# USING OF FIBROLYTIC ENZYMES (FIBROZYME) TO IMPROVE FEED UTILIZATION BY GROWING LAMBS

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## SUMMARY

Twenty-one Rahmani male lambs (aged about 6 months and weighing an average 28.72 kg) were divided into three similar groups (A,B and C), 7 lambs in each group in a feeding trial for 120 days. All groups were fed concentrate mixture (CM) at 2% of the live body weight to cover about 50% from their energy requirements according to NRC (1985). Wheat straw (WS) was offered at 0.5% of the live body weight. While, dried sugar beet tops (DSBT) was fed ad libitum. The fibrozyme was added to the CM at 0, 2 and 4 kg /ton of the control ration 1 (R1), ration 2 (R2) and ration 3 (R3), respectively which was fed to groups A, B and C. At the end of feeding trial, nine lambs were used in three digestion trials (3 lambs from each group) to evaluate the previous rations by using acid insoluble ash (AIA) technique (Van Keulen and Young, 1977). Rumen liquor and blood samples were collected at the end of the experimental period. Results indicated that addition of fibrozym significantly (P<0.05) increased DM intake by 19.6 for R2 and 19.4% for R3 compared with that of R1 (control). Digestibilities of CP and CF were also significantly (P<0.05) improved by 11.9 and 13.1% for R2 and by 15.1 and 14.4% for R3. However, addition of fibrozym significantly (P<0.05) increased the nutritive value as TDN, DCP and ME by 5.2, 16.5 and 5.6% for R2; and 5.9, 18.0 and 6.1% for R3, respectively compared with those for R1 (control). The ruminal pH values were significantly (P<0.05) lower, while, the concentration of TVFA's were significantly (P<0.05) higher in the rumen liquor of animals fed rations containing fibrozyme than for control group. In the feeding trial, dry matter intake (DMI) and average daily gain (ADG) were significantly (P<0.05) improved by 17.0 and 39.0% for lambs in group B and by 15.8 and 34.0% for lambs in group C compared with those in group A. Feed conversion and economical efficiency improved by using fibrozyme in ration of growing lambs.

**Key words:** lambs, performance, digestibility, fibrolytic enzymes (fibrozyme).

## INTRODUCTION

In many areas of the world, forages are used as a unique source of feed for-ruminants due to their abundance and low cost. However, their availability and quality are not constant throughout the year. Moreover, the digestion of forages in the rumen is relatively slow and incomplete, limiting animal performance and increasing the cost of livestock production. Tropical forages in particular have limited energy value and its cell wall is rich in lignin, silica and cutin, which limit fermentation of carbohydrates, and therefore the production of the volatile fatty acids (VFA) and microbial mass in the rumen (Dominguez Bello and Escobar, 1997).

Animal nutritionist in concordance with biotechnology and the feed industry has many a great effort to optimize the digestion of forages and cereals in the digestive tract. Manipulation of rumen fermentation by using feed additives has been a key point in ruminant nutrition and a frequent topic of study for many years. Antibiotic additives have proved to be effective in the production of ruminants, but their use is increasingly worrying, due to the resistance that they can confer to certain bacteria, which affect the respiratory and digestive tract of the animal and human beings. Antibiotic additives have been extensively studied in ruminants due to their properties for improving feed effeciency and weight gain in high-concentrate based diets. In 2003 the European Food Safety Authority (EFSA) regulated the use of antibiotics as additives. Alternatives to the use of antibiotic feed additives in ruminants are among many others, the use of fibrolytic enzymes complexes and salts of organic acids. Some studies have reported that fibrolytic enzymes improve dry matter intake (DMI) and milk yield in dairy cows fed forage-based diets (Schingoethe et al., 1999), or in dairy cows fed concentrate-based diets (Sanchez et al.,1996). However, other authors reported no effects (Sutton et al.,2003) or even negative effects (Dhiman et al., 2002).

When enzymes or organic acids are administered to animals they are metabolized in the rumen or in the posterior digestive tract, and so would not leave residues in the animal products destined for human consumption. Until now, no negative effects attributed to the use of these additives have been reported in human or animal health.

The present work aimed to investigate the effect of fibrozyme supplementation on the performance of growing lambs.

## MATERIALS AND METHODS

The present study was carried out with the cooperation between Department of Animal Production, Faculty of Agriculture, Kafr El-Sheikh, Tanta University and private farm belong to El-Hamoll city, Kafr El-Sheikh Governorate, Egypt.

Twenty-one Rahmani male lambs (aged about 6 months and weighing an average 28.72 kg) were divided into three similar groups (A,B and C), 7 lambs in each group in a feeding trial for 120 days. All groups were fed concentrate mixture (CM) at 2% of the live body weight to cover about 50% from their energy requirements according to NRC (1985). Wheat straw (WS) was offered at 0.5% of the live body weight. While, dried sugar beet tops (DSBT) was fed ad libitum. The fibrozyme was added to the CM at 0, 2 and 4 kg /ton of the control ration 1 (R1), ration 2 (R2) and ration 3 (R3), respectively which was fed to groups A, B and C.

Concentrate mixture manufactured at the company of El-Gohary at Kafer El-Sheikh City and consisted of 25.0% undecerticated cotton seed meal, 22.5% yellow corn, 25.0% wheat bran, 25.7% rice bran, 1.0% limestone, 0.5% common salt and 0.3% mineral mixture.

Fibrozyme is a nutritional supplement containing rumen protected fiber degrading enzymes designed to maximize forage utilization in ruminants; containing 20% crude protein, 8% ash and 100 XU/g xylanase. While, its ingredients were Aspergillus niger and Trichodema longibrachiatum fermentation extracts and fermentation solubles.

Lambs were fed CM and WS twice daily in almost two equal portions at 8.0 a.m. and 4.0 p.m. Fresh water was available at all times. Lambs were weighed (before the morning feeding) on 2 consective days at the begining and at the end of the treatment period; and once bi-weekly during the experimental period.

At the end of feeding trial, nine lambs with an average body weight 46 kg were used in three digestion trials (3 lambs from each group) to evaluate the previous rations by using acid insoluble ash

(AIA) technique (Van Keuien and Young, 1977). Rumen liquor samples were collected from all animals via a stomach tube at 4 hrs. after the morning feeding. The samples were filtered through two layers of cheese clothes to get clear liquid. The pH was immediately determined via Beckman pH meter. While, ammonia-nutrogen (NH3-N) and total volatile fatty acids (TVFA's) concentrations were determined according to AOAC (1990) and Warner (1964), respectively.

Blood samples were drawn from the jugular vein of each animal at the same time of rumrn liquor collection. Blood hemoglobin (Hb) concentration was determined according to the method of Drabkin (1932). Blood serum was separated within one hour and analysis for glucose (Trinder, 1969). Total serum protein and albumin were determined according to Gornall et al. (1949) and Doumas et al.(1971), respectively. While, globulin was estimated by the difference between total protein and albumin and urea-N by Patton and Crouch (1977). Red blood cells (RBCs) and white blood cells (WBCs) were counted by using a haemocytometer. GOT and GPT activity were determined according to methods described by Varley (1976). All the biochemical constituents of blood were determined calorimetrically using commercial kits. The proximate analysis of feeds and feces were carried out following the conventional methods of AOAC. (1990).

Data were statistically analyzed using General Models Procedure (one way ANOVA model) adapted by SPSS (1997). While, differences among treatment means were tested by multiple range test of Duncan (1955).

## RESULTS AND DISCUSSION

Data in table 1 showed that the chemical composition of the concentrate mixtures (CM, CMF1 and CMF2) were almost similar in all their nutrient contents. While, wheat straw chracterized by high CF (39.28%) and low CP (2.44%) compared with dried sugar beet tops (13.93 and 11.85% for CF and CP, respectively). Generally, chemical composition of the experimental ingredients was within the range reported by many authors (El-Tahan et al.,2005; Ali, 2005; Eweedah et al.,1999; Ali and El-Saidy, 2003; El-Tahan and Mohamadi, 2005; and Eweedah et al., 2005).

**Table 1:** Chemical composition (%) of the different ingredients and experimental rations.

| Item | CM | CMF! | CMF2 | WS | DSBT | Calculated composition | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | R1 | R2 | R3 |
| DM | 91.02 | 90.45 | 91.12 | 92.21 | 88.45 | 100 | 100 | 100 |
| On DM basis | | | | | | | | |
| OM | 91.85 | 92.44 | 92.35 | 86.05 | 79.43 | 87.27 | 86.62 | 86.48 |
| CP | 14.98 | 15.81 | 15.79 | 2.44 | 11.85 | 12.28 | 12.61 | 12.60 |
| CF | 12.03 | 12.58 | 12.61 | 39.28 | 13.93 | 16.41 | 16.44 | 16.39 |
| EE | 4.85 | 4.92 | 4.87 | 1.45 | 2.27 | 3.59 | 3.46 | 3.43 |
| NFE | 59.99 | 59.13 | 59.08 | 42.88 | 51.38 | 54.99 | 54.11 | 54.06 |
| Ash | 8.15 | 7.56 | 7.65 | 13.95 | 20.57 | 12.72 | 13.38 | 13.52 |

CM: concentrate mixture. CMF1: CM plus fibrozyme (2 kg/ton CM).
CMF2: CM plus fibrozyme (4 kg/ton CM). WS: wheat straw. DSBT: dried sugar beet tops.
R1: CM+WS+DSBT. R2: CMF1+WS+DSBT. R3: CMF2+WS+DSBT.
Fibrozyme distributed by International Free Trade Com. (Dr. Magady Hassan, street 9 Moukatam, Cario, Egypt) and manufactured by P.O. Box 7156 stellenbosch 7599, Republic of South Africa.

Feed intake, nutrients digestibility and nutritive value of the experimental rations are presented in table 2. Results showed that addition of fibrozym significantly (P<0.05) increased DM intake by 19.6 and 19.4% for R2 and R3, respectively compared with that of R1 (control). Digestibilities of CP and CF were also significantly (P<0.05) improved by 11.9 and 13.1% for R2 and by 15.1 and 14.4% for R3. While, the differences in feed intake and digestibilities of the nutrients between the treated rations (R2 and R3) were not significant. These results were in agreement with those recorded by Ali (2005), who found that the digestibility of CP and CF for ration containing probiotic fed to lambs were significantly (P<0.05) higher than those fed without probiotic. The improvement in nutrients digestibility may be due to the increase in the numbers of bacteria especially celluloytic bacteria, and fungi in the rumen (Wiedmeier et al., 1987). Also, Pinos-Rodriguez et al. (2002) observed that the addition of fibroyltic enzyme increased (P<0.01) DM intake, as well as OM and CP (P<0.05) for both alfalfa and ryegrass hay fed to sheep. But, the enzyme increased apparent digestibility of CP, hemicellulose (P<0.05), and NDF (P<0.01) for alfalfa hay only. Different studies (*in vitro* and *in situ*) reported that the addition of fibrolytic enzymes improved DM and NDF disappearance of dry forages (Dong et al., 1999 and Lewis et al., 1996). Regarding the *in vivo* digestibility effects of fibrolytic enzymes, Feng et al. (1996) reported an improvement of the digestibility of DM, NDF, and ADF (8.5, 8.9, and 13%, respectively) by enzyme addition to dry-grass forage fed to steers. However, Knowlton et al. (2002) reported that DM digestibility was greater in dairy cows fed enzymes, but NDF digestibility was unaffected.

**Table 2:** Feed intake, digestibility, nutritive value of experimental rations.

| Item | Experimental rations | | | SEM |
|---|---|---|---|---|
| | R1 | R2 | R3 | |
| Daily DM intake, g/h/d. | | | | |
| CM | 810 | --- | --- | --- |
| CMF1 | --- | 850 | --- | --- |
| CMF2 | --- | --- | 838 | --- |
| WS | 203 | 217 | 212 | --- |
| DSBT | 440 | 670 | 685 | --- |
| Total DM intake, g/h/d. | 1453 [b] | 1737 [a] | 1735 [a] | 0.65 |
| Digestion coefficients, % | | | | |
| DM | 59.95 | 60.50 | 61.05 | 0.45 |
| OM | 63.54 | 64.50 | 63.92 | 0.54 |
| CP | 60.15 [b] | 68.25 [a] | 69.23 [a] | 1.45 |
| CF | 58.18 [b] | 65.82 [a] | 66.54 [a] | 1.25 |
| EE | 56.48 | 58.15 | 59.24 | 0.81 |
| NFE | 60.12 | 61.80 | 62.13 | 0.74 |
| Nutritive value, % | | | | |
| TDN | 54.55 [b] | 57.39 [a] | 57.79 [a] | 0.75 |
| DCP | 7.39 [b] | 8.61 [a] | 8.72 | 0.21 |
| ME, Mcal/kg DM | 1.96 [b] | 2.07 [a] | 2.08 [a] | 0.43 |

[a,b] means in the same row with different superscripts differ significantly at ($P<0.05$).

R1: CM+WS+DSBT. R2: CMF1+WS+DSBT. R3: CMF2+WS+DSBT.

SEM: Standard error of mean.

ME, Mcal/kg DM= (TDN×3.6)/100 (Ranjhan, 1980 and Church and Pond, 1982).

Results of nutritive values of the experimental rations are showen in Table 2. Addition of fibrozym significantiy ($P<0.05$) increased the nutritive value as TDN, DCP and ME by 5.2, 16.5 and 5.6% for R2; and 5.9, 18.0 and 6.1% for R3, respectively compared with those for R1 (control). The increasing of nutritive value with fibrozym supplementation may be due to the increasing of nutrients digestion. These findings are in accordance with those shown by Ali (2005). He reported that adding the probiotic in the ration containing CFM+ corn stalks improved its nutritive value as TDN and DCP.

Data of rumen liquor and blood parameters of animals fed the experimental rations are summarized in table 3. The ruminal pH values were significantly ($P<0.05$) lower while, the concentration of TVFA's were significantly ($P<0.05$) higher in the rumen liquor of animals fed on R2 and R3 than those for animals fed on R1. No significant differences were observed in the concentration of NH3-N between the animals fed on the three experimental rations. These data agree with results obtained by Lewis et al. (1996) who reported that fibrolytic enzymes have decreased ruminal pH and increased total VFA's in steers. Mutsvangwa et al. (1992) and Moloney and Drennan (1994) found that the addition of probiotics decreased ruminal pH and $NH_3$-N or increased them as reported by Williams and Newbold (1990) and Ayala et al. (1992). While, in some experiments, there were no significant effects due to supplementation on ruminal pH, $NH_3$-N and TVFA's (El-Badawi et al., 1998; Arcos et al., 2000 and Ali, 2005). Results in table 3 showed that no significant differences were observed between the experimental rations in all blood constituents. The valus obtained were within the normal range of sheep as reported by many authers (Reece, 1991; Yousef et al., 1998 and Saleh et al., 2000), who reported that sheep blood contained 6-9 g% total proteins, 3.5-4.7 g% albumin, 8-10 g% hemoglobin, 8-38 mg% urea-N, 22-30 IU/L GOT and 12.4-16.2 IU/L GPT. However, Jain (1986) and Soliman (1997) found that the count of RBC and total WBC in the blood of sheep were $9\text{-}15\times10^6$ and $4\text{-}12\times10^3$ cells/mm$^3$, respectively.

**Table 3:** Some rumen liquor and blood parameters of rams fed the experimental rations.

| Item | Experimental rations | | | SEM |
|---|---|---|---|---|
| | R1 | R2 | R3 | |
| Rumen liquor: | | | | |
| PH | 6.51 $^{a}$ | 5.98 $^{b}$ | 6.01 $^{b}$ | 0.40 |
| NH3-N, mg/100ml | 27.50 | 26.95 | 27.01 | 0.52 |
| TVFA's, meq/100ml | 11.75 $^{b}$ | 14.42 $^{a}$ | 15.03 $^{a}$ | 0.85 |
| Blood parameters: | | | | |
| Hemoglobin, g% | 10.15 | 9.35 | 9.83 | 0.14 |
| RBC's $\times 10^{6}$, cells/mm$^{3}$ | 11.00 | 10.50 | 10.80 | 0.35 |
| WBC's$\times 10^{3}$, cells/mm$^{3}$ | 7.85 | 8.23 | 8.41 | 0.61 |
| Glucose, mg/100ml | 52.02 | 53.21 | 54.01 | 0.71 |
| Total protein, g/100ml | 7.15 | 7.35 | 7.30 | 0.31 |
| Albumen, g/100ml | 2.65 | 2.71 | 2.75 | 0.51 |
| Globulin, g/100ml | 4.50 | 4.64 | 4.55 | 0.23 |
| Urea-N, mg/dl | 20.12 | 19.98 | 21.01 | 0.12 |
| GPT, IU/L | 15.45 | 16.01 | 16.24 | 0.34 |
| GOT, IU/L | 29.50 | 30.01 | 29.85 | 0.48 |

$^{a,b}$ means in the same row with different superscripts differ significantly at (P<0.05).
R1: CM+WS+DSBT. R2: CMF1+WS+DSBT. R3: CMF2+WS+DSBT.
SEM: Standard error of mean.

The average DM intake and growth performance of lambs are presented in Table (4). Dry matter intake (DMI) and average daily gain (ADG) were significantly (P<0.05) improved by 17.0 and 39.0% for lambs in group B and by 15.8 and 34.0% for lambs in group C compared with those for the control group A. This results might be due to the higher digestible CP (Haddad and Goussous, 2005) and the increse in the fermentation capacity of rumen (Hughes, 1987) in treated rations. These results are in agreement with the findings of Ali, (2005) who reported that addition of probiotic in the ration of lambs significantly (P<0.05) improved ADG and DMI.

Table 4: Average DM intake and growth performance of lambs fed on experimental rations.

| Item | Experimental groups | | | SEM |
|---|---|---|---|---|
| | A | B | C | |
| Animals No. | 7 | 7 | 7 | --- |
| Experimental period, day | 120 | 120 | 120 | --- |
| Intial body weight, kg. | 28.86 | 28.71 | 28.71 | 0.21 |
| Final body weight, kg. | 45.78[b] | 52.23[a] | 51.39[a] | 0.43 |
| Total gain, kg. | 16.92[b] | 23.52[a] | 22.68[a] | 0.61 |
| Daily gain, g. | 141[b] | 196[a] | 189[a] | 0.96 |
| **DM intake, kg/head/day.** | | | | |
| Concentrate mixture (CM) | 0.610 | --- | --- | --- |
| CM+fibrozyme, 2 kg/ton (CMF1) | --- | 0.650 | --- | --- |
| CM+fibrozyme, 4 kg/ton (CMF2) | --- | --- | 0.642 | --- |
| Wheat straw (WS) | 0.150 | 0.160 | 0.158 | --- |
| Dried sugar beet tops (DSBT) | 0.450 | 0.596 | 0.601 | --- |
| Total DM intake, kg/head/day | 1.210[b] | 1.416[a] | 1.401[a] | 0.87 |
| Roughage ratio, % | 49.59 | 53.39 | 54.18 | --- |
| Feed conversion, kg DM/kg gain | 8.58 | 7.22 | 7.41 | --- |
| **Feed cost, LE/head/day** | | | | |
| Cost of CM | 0.61 | --- | --- | --- |
| Cost of CMF1 | --- | 0.73 | --- | --- |
| Cost of CMF2 | --- | --- | 0.81 | --- |
| Cost of WS | 0.06 | 0.06 | 0.06 | --- |
| Cost of DSBT | 0.14 | 0.18 | 0.18 | --- |
| Total cost, LE/head /day | 0.81 | 0.97 | 1.05 | --- |
| Feed cost, LE/kg gain | 5.74 | 4.95 | 5.56 | --- |
| Economical efficiency* | 2.61 | 3.03 | 2.70 | --- |

[a,b] means in the same row with different superscripts differ significantly at ($P<0.05$).
Group A: fed on R1( CM+WS+DSBT). Group B: fed on R2 (CMF1+WS+DSBT). Group C: fed on R3 (CMF2+WS+DSBT). SEM: Standard error of mean.
The price list of one ton of undecerticated cotton seed meal, yellow corn, wheat bran, rice bran, limestone, common salt and mineral mixture were 1150, 1000, 930, 850, 400, 500 and 2000 LE, respectively and the price of one kg fibrozyme was 65 LE (based on year 2005 prices).
*Economical efficiency= price of one kg LBW, 15 LE/ feed cost (LE/kg gain).

Feed conversion efficiency (kg DM/kg gain) for animals in groups B and C was better than those in group A, it was improved by 15.9 and 13.7% for rations 2 and 3, respectively. However, economical efficiency improved by 16.1 and 3.5% and feed cost, as LE/ kg gain decreased by 13.8 and 3.1% for lambs fed rations 2 and 3, respectively compared to the control ration. These results are agree with those obtained by El-Badawi et al. (1998); Abd-Ghani, (2004) and Ali (2005).

In view of the obtained results, it could be recommended that using fibrolytic enzymes (fibrozym) as a feed additives (2 kg/ton CM) had a heneficial effect on improving productive performance of growing lambs as well as improved the economical efficiency. Moreover, it produced the cheapest live body weight gain compared to other rations.

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## الملخص العربي

## استخدام ا... المحللة للألياف (الفيبروزيم) لتحسين الاستفادة من الغذاء بواسطة الحملان النامية

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أجريت هذه الدراسة علي ٢١ من ذكور الحملان الرحماني (متوسط عمرها ٦ شهور, و متوسط وزنها ٢٨,٧٢كجم) قسمت إلي ٣ مجموعات متماثلة (ا, ب, ج) ٧ حملان في كل مجموعة في تجربة نمو استمرت ١٢٠ يوم. غذيت كل المجموعات علي مخلوط العلف المركز بنسبة ٢% من وزن الحيوان الحي لتغطي ٥٠% من احتياجاتها من الطاقة بينما قدم تبن القمح بنسبة ٠,٥% من وزن الحيوان الحي و بينما عرش بنجر السكر المجفف غذي حتى الشبع. أضيف الفيبروزيم لمخلوط العلف المركز بنسب صفر, ٢, ٤ كجم/طن في عليقة الكنترول (عليقة ١), عليقة(٢), عليقة (٣) علي الترتيب و التي غذيت للثلاث مجموعات من الحملان ( أ, ب, ج) في تجربة النمو علي الترتيب. في نهاية تجربة النمو أستخدم ٩ حملان في ثلاث تجارب هضم (٣ حملان من كل مجموعة) لتقييم العلائق السابقة باستخدام طريقة AIA . كما أخذت عينات من سائل الكرش و الدم في نهاية فترة التجربة. وأوضحت النتائج ما يلي:

١- إضافة الفيبروزيم أدت إلي زيادة معنوية (٠,٠٥) في المادة الجافة المأكولة بنسبة ١٩,٦% للعليقة (٢), ١٩,٤% للعليقة (٣) مقارنة بعليقة الكنترول. تحسن معامل هضم البروتين الخام و الألياف الخام معنويا (٠,٠٥) بنسبة ١١,٩, ١٣,١% للعليقة (٢)و بنسبة ١٥,١, ١٤,٤% للعليقة (٣) مقارنة بعليقة الكنترول.

٢- أدت إضافة الفيبروزيم إلي زيادة معنوية (٠,٠٥) في القيمة الغذائية في صورة مجموع مركبات غذائية مهضومة و بروتين مهضوم و طاقة قابلة للتمثيل بنسبة ٥,٢, ١٦,٥, ٥,٦% علي الترتيب للعليقة (٢) و بنسبة ٥,٩, ١٨,٠, ٦,١% علي الترتيب للعليقة (٣) مقارنة بالعليقة ١ (الكنترول).

٣- انخفضت قيم ال pH بينما ازداد تركيز الأحماض الدهنية الطيارة الكلية في سائل الكرش معنويا (٠,٠٥) للحملان المغذاة علي علائق محتوية علي الفيبروزيم عن مجموعة الكنترول.

٤- في تجربة النمو تحسن كلا من المادة الجافة المأكولة و الزيادة اليومية معنويا (٠,٠٥) بنسبة ١٧,٠, ٣٩,٠% لحملان المجموعة (ب) و بنسبة ١٥,٨, ٣٤,٠% لحملان المجموعة ج مقارنة بحملان المجموعة (أ).

٥- تحسن معدل تحويل الغذاء والكفاءة الاقتصادية باستخدام الفيبروزيم في عليقة الحملان النامية.