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Impact of Two commercial Types of Feed Supplement on Rumen Juice properties and Body Weight in Goats

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Key words

probiotics, rumen juice, digestibility, fibrolytic enzymes

ABSTRACT:

Non pregnant female goats (12 animals) free from internal and external parasites and kept under observation for 4 weeks before being supplemented with two different kind of feed supplement for 8 weeks . Goats of experiment were divided into 3 groups each of them consists of 4 goat . (G1): Treated with probiotic TOP 2X^{R} with dose 1ml/liter of water**,** (G2): treated with another supplement which contain fibrolytic enzymes GALZYM^{R} with dose 1ml/3liters of water and (G3): control group. Rumen juice samples were obtained weekly to observe the effect of bacterial probiotics TOP-2X^{R} and fibrolytic enzymes Galzym^{R} on the food digestibility of the small ruminants (goat) as well as the effect of them on some physical and biochemical properties of ruminal juice as well as body weight of treated animals and also to throw some lights on hematological parameters .Results of the study showed that using of bacterial probiotic TOP2X^{R} as a dietary supplement is more beneficial than using of the supplement which contain fibrolytic enzymes GALZYM ^{R}. TOP2X^{R} the bacterial probiotic enhancing body weight , protozoal count, level of T.V.F.A more than GALZYM

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1. INTRODUCTION

Feed additives means, a some of ingredients that added to feed of large or small animals and it will improve the productive efficiency (body weight, , feed conversion, carcass traits, and some immune response parameters) and economic efficiency (decreasing productive cost, increasing return and net profit) of animals production (Ghasmi et al. 2006).

The fibrolytic enzymes can be used to improve milk production in lactating cows. Also, animals fed diets containing a direct-fed fibrolytic enzyme formulation had increased body weight gain, but the effect of addition of the enzyme formulation on milk yield and manure nutrient excretion differed for early and late lactation cows (Knowlton et al. 2002).

Animal production relies heavily on antibiotics, both for treatment of diseases and for growth promotion. With increasing public concerns associated with antibiotic resistance, the ban on sub-therapeutic antibiotic usage in Europe and the potential for a ban in other regions of the world, there is increasing pressure to reduce the use of antibiotics in feed. Addition of probiotics to feed is one of the alternatives to be used as a replacement for antibiotics. There is sufficient evidence to show that probiotics are effective in enhancing the immune system, increasing body weight gain, reducing diarrhea, and improving feed conversion efficiency (Patterson et al., 2003).

Enzymatic probiotic are classified broadly by the substrate on which they act and by their specificity. Commercial enzyme products are fermentation extracts of bacterial (Bacillus spp.) or fungal (Trichoderma and Aspergillus spp.) origin (Cheeke 2005). Enzyme supplementation increases total tract digestibility of organic matter and fiber. The proportion of the diet to which the enzyme is applied must be maximized to ensure a beneficial response (Bowman et al. 2002).

This study aimed to compare between the effect of two different types of probiotics (TOP2x)® ,(GALZYM) on some biochemical and physical rumen juice properties and body weight of goats .

2. MATERIALS AND METHODS

This experiment was carried out on 12 female non pregnant goats and it was free from enternal and external parasites and it was kept under observation for 4 weeks before the beginning of the experiment. All goats were fed on dry ration which consisted of 7.5 kg. Concentrate from El fagr* ration (kilo 57 alex-cairo desert road at el shommoo entry), (14% protein). This concentrate ration was consisted of corn 26%, bran 42%, extract 20%, and sod. chloride 3% in addition to 7.5 kg tibn and increase gradually according to the increasing of body weight

Animals under investigation were divided into 3 groups each of them 4 goat:

(G1): (4 goats) supplemented with probiotic TOP 2X ^{R} for 8 weeks with dose 1 ml/liter of water

(G2): (4 goats) supplemented with enzyme supplement which contain fibrolytic enzymes GALZYM® for 8 weeks with dose 1ml/ 3liter of water

Control group (c. group) without addition of probiotics or enzyme supplement

1-Sampling:

1.1-Fecal sampling: for guaranteeing that all the animals of experiment is free from internal parasite

1.2-Rumen juice samples:

From all goats in the experimental and field studies, rumen juice samples were collected by using a simple ordinary rubber tube (16 mm diameter connecting with a suction plastic syringe 60 ml capacity). Each sample about 100 ml was taken from different levels of the ruminal contents in a clean dry and sterile flask. The color, odor, consistency and PH were examined immediately after sampling, and then the samples were sieved and strained through a 4 folds of sterile gauze and divided into 3 portions and preserved as follow, the first portion was used immediately for estimation of ammonia nitrogen concentration, the second portion was preserved by addition of 1 ml HCL N/100 and 2 ml orthophosphoric acid to each 2 ml of rumen juice then deep freezing for determination of total volatile fatty acids, the third portion was fixed by 4 times volume of 10% methyl green formol saline to one volume rumen liquor sample then kept in dark place for counting of rumen protozoa microscopically.

2- Feed supplements used in experimental studies.

2.1- TOP 2X^{R} produced by Brookside Agra and imported by Top Vet. International Probiotic consisted of 260 ml/liter dried bacillus subtillis, phosphoric acid 70 ml/liter, Lysine 8.2 g, glysine 4.8g and fed by dose of 1 ml/1liter of water.

2.2- GALZYM® produced by Textan company and imported by El Nehesi company .It is a combination of a group of exogenous and fibrolytic enzymes consisted of, cellulase: 100000000 unit, xylanase 1500000 unit, lipase 6500 unit, alpha amylase 250000 unit, protease 400000 unit and Pectinase 30000 unit and fed by a dose of 1 ml /3 liters of water

3-Fecal examination: for guaranteeing that all the animals of experiment are free from internal parasite according to method described by Kelly (1984)

4-Ruminal liquor analysis:

4.1- Physical properties of ruminal juice:

The color, odor and consistency of the rumen juice were examined immediately after collection by the method described by Rosenberger et al., (1979) and Radostitis et al., (2007) and the Sediment activity test was determined according to the method described by Nichols and Penn (1958).

4.2- Microscopic examination of protozoa: It was preformed according to the method described by Rosenberger et al., (1979) and Ruminal protozoal count: It was done according to the method described by Ogimata and Imai (1981).

4.3 -Biochemical examination of ruminal juice:

4.3.1- Hydrogen ion concentration (PH): Rumen pH was determined immediately after collection of strained ruminal juice by the use of electric pH meter.

4.3.2- Determination of total volatile fatty acid (T.V.F.A): The T.V.F.A concentration was determined by steam distillation method as described by Warner (1962). The evaluation was done by Keldahl methods.

4.3.3- Detection of ammonia nitrogen: It occurred immediately after collection of rumen juice. It was detected according to the method described by Conway (1957).

5-Statistical analysis: The data obtained from this investigation was stastically analyzed according to **SAS (2002).**

3. RESULTS

1-Effect of TOP 2X^{R} and GALZYM^{R} on the results of body weight:-

Before the experiment Table (1) showed that, the body weight at 1st week was (29.00±1.22 kg) for (G1) ,(25.00±1.68 kg) for (G2)and (25.50±1.85 Kg) for control group, and at the 8th

week of the experiment body weight average for (G1) was (33.00±1.78 kg),(29.75±1.03 kg) for (G2) and(27.75±1.93 Kg) for control group. And this results indicate that body weight show higher score in (G1) and followed by control group then (G2)

2-Eeffect of TOP 2X^{R} and GALZYM^{R} on ruminal juice :

2.1-Effect Of TOP 2X^{R} and GALZYM^{R} on some physical characters of the rumen juice: probiotics had non-significant changes in probiotics administrated groups in comparison with control one as it shown in table (2), the color of rumen juice was varied from olive green to brownish green, while the odor was aromatic,. The consistency was slightly viscid to watery .

2.2-Effect of TOP2X® and GALZYM® on the results of sediment activity test: Table (3) showed that the sedimentation activity test in 1st week for (G1) is (9.18±00.18),(9.18±0.18) for (G2) and (8.20±0.55) for control group, in 8th week results was (3.25±0.25) for (G1) , (4.25±0.75) for (G2) and (4.75±1.1) for control group and this result show improvement of SAT in (G1) followed by (G2) and then control group.

3-Effect of TOP 2X® and GALZYM® on protozoal activity of rumen juice :

3.1-Effect of TOP 2X^{R} and GALZYM^{R} on protozoal count: Table(4) cleared that the protozoal count level differ significantly (P< 0.01) among different groups that treated **with probiotic, and** control group and also among different periods of experiment. Protozoal count was higher in (G1) followed by (G2) then control group, the protozoal count at 1st week was ($5.50*10^4$±1.19) for (G1), ($3.25*10^4$±0.75) for (G2)and ($4.25*10^4$±0.25/ml) for control, and at the 8th week the protozoal count for (G1) was ($8.50*10^4$±1.19), ($5.75*10^4$±1.44) and ($3.25*10^4$±0.48/ml) for control group

3.2-Effect of TOP 2X^{R} and GALZYM ^{R} on protozoal motility**:** Table (5) recorded motile, active and crowded protozoa in rumen juice of the control healthy goat and its core were (+) and score were (+++) motile, active and crowded in G_1 and in G_2 protzoal motility were motile but not active and crowded ant score were (++) .

4- Effect of TOP 2X® and GALZYM® on some biochemical properties of rumen juice

4.1-Effect of TOP 2X^{R} and GALZYM^{R} on PH level:- The level of pH at 1st week was (5.40±0.08) for (G1) ,(5.58±0.08) for (G2)and (5.76±0.32) for control, and at the 8th week level of PH for (G1) were (6.93±0.05)higher than (G2) with score (6.55±0.21) and (6.63±0.18) for control group (Table, 6).

4.2-Effect of TOP 2X^{R} and GALZYM^{R} on ruminal ammonia level :The result of ruminal ammonia level at the end of experiment cleared that (G2) recorded a marked increase in ammonia level than (G1) and followed by control group. Ruminal ammonia level at 1st week were (30.80±9.97) for (G1) ,(62.25±7.75) for (G2)and (35.25±7.70mg%) for control , and at the 8th week ammonia level for (G1) was (39.50±5.50),(53.25±8.50) and (30.00±6.58mg%) for control group (Table, 7).

4.3-Effect of probiotics on total volatile fatty acids: Table (8), cleared that, the total volatile fatty acids level at 1st week was (51.25±0.99 MEQ/L) for (G1), (38.75±2.39 MEQ/L) for (G2) and (48.75±2.39 MEQ/L) for control, and at the 8th week the total volatile fatty acids level for (G1) was (63.75±3.15 MEQ/L) and it show the highest level of T.V.F.A followed by (G2) (58.75±2.39 MEQ/L) then (50.00±2.89MEQ/L) for control group

Table 1. Effect of TOP 2X® and GALZYM® on body weight of goat among different weeks of experiment.

Weeks	Top2 X^{R} (G1)	Galzym^{R} (G2)	Control
1st week	29.00±1.22B^{a}	25.00±1.68B^{b}	25.50±1.85B^{b}
8th week	33.00±1.78A^{a}	29.75±1.03A^{b}	27.75±1.93Ac

- Capital letters indicated that: Means within the same column of different letters are significantly different at (P < 0.01).

- Small letters indicated that: Means within the same row of different letters are significantly different at (P < 0.01).

- No of animals= 4

Table 2. The Effect of TOP 2X® and GALZYM® on physical characters of the rumen juice among all weeks of experiment

Group Parameter	Control	G_1	G_2
Color	Olive green to brownish green	Olive green to brownish green	light green to brownish green
Odor	Aromatic odor	Aromatic odor	Aromatic odor
Consistency	Slightly viscid	Slightly viscid	Slightly watery

Table 3. Effect of TOP 2X^R and GALZYM ^{R} on SAT level of goat among different weeks of experiment.

Weeks	Top2 X^R (G1)	Galzym^R (G2)	Control
1st week	8.25±0.25A^a	9.18±0.18A^a	8.20±0.55A^a
2nd week	7.50±0.29B^a	8.00±1.22B^a	8.14±1.44A^a
3rd week	6.00±1.08C^a	7.00±1.00C^a	8.00±1.78A^a
4th week	5.00±0.58D^a	5.25±0.03E^{ab}	6.25±0.85E^a
5th week	4.50±0.50E^a	6.00±1.22D^a	5.50±0.87D^a
6th week	3.25±0.25F^b	6.25±1.25D^{a}b	7.50±1.66B^a
7th week	3.50±0.29F^b	4.55±0.91F^b	6.75±2.29C^a
8th week	3.25±0.25F^b	4.25±0.75F^b	4.75±1.18F^a

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- Small letters indicated that: Means within the same row of different letters are significantly different at ($P < 0.01$).
- No of animals= 4

Table 4. Effect of TOP 2X® and GALZYM® on protozoal count (No X 10^4) of goat among different weeks of experiment.

Weeks	Top2 X ^{R}(G1)	Galzym ^{R}(G2)	Control
1st week	5.50±1.19C	3.25±0.75C^a	4.25±0.25A^a
2nd week	6.00±1.35C	3.25±0.75C^a	4.50±0.29A^a
3rd week	8.00±1.08B	1.25±0.25D^b	3.25±0.48C^b
4th week	8.50±1.66B	6.25±1.65A^a	4.75±0.48A^a
5th week	8.50±0.87B	5.75±1.44B^{ab}	4.75±0.48A^a
6th week	8.50±0.87B	5.75±1.44B^{ab}	4.75±0.48A^a
7th week	9.00±1.29A	5.75±1.44B^{ab}	3.25±0.75C^b
8th week	8.50±1.19B	5.75±1.44B^{ab}	3.25±0.48C^b

- Capital letters indicated that: Means within the same column of different letters are significantly different at ($P < 0.01$).
- Small letters indicated that: Means within the same row of different letters are significantly different at ($P < 0.01$).
- No of animals= 4

Table 5. Effect of TOP 2X® and GALZYM® on protozoal motility level of goat among different weeks of experiment.

Weeks	Top2 X^R (G1)	$Galzym^R$ (G2)	Control
1st week	(+)	(+)	(+)
2nd week	(++)	(+)	(+)
3rd week	(++)	(+)	(+)
4th week	(++)	(++)	(+)
5th week	(++)	(++)	(+)
6th week	(++)	(++)	(+)
7th week	(++)	(++)	(+)
8th week	(++)	(++)	(+)

Table 6. Effect of TOP $2X^R$ and $GALZYM^R$ on PH level of goat among different weeks of experiment.

Weeks	Top2 X^R (G1)	$Galzym^R$ (G2)	Control
1st week	6.40±0.08C	$6.58±0.08B^a$	$6.76±0.32B^a$
2nd week	6.98±0.03B	$6.88±0.14A^a$	$6.00±0.25A^b$
3rd week	6.95±0.05B	$6.50±0.36A^a$	$6.25±0.21A^a$
4th week	6.95±0.05B	$6.70±0.14A^{ab}$	$6.40±0.21A^b$
5th week	7.40±0.00A	$6.63±0.20A^{ab}$	$6.40±0.21A^b$
6th week	7.40±0.00A	$6.88±0.05A^a$	$6.40±0.21A^b$
7th week	7.40±0.00A	$6.55±0.37A^b$	$6.40±0.29A^a$
8th week	6.93±0.05B	$6.55±0.21A^b$	$6.40±0.18A^a$

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- No of animals= 4

Table (7): Effect of TOP $2X^R$ and $GALZYM^R$ on ruminal ammonia level (mg/dl) of goat among different weeks of experiment.

Weeks	Top2 X^R(G1)	$Galzym^R$ (G2)	Control
1st week	$30.80±9.97E^b$	62.25±7.75A	$35.25±7.70A^a$
2nd week	$31.75±7.49D^b$	56.25±8.75C	$30.25±8.76B^a$
3rd week	$34.75±5.22C^b$	55.00±6.12D	$21.00±4.04D^b$
4th week	$38.75±4.27^{ab}$	57.50±9.24B	$21.00±4.04D^b$
5th week	$39.25±5.15B^b$	52.50±7.77F	$21.00±4.04D^b$
6th week	$39.00±5.80B^b$	57.50±9.24B	$21.00±4.04D^b$
7th week	$40.00±4.90A^b$	53.25±8.50E	$23.00±5.45C^b$
8th week	$39.50±5.50B^{ab}$	53.25±8.50E	$30.00±6.58B^a$

- Capital letters indicated that: Means within the same column of different letters are significantly different at ($P < 0.01$).
- Small letters indicated that: Means within the same row of different letters are significantly different at ($P < 0.01$).
- No of animals= 4

Table 8. Effect of TOP 2X® andGALZYM® on total volatile fatty acids of rumen fluid level of goat among different weeks of experiment.

Weeks	Top2 x^{R} (G1)	Galzym^{R} (G2)	Control
1st week	51.25±0.99E	38.75±2.39F^{c}	48.75±2.39E^{b}
2nd week	51.50±1.19E	47.50±2.50E^{b}	47.50±1.44D^{b}
3rd week	51.50±1.19E	49.25±0.75D^{b}	52.50±3.23B^{a}
4th week	53.25±0.75D	50.00±0.01D^{b}	52.50±3.23B^{a}
5th week	57.50±1.44C	52.50±1.44C^{b}	53.75±5.15A^{a}
6th week	60.00±0.01B	52.50±1.44C^{b}	53.75±5.15A^{a}
7th week	63.50±1.55A	55.00±2.04B^{a}	48.75±2.39c^{b}
8th week	63.75±3.15A	58.75±2.39A^{a}	50.00±2.89C^{a}

- Capital letters indicated that: Means within the same column of different letters are significantly different at ($P < 0.01$).

- Small letters indicated that: Means within the same row of different letters are significantly different at ($P < 0.01$).

- No of animals= 4

4. DISCUSSION

Feed additives means, a sum of ingredients that added to feed of large or small animals and it will improve the productive efficiency (body weight, body weight gain, feed conversion, carcass traits, and some immune response parameters) and economic efficiency (decreasing productive cost, increasing return and net profit) of animals production.

Our results about the effect of probiotics on the results of body weight indicated that, the level of body weight in at 8th weeks higher than that of the 1st week of the experiment and body weight level showed a higher level in(G1), followed by control group and (G2)of lower body weight level. The results indicated that, the bacterial probiotic improved the body weight of goat than the fibrolytic enzymes probiotic and control group .Our results agreed with those of Ghasmi et al. (2006) where they reported that, the feed additives as bacterial probiotics and fibrolytic enzymes probiotic improve the body weight through improving food conversion and digestibility of the animals. But this result disagree with Knowlton et al. (2002) who observed that, animals fed diets containing a direct-fed fibrolytic enzyme formulation had increased body weight gain.

The results of the effect of probiotic and enzymatic probiotic on of rumen juice cleared that,the physical characters of the rumen juice were not changed throughout the experimental period between the control group and probiotics supplemented groups as color odour put (G2) shown a watery consistency of rumen juice and this result agree with (Hristov et al., 2000) who reported that using of the exogenous polysaccharide-degrading enzymes (EPDE). Ruminal fluid viscosity was numerically lower in heifers receiving (EPDE) diet than in those in the control group ($P = .23$), and this result agree with Salem (2006) who reported that Physical characters of the rumen juice were not changed throughout the experimental period between the control group and probiotics supplemented groups . and both (G1) and (G2) shown an increasing of protozoal count, as the level of protozoal count showed a higher level in (G1) more than (G2) and this result agree with (Salem, 2006) where they reported that that, he pre-feeding addition of fibrolytic enzyme products to high grain diets fed to dairy cows has shown to modify microbial populations and protozoal property in the rumen.

While, the results of the effect of probiotics on PH level cleared that, the level of pH increased progressively from the 1st week to the last week of the experiment in all examined groups. The level of PH in(G1) higher than that of (G2)and control group and the lower pH observed in control group . But at the end of experiment the level of PH show no great significant between (G1) and (G2) and control group, and this result disagree with, Lyle et al. (1981) reported that the ruminal PH was affected by Monensin, type of protein supplement and proportions of whole wheat and corn in forage. Also, Hayam et al. (1994) recorded that the PH of lamb ruminal juice was highly significant decreased

from 6.865±.89 to 6.22±0.147 after supplementation with Bospro (preprobiotic). Also, Hristov et al. (2000) study the effects of supplying increasing ruminal doses of exogenous polysaccharide-degrading enzymes (EPDE) on rumen fermentation and nutrient digestion were studied using eight ruminally cannulated heifers, four of which were also duodenally cannulated replicated. The heifers were fed a diet preparation containing polysaccharide-degrading enzymes .Enzyme treatment not affect ruminal PH

The results of the effect of probiotics on ammonia level cleared that, no great significant in ammonia level between (G1) and (G2) and control group and that disagree with, Krueger et al. (2008) where they reported that, feeding probiotics and increase the ammonia level, and Hristov et al. (2000) also recorded an increasing of ammonia N concentration. and disagree with Dinius et al. (1976) reported that Monensin decreased ruminal ammonia when orchard grass was fed for steers. Bartley et al. (1979) reported that Monensin and Lasalocid at concentration between 11 to 66 ppm depressed microbial proteins synthesis. However all antibiotics at 176 ppm cause severely inhibition to the protein synthesis and consequently inhibit production of ammonia nitrogen in bulls.

The results of the effect of probiotics on total volatile fatty acids indicated that, the level of total volatile fatty acids increased progressively from the 1st week to the last week of the experiment especially at the 7th and 8th week of the experiment. The results cleared that, (G1)of higher level of total volatile fatty acids followed by (G2)and both of them higher than that of the control group. And this result agree with (Hristov et al., 2000) who reported that, addition of exogenous fibrolytic enzymes in the form of Fibrozyme™ for early-lactation Polish Holstein-Friesian cows increases total volatile fatty acids (TVFA) and also agree with those of Hayam et al. (1994) showed that the lactic acid of ruminal juice in healthy lambs was highly significantly increased from 0.023±0.006 to 0.66±0.006% after addition of preprobiotics (Bospro) as well as a significant increase of T.V.F.A. from 84.8±1.603 to 93.0±2.33 mEq/L, respectively.

5. CONCLUSION

Our result conclude that using of bacterial probiotic(top2x) as a dietary supplement is more beneficial than using of probiotic which contain fibrolytic enzymes GALZYM^R .As TOP2X ^{R} the bacterial probiotic enhancing body weight gain and increasing protozoal motility and count .

- TOP2X^R also increasing the level of T.V.F.A more than GALZYM^R
- TOP2X^R also has a significant effect on some blood parameters as PCV and Hb

6. REFERENCE

Bartley, E.E., Herod, E.L. , Bechtle, R.M, Sapienza, D.A. Brent,B.E., Davidovich, A. 1979. Effect of Monensin or Lasolacid with or without Niacine or Amicloral on rumen fermentation and feed efficiency. J. Anim. Sci. 49: 1066-1070.

Bowman, G.R., Beauchemin, K.A, Shelford, J.A. 2002. The proportion of the diet to which fibrolytic enzymes are added affects nutrient digestion by lactating dairy cows. J. Dairy. Sci. 85: 3420-3429.

Cheeke, P.R. 2005. Applied Animal Nutrition, Feeds and Feeding. 3rd Ed. Pearson, Premitice Hall. Nutrition 24: 247-253.

Conway ,E.L. 1957. Micro diffusion analysis and volumetric errors. 2nd Ed London Crosby-Lock Wood and Son Ltd**.** 226: 497-509.

Dinius, D.A., Simpson , M.E. , March, P.B. 1976. Effect of Monensin fed with forage on digestion and the ruminal ecosystem of steers. J. Anim. Sci. 42-229.

Ghasmi, H.A., Tahmasbi, A.M., Moghaddam, G.H., Mehri, M., Alijani, S., Kashefi, E.,Fasihi, A., 2006. The effect of phytase and Saccharomyces cervisiae (Sc47) supplementation on performance, serum parameters, phosphorous and calcium retention of broiler chickens. Poul. Sci.5 (2):162- 168.

Hayam, M. Samy., Ibrahim, M.T., Mohga, S. A. 1994. Body weight development, ruminal fluid characteristics and some blood constituents of lambs fed on diet supplemented with Bospro. Assiut Vet. Med. J. 31 (61): 97-107.

Hristov, A.N., McAllister,T.A., Cheng, K.J. 2000. Intraruminal supplementation with increasing levels of exogenous polysaccharide-degrading enzymes: effects on nutrient digestion in cattle fed a barley grain diet. J. Anim. Sci. 78 (2):477-487.

Kelly, W.R . 1984 . Veterinary Clinical Diagnosis .edn 3 , Typeret by Mc Millian India ltd., Bangalore Printed and Bound in Great Britain by William Clowes Limited , Beccles and London P. 254.

Knowlton. K.F., McKinney, J.M., Cobb, C. 2002. Effect of a direct-fed fibrolytic enzyme formulation on nutrient intake, partitioning, and excretion in early and late lactation Holstein cows. J. Dairy. Sci. 85(12):3328-3335.

Krueger, N.A., Adesogan, A.T., Staples, C.R., Krueger, W.K., Kim, S.C., Littell, R.C., Sollenberger, L.E. 2008. Effect of method of applying fibrolytic enzymes or ammonia to

Bermudagrass hay on feed intake, digestion, and growth of beef steers. J. Anim. Sci. 86 (4): 882-889.

Lyle, R.R., Johnson, R.R. , Bucltus, W.R. 1981. Ruminal characteristics as affected by monensin and type of protein supplemented. J. Anim. Sci., 53: (5)1377-1382.

Nichols, R.E., Penn, X.E. 1958. Simple methods for the detection of unfavorable changes in Ruminal Ingesta. J. Amer. Vet. Med. Ass. 133: 275-277.

Ogimata, K., Imai, S. 1981. Atlas of Rumen Microbiology. Japan. Scientific Societies, press Tokyo, 230 PP. Current Microbiology 35: 22-27

Patterson, J. A., Burkholder, K. M. 2003. Application of prebiotics and probiotics Sci. 82: 627-631.

Radostitis ,O.M., Gay ,C.C., Blood , D.C. , Hincheliff, K.W. 2007: (Atext book of the diseases of Cattle, Sheep, Pigs, Goats and Horses) Veterinary Medicine, 7th Edition. Bailliere, Tindall, London. 7th Ed. PP. 864-873.

Rosenberger, G., Dirkren, G., Frunber , H.D., Grunert, E., Krause, D.,Steber, M. 1979. Clinical examination of cattle. Verlage Paul Parey, Perlin and Hamburg, Transulation 2nd edition 313: 36-47.

Salem 2006: Effect of some preprobiotics on ruminal contents of sheep. M.V.Sc. Thesis, Fac. of Vet. Med., Zagazig University University.

Warner, D., Keith, S., Walter, W. 1962. Effect of foliar application of urea, glucose and calcium carbonate on bloat in lambs. J. Anim. Sci. 21:757-760