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EFFECT OF EXOGENOUS FIBROLYTIC ENZYMES ON PERFORMANCE OF LOCAL MALE GOATS

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Abstract

The study was carried out at the Ruminant Researches Station, Department of Livestock Research, and Section of Agricultural Research, in the district of Abu Ghraib / Baghdad. The objective of this study was to assess the effect of exogenous fibrolytic enzyme (EFE) (Safizym®- France) on the performance of local male goats. The study included two experiments: Experiment 2 (Nutritional Trail), the experiment was conducted during the period from 22 May 2017 to 17 July 2017. Eighteen males of local goats aged 4-5 months were used in this experiment. The animals were randomly assigned to three equal groups (6 animals/group). The first group (control) without enzyme, the second group (T1) treated with the EFE of 500g/ton of concentrate feed, the third group (T2) treated with the EFE of 1000g/ ton of concentrate feed. Experiment 2 (Digestion Trail), The digestion trail continued for a week during the period from 22 July 2017 until 28 July 2017. In this trail, nine local male goats were used. Three males from each group from experiment 1 were selected and submitted to the same previous treatments. The results showed no significant differences in body weight among the treatments during the duration of the experiment as well as between the weeks within the same treatment as a result of treatment with EFE of 500 g/ ton and 1000 g/ ton of concentrate feed. There were no significant effect on dry matter intake, daily weight gain and feed conversion efficiency. The results of the second experiment showed no significant effect of the treatment with EFE in the digestion coefficient of all nutrients as well as the total digestible nutrients.

Keywords: Fibrolytic enzymes, Performance, Local male goats.

تأثير الانزيمات المحللة للألياف في أداء ذكور الماعز المحلي

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الخلاصة

أجريت الدراسة في محطة أبحاث المجترات التابعة لقسم بحوث الثروة الحيوانية / دائرة البحوث الزراعية الواقعة في قضاء أبي غريب/ بغداد، لتقييم تأثير الأنزيمات الخارجية المحللة للألياف (Safazym®– France) في أداء الماعز المحلي. وتضمنت الدراسة تجربتان: التجربة الأولى (التجربة التغذوية) أجريت التجربة للفترة من 2017/5/22 ولغاية 2017/7/17 استعمل في هذه التجربة 18 ثمانية عشر ذكراً من جداء الماعز المحلي بعمر 4–5 أشهر، وزعت عشوائياً على ثلاث مجاميع متساوية (6 حيوانات/ مجموعة)، مجموعة السيطرة بدون انزيم C، مجموعة المعاملة بالأنزيمات المحللة للألياف بنسبة 500 غم/ طن من العلف المركز (T1) ومجموعة المعاملة بالأنزيمات المحللة للألياف بنسبة 1000 غم/ طن من العلف المركز T2. التجربة الثانية (تجربة الهضم) استمرت تجربة الهضم لمدة اسبوع وللفترة من 2017/7/22 ولغاية 2017/7/28 استخدم في هذه التجربة 9 تسعة ذكور من جداء الماعز المحلي حيث تم اختيار ثلاث جداء من كل مجموعة من حيوانات التجربة الاولى وخضعت لنفس المعاملات السابقة. بينت نتائج التجربة الاولى عدم وجود فروقات معنوية في وزن الجسم بين المعاملات طوال مدة التجربة وكذلك بين الأسابيع ضمن المعاملة الواحدة نتيجة للمعاملة بالأنزيمات الخارجية المحللة للألياف بمستويين 500غم/طن و1000غم/طن، كما لم يكن هنالك تأثير معنوي على كل من المادة الجافة المتناولة والزيادة الوزنية اليومية وكفاءة التحويل الغذائي. وبينت نتائج التجربة الثانية عدم وجود تأثير معنوي للمعاملة بالأنزيمات الخارجية المحللة للألياف في معامل هضم جميع العناصر الغذائية وكذلك مجموع العناصر الغذائية المهضومة (TDN).

كلمات مفتاحية: الانزيمات المحللة للألياف، الأداء، ذكور الماعز المحلي.

Introduction

Worldwide demand for animal based products is increasing and hence the importance reason of applying strategies to improve animal productivity. The major constraints in the livestock sector today are the high feed costs and the low quality of available feed resources, especially in tropical developing countries (23). In some ruminant production systems, forages constitute the major portion of all available feed resources, and any improvement in the nutritive value of these feeds with high fiber content and low digestibility may increase the productivity of the animals (10). In

addition, nutrition costs are the largest in production systems and profitability are depend on the proportionality between production costs and the nutritive value of the feeds available (26). The ability of ruminants to convert plant biomass unsuitable for human consumption into meat and milk is of great importance, especially the efficiency of this process is largely dependent on the digestibility of plant cell walls (15). It has been largely confirmed that nutritive value could be improved substantially by different methods, including chemical, physical and microbiological treatments (20). In this respect, exogenous enzymes have shown promise by analyzing plant cell walls (7). The addition of exogenous fibrolytic enzymes as food additives has recently attracted researchers' attention. It has been shown that exogenous fibrolytic enzymes are working synergistically with microbial enzymes in the rumen to enhance the digestibility and nutritive value of high-fiber feeds (17). (18) also noted that exogenous fibrolytic enzymes may enhance the adhesion of rumen microbes or improve their access to the tissue of cell walls, thus accelerating the rate of fiber digestion. Studies have shown that goats have been used to confirm the effect of exogenous fibrolytic enzymes and that the results are weak due to the ability of goats to benefit from fibers that exceed the capacity of large ruminants (5). In addition, information on the effect of rumen fermentation is rare (19). Therefore, this study was conducted to evaluate the effect of exogenous fibrolytic enzymes on feed consumption, weight gains, feed conversion efficiency, and digestion coefficient in local male goats.

Material and Methods

Design of Experiment 1(Feeding Trial): The experiment was conducted in the ruminant researches station / department of livestock research section / office of agricultural research in the district of Abu Ghraib (Baghdad) for the period from 22/5/2017 to 17/7/2017. In this experiment, eighteen male goats from local goats aged 4-5 months obtained from the same station were used in this experiment. The animals were randomly assigned to three equal groups (6 animals/group). The first group (control) without enzyme, the second group (T1) treated with the EFE of 500g/ton of concentrate feed, the third group (T2) treated with the EFE of 1000g/ ton of concentrate feed. The average animal weights at the beginning of the experiment were 16.50, 16.08 and 15.17 kg for the three groups above respectively.

Management and Feeding System: The animals were subjected to a preliminary period of 12 days before the experiment was started and the group was fed within the shaded section of the cowshed where forages (alfalfa hay) was provided *ad libitum* and concentrate feed (without enzyme) was calculated for each animal 100g daily with clean water provided free. After the primary period, the animals were introduced into the experiment program. The animals were introduced to the individual cages in the same cowshed and the cages were provided with two feeders and a water bucket. The forage was provided with 2% body weight and the concentrate feed at 150 g / day. The amounts of feed were divided into two meals, a morning in the hour 8:00 am and evening at 3:00 pm with clean water provided *ad libitum*. The amount of forage feed provided was adjusted according to the change of body weight. The animals are

weighed every two weeks. Also, the amount of concentrated feed is increased by 50 g every week depending on the animal consumption of the forage. The exogenous fibrolytic enzymes were added to the concentrated diet, and the components of the concentrated meal were mixed and the enzyme was added to it weekly. The Premix was added to the feed by 2 kg/ton.

Table 1 Proportions and components of the Concentrate.

Feed material	%
ground barley	59
Wheat Bran	30
ground Corn	10
Food salt	1
Total	100

Table 2 Chemical analysis of feed materials used in the experiment (%).

Nutrients	Alfalfa hay	Concentrate
Moisture	10.66	6.39
Dry matter	89.34	93.61
Crud protein	20.90	10.62
Crud fiber	16.64	14.32
Ether extract	3.24	4.89
Ash	8.19	5.81
Nitrogen free extract	51.03	64.36
metabolizable energy	11.19	12.78

metabolizable energy (MJ/Kg dry matter) = NFE 0.014 + CF 0.005 + EE 0.031 + CP 0.012 (14).

Components of Exogenous Fibrolytic Enzymes (EFE) Used in the Experiment:
Brand name: Xylanase powder for animal feed.
Company: SAFIZYM®
Main activity: Xylanase (EC 3.2.1.8): 1400,000 units of Xylanase / kg.
Additional Activities:
B-glucanase (EC 3.2.1.6): 1,250,000 units of glucanase / kg.
Cellulase (F. pases-EC 3.2.1.4) 5000 units F. pases / kg.
Feed intake: The amount of feed intake per day was calculated by subtracting the amount of residual feed from the offered feed for forage and concentrate on each animal, as in the following equation: Feed intake (g) =offered feed – residual feed.
Body Weight and Weight Gains: Body weight was measured at the start of the experiment and thereafter every two weeks until the end of the experiment. The total weight gain for each animal was calculated as in the following equation: Total weight gain (kg) = final body weight–primary body weight.
Efficiency of Feed Conversion: The efficiency of feed conversion was based on the dry matter of both forage and concentration consumed during a certain period that required to an increase in body weight in the same period and according to the following equation: Efficiency of Feed Conversion (kg feed / kg weight gain) = Amount of feed consumed / total weight gain.
Design of Experiment 2 (Digestive Trial): The experiment lasted for one week for the period from 22/7/2017 until 28/7/2017. In this experiment, nine males from the local

goat were used. Three animals from each feeding trial groups were selected and subjected to the same previous treatments. The amount of feed consumed was calculated daily, and the feces was collected daily for a whole week through the handmade collection bags which were settled on the animals, the bag was emptied after the morning feeding, the feces weight daily and data was recorded and kept on a portion from the samples. At the end of the week the samples were mixing to take 10% of them and freeze for carrying out the approximate analysis and calculation of digestion coefficient.

statistical analysis: Complete randomize design (CRD) was followed as a one way analysis. The trend included the effect of experiment parameters once, and experiment intervals for each transaction another time, following the general linear model and using the SAS statistical program the version 9.1 (21). Differences between mean values were tested using the Duncan multidimensional test (9) at a significant level ($P \leq 0.05$) according to the mathematical model: $Yij = \mu + Ti + Eij$.

Results and Discussion

Experiment 1 (Feeding Trial): Effect of exogenous fibrolytic enzymes on body weight: Table 3 indicates that there was no significant difference in body weight between the treatments along of the experiment period and there was no significant differences between the weeks within the single treatment when adding the EFE of the two levels 500 g / ton and 1000 g / ton compared to the control group and this is consistent with (3). Where she noted. There was no significant difference in body weight between the treatments and during the weeks of experiment with the use of exogenous fibrolytic enzymes (Safizym®-France) in three levels 1, 3 and 5 kg /ton in the diets of Awassi lactating ewes. The results were also consistent with (11), where he found no significant differences in body weight of lactating goats when fibrolytic enzymes were added in the recommended quantity (4.7 ml/kg of concentrated feed). (2) found that the dosage of the 5 g/head/ day of the Safizym®-France to Awassi lambs had significantly higher ($P<0.05$) than the control group since the eleventh month until the end of the experiment in the fourteenth month. The result of current study may be due to higher temperatures during the experiment period, where temperatures ranged between 45-50 degrees celsius, resulting in low consumption of feed and consequently no effect to the addition of exogenous enzymes.

Effect of exogenous fibrolytic enzymes on dry matter, daily weight gain and feed conversion efficiency: Table 4 shows that there is no significant difference between treatment in final body weight and this is consistent with (8) who found in a study conducted to assess the effect of high levels of EFE 5 and 10 g / Kg dry matter of the total diet containing 60% of the oat grain on the performance and digestion coefficient of the lambs, the treatment did not effect on final body weight. The results also agree with (24) in a study done on goat to assess the effect of adding different levels of a mixture of enzymes produced from Aspergillus spp. BCC 274 at 0, 2, 4 and 6 g /kg dry matter of the mixed total ration containing palm leaf silage in dry matter intake and the growth of the goat, where the treatment had no effect on the final body weight.

Table 3 Effect of treatment with exogenous fibrolytic enzymes and duration in weeks on the body weight kg of local goats (mean ± standard error).

Periods	Treatments			Moral level
	C	T1	T2	
First day	16.50 ± 1.36*	16.08 ± 1.75	15.16 ± 1.60	**N.S.****
Second week	15.83 ± 1.47	15.08 ± 1.72	14.75 ± 1.21	**N.S.**
Fourth week	16.91 ± 1.30	16.16 ± 1.83	15.75 ± 1.03	**N.S.**
Sixth week	17.41 ± 1.26	16.41 ± 1.80	16.66 ± 1.04	**N.S.**
Eighth week	19.91 ± 1.31	19.04 ± 1.66	18.79 ± 0.996	**N.S.**
Moral level	N.S.	N.S.	N.S.	

***** Values represent the average ± standard error.

**N.S: means that there are no significant differences between the averages at a significant level ($P \leq 0.05$).

The results of the current study are not consistent with (1), who noted the superiority of treatment fungal enzymes significantly ($P<0.05$) on the control group in the final body weight. Table 4 indicates that there is no significant difference between the dry matter intake from forage and concentrate and total intake over the duration of the experiment, this may be due to a decrease in the rate of rumen fermentation and digestibility, resulting in a reduced rate of disappearance of digested material during the gastrointestinal tract and thus limit of intake (25). This is agree with (13) in a study carried on lambs to assess the effect of EFE and method of addition the enzyme in the performance of lambs and the nutrients intake, as there was no effect of treatment in the dry matter intake. The results of the study were also consistent with (8, 24 and 11). This finding is inconsistent with (20) in a study to assess the effect of commercial enzyme ZADO® on nutrient digestibility in sheep and goats fed on wheat straw *ad libitum* with a specific amount of concentrate feed with or without enzyme 10 g/animal/day, noting that the addition of the enzyme to sheep and goat diets led to a significant increase ($P<0.05$) in the dry matter intake. The results in table 4 indicate that there is no significant difference in daily weight gain of the goats treated with the EFE compared with the control group. Although there is a numerical increase in the second treatment T2, this result agree with (8) he showed no changes in the daily weight gain of lambs when treated with high levels of the enzyme. The results of the current study were consistent with (24), where the enzyme treatment did not have a significant effect on the rate of weight gain of goat but the group treated with the enzyme at 2 g/kg dry matter had the highest mean of daily weight gain compared to other levels of the enzyme. The results were not consistent with (13) in a study conducted on the growing lambs, the mean daily weight gain was significantly affected ($P<0.05$) by the addition of the enzyme. The results in the present study are also inconsistent with (12) in a study of male goats. The researcher found that the enzyme treatment was significantly higher ($P<0.001$) than the control treatment, where the daily mean weight gain was 83.49 g/day compared to 68.33 g/day to the control. As noted by (20) in a study on sheep and goats, Goats are superior on sheep ($P<0.01$) 112.8 g/day compared to 102.6 g/day for goats and sheep respectively. Table 4 shows no significant differences between the feed conversion efficiency, although there is a reduction in the second transaction T2. This is agree with (8 and 13). While

this finding is not consistent with (20) Where goats were significantly superior (P<0.05) in feed conversion efficiency 5.6 kg diet /kg weight gain compared to 7.3 kg diet/kg weight gain for sheep and goats respectively. These differences in response to enzyme addition between the current study and other studies may be due to differences in activity of the enzyme, the substance under the enzyme, or the source of the microbes used in the production of exogenous fibrolytic enzymes (6).

Table 4 Effect of Treatment with EFE in the Dry matter intake, Weight gain and feed Conversion Efficiency of the Local Goat males (Average ± standard error).

Attributes studied	Treatments			Moral level
	C	T1	T2	
Primary weight (kg)	16.50 ± 1.36*	16.08 ± 1.75	15.16 ± 1.60	N.S.**
Final weight (kg)	19.91 ± 1.31	19.04 ± 1.66	18.79 ± 0.996	N.S.
Total weight gain (kg)	3.41 ± 0.712	2.95 ± 0.367	3.62 ± 0.974	N.S.
Daily weight gain (g)	59.94 ± 12.4	51.90 ± 6.44	63.60 ± 17.0	N.S.
forage intake based on dry weight (kg)	13.69 ± 1.47	13.47 ± 1.94	13.32 ± 0.902	N.S.
Concentrate feed based on dry weight (kg)	13.24 ± 0.578	12.53 ± 0.458	13.24 ± 0.555	N.S.
Total feed material consumed on dry weight basis (kg)	26.93 ± 1.66	26.00 ± 2.27	26.56 ± 1.15	N.S.
Feed conversion efficiency (kg dry matter / kg weight gain)	9.07 ± 1.37	9.37 ± 1.14	6.60 ± 2.44	N.S.

*Values represent the average ± standard error.

**N.S: means that there are no significant differences between the averages at a significant level (P≤0.05)

Experiment 2 (Digestion Trial): Table 5 indicate that is no significant differences between the treatments when adding EFE in digestion coefficient and total digestible nutrients (TDN). This can be attributed to the competition between exogenous enzymes with rumen microbes in cellulose binding sites in feed, where (17) reported that the addition of enzymes leads to competition, which explains the lack of response or even the observed negative responses with increased amounts of exognous enzymes added to the live body. This result is consistent with (4), there were no significant differences between digestion coefficient of the nutrients when increasing the level of EFE in the Awassi sheep and goats. (8) indicated no significant differences between the treatments in digestion coefficients of dry matter (DM) and neutral detergent fiber (NDF). (24) found similar results where the digestion coefficient of DM, organic matter (OM) and crude protein (CP) was not affected in goats when increasing levels of EFE were added to the concentrate diet. The result is consistent with (16), where noting that the digestibility of, OM, and NDF in lambs was not affected by increasing the level of external enzymes added to the concentrated diet. The results were not consistent with (22) in a study to assess the effect of adding external enzymes to the diet with different ratios of carbohydrate non-fibril and neutral detergent fiber NFC / NDF in growth performance, nutrient digestibility and ruminal fermentation in Chinese domesticated black goats Where he compared the use of high ratios with low ratios of NFC / NDF 1.06 or 1.66 with or without the addition of EFE (0 or 0.4 g) of cellulose and xylanase / kg dry matter from

the diet, it was found that the treatment at the high level of NFC/NDF with the addition of the enzyme resulted in a significant increase in digestion coefficients of OM, acid detergent fiber (ADF) and NDF. This finding is not consistent with (13) in a study conducted on the growing lambs, where he noting that the addition of the enzyme was improved (P<0.05) DM, OM, NDF, ADF. The present result is not consistent with (5) where there was a significant improvement (P<0.05) in feed digestibility through DM, OM, CP, NDF and ADF in the goat group that treated with enzymes compared with the control group.

Table 5 Effect of Treatment with EFE in Digestion Coefficient and total Digestible Nutrients (mean ± standard error).

Nutrients	Treatments			Moral level
	C	T1	T2	
DM	67.8 ± 2.17*	69.0 ± 4.45	61.2 ± 2.95	**N.S.****
CF	59.5 ± 4.03	60.4 ± 5.49	46.0 ± 16.6	**N.S.**
CP	86.1 ± 1.41	85.7 ± 1.78	83.3 ± 1.61	**N.S.**
EE	91.3 ± 2.04	83.3 ± 4.39	90.0 ± 0.780	**N.S.**
NFE	61.6 ± 2.56	54.4 ± 2.46	53.3 ± 1.54	**N.S.**
OM	66.9 ± 2.05	62.2 ± 1.57	59.1 ± 3.83	**N.S.**
Cellulose	91.0 ± 1.57	83.2 ± 3.26	85.2 ± 2.90	**N.S.**
Hemicellulose	76.3 ± 4.48	76.9 ± 2.25	84.0 ± 1.56	**N.S.**
NDF	82.1 ± 0.534	78.8 ± 1.54	77.3 ± 2.22	**N.S.**
ADF	84.6 ± 2.30	79.7 ± 1.69	74.5 ± 3.21	**N.S.**
TDN	67.0 ± 1.82	62.0 ± 1.58	59.9 ± 3.55	**N.S.**

*Values represent the average ± standard error
** N.S: means that there are no significant differences between the averages at a significant level (P≤0.05)
EE=Ether Extract
NFE = Nitrogen Free Extract
NDF = Neutral Detergent Fiber
ADF = Acid Detergent Fiber
TDN = Total Digestible Nutrients

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