O.A.C. [7] and Warner [9], respectively. Blood urea nitrogen (BUN) and total protein (TP) were determined by commercial kits (Diamond Diognostics, Egypt). Chemical analysis of milk for total solids (TS), fat (F), solids not fat(SNF), protein (P), urea and lactose (Lact.) using milk scan (N.Foss electric, Denmark)

Statistical Analysis: Data obtained in this study was statistically analyzed by one way of variances according to SAS [10] and the model was:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where:
Y_{ij} = experimental observation
μ = general mean
T_i = effect of treatment
e_{ij} = experimental error

Differences among means were compared by Duncan's multiple range test of Duncan [11].

RESULTS AND DISSECTION

Chemical Composition: Data in Table 1 indicated high decrease in CF and slight decrease in NDF, ADF, ADL, cellulose, DM and OM in MUWS compared with control (UWS). Reduced OM might be due to higher ash content. The decrease of CF values in the biological treatment may be due to break the lingo-cellulose bonds and the cellulose could be hydrolyzed and utilized by bacteria in the rumen as stated by Shakweer [12], El-Ashry *et al.* [13] and Chang [14].

Stokes and Chen [15] reported a reduction of NDF value after enzyme addition to corn silage. In general, all fiber fraction decreased by treated roughage especially with biological treatments compared with untreated. These results agreed with those obtained by Abd-El-Aziz [16] who reported that the impact of ZAD compound was to use cellulose and hemicelluloses of the treated roughage as an energy source for production of biomass. On the other hand, Gado [5] found that enzymatic treatment reduced the percentage of fiber fraction.

Crude protein, NFE, EE and ash in MUWS and MUZWS was increased by (67.9 and 120.8%), (4.6 and 5.6%), (9.7 and 27.7 %) and (9.0 and 9.8 %), respectively, compared with UWS. The increase of CP content is because of the nitrogen content of added urea, microbial protein from bacteria treatment and nitrogen content of growing celluloytic bacteria in silage. These results agreed with those recorded by Abd El-Galil [17], Zhao, *et al.*, [18] and Gado *et al.* [19]. The increase of EE may be due to addition of celluloytic bacteria. These results are in agreement with those obtained by Abd El-Aziz, [16] and Abd-El-Galil [20] who reported that addition of celluloytic bacteria resulted in an increases of EE. Increasing ash was a reflection of decreasing CF and OM as a result of biological treatment which utilized soluble and structural carbohydrates. Similar trend was observed by Shoukry *et al.* [21], Galila[22] and Salem [23].

Voluntary Feed Intake: Data in Table 2 indicated a significant increase ($p<0.05$) of roughage intake (g/h/d) between D3 and other groups being (594.2 g/h/d) followed by D4, D2 and D1, respectively. This may be due to the variation in CF content being the lowest in D3 as a result of biological treatment. These results are in agreement with those obtained by Kent *et al.*, [24], Mahrous and Abo Ammou[25], Gado *et al.*[26] and Fayed *et al.* [27]

Table 1: Chemical composition of untreated, treated wheat straw and concentrate feed mixture, (as DM basis)

Items	UWS	MUWS	MUZWS	CFM
DM	89.30	86.50	89.00	91.61
OM	87.20	86.05	85.95	90.89
CP	3.89	6.53	8.59	15.53
EE	1.55	1.70	1.98	3.14
CF	38.00	32.04	29.17	11.59
NFE	43.76	45.78	46.21	60.63
Ash	12.80	13.95	14.05	9.11
Fiber fraction				
NDF	81.72	80.53	78.01	35.40
ADF	46.95	45.60	45.50	16.86
ADL	11.06	10.39	10.10	6.73
Hemicelluloses	34.77	34.93	32.51	18.54
Cellulose	35.89	35.21	35.40	10.13

UWS: untreated wheat straw, MUWS: treated wheat straw with 3% molasses and 3% urea, MUZWS: MUWS treated with ZAD solution, CFM: concentrate feed mixture.

Table 2: Voluntary feed intake, digestion coefficient and nitrogen balance of goats fed experimental diet.

Items	D1	D2	D3	D4
LBW,Kg	43.03	43.21	45.14	43.92
Dry matter intake g/h/d				
Roughage	297.7^{b}	298.0^{b}	594.2^{a}	384.4^{b}
CFM	394.2	395.9	413.6	402.4
Total intake	691.9^{b}	693.9^{b}	1007.8^{a}	786.8^{b}
Digestion coefficient %				
DM	53.37^{c}	59.49^{b}	66.21^{a}	63.29^{ab}
OM	61.39	62.87	67.66	64.57
CP	63.75^{b}	72.02^{a}	74.61^{a}	70.59^{a}
EE	70.93^{b}	75.17^{ab}	81.34^{a}	78.74^{a}
CF	53.53^{c}	56.76^{bc}	66.07^{a}	60.64^{b}
NFE	54.93^{b}	62.64^{a}	66.15^{a}	64.07^{a}
NDF	45.48^{c}	56.38^{b}	64.52^{a}	62.04^{ab}
ADF	37.22^{b}	41.48^{b}	55.01^{a}	53.23^{a}
ADL	7.18^{c}	18.37^{b}	26.02^{a}	18.38^{b}
Cellulose	49.44^{b}	50.61^{b}	66.29^{a}	66.68^{a}
Hemicelluloses	55.98^{b}	73.49^{a}	78.01^{a}	72.11^{a}
Nutritive value %				
TDN	52.24^{b}	58.21^{a}	61.96^{a}	59.81^{a}
DCP	6.71^{b}	8.40^{ab}	8.54^{a}	8.24^{ab}
Nitrogen utilization				
Nitrogen intake	11.64^{b}	12.94^{b}	18.43^{a}	14.01^{b}
Feacal nitrogen	4.22^{ab}	3.62^{b}	4.68^{a}	4.12^{ab}
Urinary nitrogen	7.40	7.34	7.57	7.16
Total nitrogen execration	11.62	10.96	12.25	11.28
Nitrogen balance	0.02^{c}	1.98^{bc}	6.18^{a}	2.73^{b}
% of Nitrogen intake	0.17^{c}	15.30^{bc}	33.53^{a}	19.49^{ab}

a,b and c means in the same row with different superscripts differ significant($p<0.05$).

D1: untreted wheat straw, D2: D1 treated 3% urea + 3% molasses, D3: D2 treed ZAD solution and D4: D2 added with 20g/h/d of ZADO powder.

who indicated that biological treatment of roughage improved intake compared with untreated roughage. On the other hand, CFM showed no differences among groups because all groups received 50% of their maintenance requirement from CFM.

Digestibility Coefficient and Nutritive Value: Nutrients digestion coefficients and nutritive value (Table 2) showed significant difference ($p<0.05$) among groups except OM digestibility. Experimental diets D3, D4 and D2 were significantly ($p<0.05$) higher than control regarding the digestibility of DM, CP and NFE by (24.1, 17.0 and 20.4 %), (18.6, 10.7 and 16.6 %) and (11.5, 13.0 and 14.0 %), respectively.

Also, there was a significant ($p<0.05$) increase of the digestibility of CF and EE in D3 and D4 compared with D1, while the difference between D1 and D2 was not significant. The highest nutrients digestion coefficient in D3 followed by D4 may be due to many reasons such as better palatability and better utilization by the host animal [26], higher CP content in spent roughage compared with untreated [28], increase of microorganisms biomass[16] and increase the activity of enzymes produced by microorganisms. These results were in harmony with those obtained by Abd-El-Aziz [16], Mahrous and Abou Ammou [25] and Gorden[29] they found that roughage treated by biological treatment increased nutrients digestibility.

Generally, the data referred that bacterial treatment positively affected nutrients digestibility of wheat straw. Digestion coefficients of NDF, ADF and ADL were the highest in D3 compared with other groups. These results were similar with those of Gado *et al.* [26], Fayed *et al.* [27] and Cleale *et al.* [30]. The same trend was obtained by cellulose and hemicelluloses digestibility's were D3 and D4 recorded the highest value compared with D1 and D2. This improvement in fiber fractions digestion may be due to that biological treatments broke lignocellulosic bond as indicated by El-Ashry *et al.* [13], Mahrous and Abou Ammou [25] and Deraz and Ismail [31]. On the other hand, Gado *et al.* [19] showed that the improvement of nutrients digestibility when rations supplemented by ZAD compound was attributed to the improvement of absorption and feed utilization.

Nutritive value of diets (Table, 2) as total digestible nutrient (TDN) was significantly ($P<0.05$) improved by 11.43, 18.61 and 14.50%, respectively for D2, D3 and D4 compared with D1. But, DCP was only significantly ($P<0.05$) between D3 and D1 or D3 and D4. In this convection Puppo and Stam [32], Stamford *et al.* [33] and Grjic *et al.*[34].found that treatment of rice straw by bacteria improved TDN and DCP by about 13.5 and 21.3%, respectively, compared with untreated straw.

Nitrogen Balance: Effect of the experimental rations on nitrogen balance is presented in Table 2 showed that nitrogen intake (NI) g/h/d for D3 was significantly ($p<0.05$) highest (18.43 g/h/d) compared with other groups. while, the lowest value was in D1 (11.64 g/h/d). These results are mainly attributed to higher dry matter intake and CP digestibility of D3. The same diet (D3) recorded the highest total nitrogen execration (12.25 g/h/d). However, all groups showed positive nitrogen balance and D3 recorded the highest value (6.18 g/h/d) of nitrogen balance, while the lowest value (0.02 g/h/d) was in D1.The highest value of nitrogen balance could be attributer to higher nitrogen intake and higher digestion of CP. This result is close to that obtained by Abd-El-Galil [17] that a positive nitrogen balance, when goats fed on bagass treated with cellulase enzymes and bacteria.

Rumen Liquor Parameters

A) Ruminal pH: Data of the rumen liquor parameters in Table 3 showed that D2 had a significant ($p<0.05$) lower ruminal pH value before feeding (at zero time) compared with other groups. The highest value of ruminal pH before feeding was in D4 followed by D3. These results are in agreement with those obtained by Mahrous and Abou Ammou[25]. No significant ($p<0.05$) difference found in ruminal pH value after feeding (at 3 and 6hr) among groups. The fluctuation in the ruminal pH during sampling time may be due to the changes in NH3-N and TVFA,s values as affected by treatments. The mean pH value showed a significant difference ($p<0.05$) between D2 and the other groups. Highest pH value (6.48) was recorded by D3 and the lowest value was by D2 (6.18). Generally, the pH values were always above 6.00 which ensure of maximal celluloalytic activity and microbial protein synthesis [35].

B) Volatile Fatty Acids (VFA,s): Data in the same Table showed a significant difference ($p<0.05$) of TVFA,s value between D2 and D3 and the other groups. The highest value of TVFA,s before feeding was in D4 followed by D2 (11.39 and 10.55 mleq/100mg), respectively. While, there was a significant ($p<0.05$) difference in TVFA,s after feeding (at 3 hr) only between D3 and D4 with no significantly among D1, D2 and D4. Total volatile fatty acids value reached its maximum at 6 hrs post feeding with highest value for D4 and the lowest was D1.These results are in agreement with Henies[36].

Table 3: Effect of experimental diets on some rumen parameters of goats during digestibility trails

Items	Experimental diets D1	D2	D3	D4
pH				
0hr	6.69^{a}	6.22^{b}	6.70^{a}	6.78^{a}
3hr	6.37	6.15	6.43	6.19
6hr	6.33	6.16	6.30	6.38
Mean	6.46^{a}	6.18^{b}	6.48^{a}	6.45^{a}
TVFA(mleq/100mgRL)				
0hr	9.29^{c}	10.55^{b}	10.48^{b}	11.39^{a}
3hr	12.54^{ab}	12.02^{ab}	11.85^{b}	12.78^{a}
6hr	10.32^{c}	11.44^{ab}	11.07^{b}	11.80^{a}
Mean	10.72	11.34	11.13	11.99
NH3-N (mg/100mgRL)				
0hr	20.16^{b}	23.75^{a}	22.87^{b}	36.34^{a}
3hr	20.79^{c}	36.09^{a}	29.35^{b}	39.46^{a}
6hr	20.48^{c}	28.54^{b}	22.16^{c}	37.58^{a}
Mean	20.48^{d}	29.46^{b}	24.79^{c}	37.79^{a}

a, b and c means in the same row with different superscripts differ significant ($p<0.05$).

The mean value of TVFA,s showed that no significant differences among groups and the lowest value (10.72 mleq/100mg) was in D1 and the highest value (11.99 mleq/100mg) was in D4. These results are in agreement with those obtained by Mahrous and Abou Ammou [25] who found that the highest value of TVFA,s was in rice straw treated biologically with *Sacchromyces cerevisia* and the lowest value was in untreated. These results of biological treatments might be related to the more utilization of the dietary energy and positive fermentation in the rumen [26]. Such trend observed by Fouad *et al.* [37] indicated that the animals fed treated straw with chemical and chmi-fungal treatment showed higher TVFA,s concentration than those fed untreated straw.

C) NH3-N Concentration: Ammonia-N (NH3-N) concentration before feeding (at zero time) showed significant difference between (D1, D3) and (D2, D4). The highest value of NH3-N concentration was in D4 while the lowest value was in D1 at all times. Post feeding (at 3 hr) data showed significant differences among D1, D3 and other groups while at 6 hrs the differences were significant among D2, D4 and other groups. After 3 hours of feeding NH3-N concentration tend to decrease to reach its minimum of 6 hrs in all groups. This reduction of ammonia in the rumen liquor appears to be a result of stimulated microbial activity and increased incorporation of ammonia into microbial protein. The mean value of NH3-N concentration showed that significant differences among groups and the highest value was in D4 and the lowest value was in D1 (37.79 and 20.48 mg/10ml RL). Our results were on line with the results of Mahrous and Abou Ammou [25] and El-Ashry, *et al.* [38] and that rice straw treated biologically with *Sacchromyces cerevisiae* showed the highest value of NH3-N compared with other groups.

Table 4: Blood parameters as affected by experimental diets during digestibility trails

Items	Experimental diets D1	D2	D3	D4
Total protein (gm)				
0hr	6.06^{c}	6.50^{bc}	7.58^{a}	6.65^{b}
3hr	6.38^{b}	6.24^{b}	7.40^{a}	7.26^{a}
6hr	5.68^{c}	6.47^{b}	7.45^{a}	7.05^{ab}
Mean	6.04^{c}	6.40^{c}	7.48^{a}	6.99^{b}
Urea-N (mg/100 ml)				
0hr	30.77	29.45	33.68	31.92
3hr	28.99^{b}	35.73^{a}	32.61^{ab}	35.84^{a}
6hr	25.67	33.58	28.22	27.90
Mean	28.48	32.92	31.50	31.89

a, b and c means in the same row with different superscripts differ significant ($p<0.05$).

Blood Parameters: Data of the mean value of blood parameters in Table 4 showed that there were significant ($p<0.05$) differences in TP among D3, D4 and other groups with no significance between D1 and D2.The highest mean value of TP was in D3 followed by D4 (7.48 mg and 6.99 mg), respectively. This increase may be due to the increase of protein intake and its higher digestibility which reflected on the blood components [39]. Also, Rowland [40] found that the dietary protein affected the concentration of plasma protein especially when animals fed low protein diet.

Mean values of TP in goats ranged between 6.04 to 7.48 mg/100 ml and with in the normal range obtained by Gado *et al.* [19].

The mean values of urea concentration (Table 4) showed that no significant ($p<0.05$) differences among groups. The highest mean value of blood urea concentration was in D2 (32.92 mg/100ml). This result are in agreement with those obtained by Salem [23] and Mohamed [41] who mentioned that urea concentration tends to be higher when lambs fed rations containing

Table 5: Effect of the experimental diets on the production efficiency of does

Items	D2	D3	D4
Dray matter intake			
Roughage g/h/d	356.150	436.880	379.730
Concentrate g/h/d	580.000	574.000	581.400
TDMI g/h/d	936.150	1010.880	961.130
TDNI	544.930	626.340	574.850
Milk production L/d	0.845	1.072	1.058
FCM, 4%	0.659	0.985	0.969
Milk composition, %			
Fat	2.53	3.46	3.44
Protein	1.70^{b}	2.68^{a}	2.53^{a}
Lactose	4.37	4.26	3.92
Urea	19.71^{a}	20.32^{a}	12.62^{b}
T. solid	9.41	12.62	10.18
S.N.F	6.79	7.67	7.23
Feed conversion			
Kg TDN/1 liter milk	0.645	0.584	0.543
Feed cost LE /h/d			
Roughage	0.202	0.265	0.215
CFM + ZADO	0.886 +0	0.877+ 0	0.889 +0.2
Total	1.088	1.142	1.304
Feed cost/1 liter milk	1.29	1.07	1.23

a, b and c means in the same row with different superscripts differ significant ($p<0.05$).

ureated or ammoniated rice straw than those fed untreated rice straw. The mean values of urea concentration ranged between 28.48 and 32.92 mg/100 ml and in was within the normal range reported by Mahrous *et al.* [39].

Production Efficiency of Does Fed Tested Diet: Voluntary feed intake of does during lactation period, Table 5 indicated that roughage intake was higher (436.88 g/h/d) in D3 and increased by 22.7 % than D2 (untreated biologically). This could be referred to its higher palatability, higher CP and lower CF contents in D3. This result is in agreement with those reported by Abd El Galil [17], Kent *et al.,* [24] and Kholif *et al.* [42] they observed that biological treatment improved roughage intake compared with untreated roughage. On the other hand, CFM intake was nearly similar in all groups because all groups received 100% of maintains requirements of concentrate. Higher roughage reflected on total dry matter intake which was higher in D3 followed by D4 then D2.

Results in the same Table showed that there was no significant difference among groups in daily milk production and fat corrected milk. Although, D3 recorded the highest value of milk production and fat corrected milk followed by D4 then D2. It is probably attributed to a shift in microbial population and their end products. This increase in milk production may be due to high DM intake. Marghany *et al.*[43] reported that a consistently high DMI is critical to supply the nutrients that are necessary to support milk yield.

Also, Stock [44] reported that enzyme treatment of Holstein cows rations increased milk production and fat corrected milk (FCM). Similar trend was obtained by Kholif *et al.* [42], Kung *et al.* [45] and El-Ashry *et al.* [46] that milk production and 4% fat corrected milk was improved when animals fed biologically treated roughage compared with untreated.

There were significant ($p<0.05$) variation in milk protein and urea among groups being (1.70 and 19.71%), (2.68 and 20.32%) and (2.53 and 12.62%), respectively. While, there were no significant ($p<0.05$) difference in other compounds (fat, lactose, total soiled and soiled non fat) among groups. The highest milk protein for goats fed D3 may be due to its higher feeding value, protein intake and better nutrients digestion and utilization. Also, Dawson [47] found that increasing milk protein content by probiotic supplementation may be due to stimulation of rumen microbes that cause altering in microbial protein synthesis and increase protein yield in the milk. Higher percent of milk fat of goats fed biologically treated roughage (D3 and D4) may be due to higher roughage intake and EE content (1.98 %) as well as higher EE digestibility.

Feed conversion as TDN/1 liter milk was better in D4 followed by D3 compared with D2 (0.543, 0.584 and 0.645 kg TDN/1 liter milk), respectively. This improvement may be due to the mode of action of probiotics which may operate by producing antibiotic substances and inhibiting harmful bacteria, altering microbial metabolism and decreasing intestinal pH. These results are in agreement with those obtained by Sissonse [48]. Feed cost /1 liter milk was better in D3 followed by D4 compared with D2 (1.07, 1.23 and 1.29 L.E), respectively. This may be due to higher milk production and lower feed cost of CFM in D3.

Growth Performance of Growing Male Goats: Data in Table 6 indicated that initial body weight (kg) in all groups was nearly similar while final body weight was higher in D3 followed by D4 then D2 (34.47, 31.39 and 29.11 kg), respectively. Meanwhile, total and daily body gain had the same trend being (20.44, 17.34 and 15.23 kg) and (113.55, 96.33 and 84.61 g), in the same order. These results may be due to higher CP digestibility and dry matter and TDN intake in D3 and D4 compared with D2.

Table 6: Effect of the experimental diets on live body weight gain, feed intake and feed conversion of growing goats

	Experimental diets		
Items	D2	D3	D4
Live body weight change			
Initial body weight, Kg	13.88	14.03	14.05
Final body weight, Kg	29.11	34.47	31.39
Total body weight gain, Kg	15.23^{b}	20.44^{a}	17.34^{ab}
Daily body weight gain, g	84.61^{b}	113.55^{a}	96.33^{ab}
Feed intake g/h/d			
Roughage	451.40	509.25	477.25
CFM	400.95	496.59	431.70
Total intake	852.35	1005.84	908.95
TDN intake g/h/d	496.15	623.22	543.64
DCP intake g/h/d	71.60	85.89	74.90
Feed conversion g intake / g gain			
Dry matter intake	10.07	8.86	9.44
TDN intake	5.86	5.49	5.64

a, b and c means in the same row with different superscripts differ significant ($p< 0.05$).

Table 7: Economical evaluation of the experimental diets

Items	D2	D3	D4
Price of feed intake /d/LE*			
CFM	0.613	0.759	0.660
Roughage	0.256	0.309	0.270
ZADO powder	0.000	0.000	0.200
Total Feed cost daily	0.869	1.068	1.130
Feed cost /Kg gain	10.270	9.410	11.730
Difference between cost and selling price of Kg, LE	9.730	10.590	8.270
Final margin, LE /h	148.190	216.460	143.400
Economic feed efficiency**	1.950	2.130	1.710

*based on market prices at the beginning of the experiment. The price of ton/LE was as follows:

CFM, 1400, wheat straw treated with 3% molasses + 3% urea, 490,

wheat straw treated with 3% molasses + 3% urea + ZAD solution, 540, the price of 20g ZADO powder,0.020.

The price of one Kg live body weight at selling time was 20 LE.

** Economic feed efficiency expressed as the ratio between the price of total live body weight gain and the price of feed consumed to that gain.

The highest roughage intake recorded by D3 followed by D4 while, the lowest value was in D2.This result agreed with those found by fayed *et al.,* [27]. Also, TDN intake g/h/d showed the highest value (623.22 g/h/d) in D3 while, the lowest value (496.15 g/h/d) recorded by D2. Increasing of TDN intake may be due to higher digestibility nutritive value and dry matter intake.

The same trend was found for DCP intake (g/h/d) being the highest in D3 followed by D4 then D2. Feed conversion as DM intake or TDN intake/1 kg gain was better in D3 compared with D4 and D2.These results were similar with Mahrous and Abou Ammou [25], Gado *et al.* [26] and Fayed *et al.* [27] who reported that feed conversion was better with diet treated biologically compared with untreated.

Economical Efficiency of Growing Male Goats: Data of the economical evaluation (Table 7) showed that the feeding cost to produce one kg body gain was higher for goats fed D4.This due to the price of ZADO compound. On the other hand, goats fed D3 recorded the lowest value (9.41 LE).This may be due to higher gain in D3 than other treatments. Also, this group (D3) showed the highest final margin and increased by 31.54 % compared with D2. This because higher total gain and lower feed cost in D3. Economical efficiency was the highest in D3 followed by D2 then D4 being 2.13, 1.95 and 1.71, receptively.

Generally from the pervious results it could be concluded that using wheat straw treated chemically with (3% urea and 3% molasses) then biologically with (ZAD solution, 1L/Ton) in lactating and growing goats, seem to be good economically.

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