Role of Bacterial Treatments for Upgrading Nutritive Value of Bean Straw and Native Goats Performance

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Abstract: Twenty baladi kids (16.20 ±0.52 kg; four months age) were divided into four equal groups (five animals each). The animals were randomly assigned using a complete randomize design to receive one of the four rations for 90 days. All animals fed 50% concentrate feed mixture plus one of the roughages as follows: 50% rice straw (R1), 50% untreated bean straw (R2), 50% bean straw treated with *Bacillus sp.* (R3) and 50% bean straw treated with *Ruminococcus albus* (R4). Four digestion trails were carried out using metabolic cages to determine nutrients digestibility and feeding values. In addition, some rumen and blood parameters of experimental rations were determined. Data obtained revealed that treated bean straw with *Ruminococcus albus* (R4) was the highest CP and the lowest value of CF, ADF, ADL and cellulose. No significant differences were observed in total dry matter intake DMI **(kg/ h/d)** among R2, R3 and R4. Total gain, average daily gain (ADG) and feed efficiency (kg gain/kg DMI) were significantly ($P<0.05$) higher for R4 and R3 followed with R2 then R1. Bean straw treated with *Bacillus sp*. Or *Ruminococcus albus* had significantly ($P<0.05$) higher digestibilities of OM, CP, CF, EE, NFE, NDF, ADF and cellulose % than bean straw without treatment (R1) or control ration (R1). Total digestible nutrient (TDN) and digestible crude protein (DCP) had significantly ($P<0.05$) higher values for R4 (67.76% and 10.32%) and R3 (66.88% and 10.05%) than those of R2 (63.55% and 7.28%) then R1 (62.15% and 5.36%), respectively. Total volatile fatty acids (TVFA's) mean value and blood total protein for R4 was significantly higher (12.97 m.equ./100ml and 12.07 mg/100ml, respectively) than that of R3 then R2, and the lowest value was observed with R1. Further more, rumen ammonia NH_3-N (13.95mg/100ml) and blood plasma urea (10.63 mg/100ml) were recorded significant higher values ($P<0.05$) for R4 and R3 than those of R2 and R1, while creatinine had no significant differences among all treatments. It was concluded that treatment of 50% bean straw treated with bacteria (*Ruminococcus or Bacillus)* improved its nutrient digestibility, ADG, and feed efficiency.

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1. Introduction:

In Egypt the annual agriculture by-products estimated to be around 30 million tons of dry material (Nawar, 2007). Approximately two thirds of the crop residues are burned or wasted, and hence lead to environmental pollution and consequently health hazards. Utilization of such by-products can not only be used in favor of solving feed shortage problem but also as a method to control environmental pollution (Zaza, 2004).

Ruminant livestock in tropics and sub-tropics receive most of their dietary needs from native pasture and crop residues (Mekasha *et al.*, 2002). By-product and crop residuals are becoming more important in livestock feeding system for availability for use at competitive prices relative to other commodities (Grasser *et al.* 1995).

Recently, prices of concentrate feedstuffs increased dramatically. Since most of concentrate feedstuffs used in animal feeding in Egypt is imported from abroad. Feeding is the most important cost item for livestock production which represents about 70% of the total production costs in Egypt (Borhami and Yacout, 2001); therefore, more attention was given to agro industrial by-products.

Every year, many millions tons of carbohydrate remain unused as celluloltic wastes in field and factories, because there are no simple technique allow to utilize such agricultural wastes. The agricultural by-products considered as stable source of ruminant feeds and nowadays interest in their effective utilization is increasing all over the world due to economical factors and pollution.

Non traditional feed resources such as crop residues and agro-industrial by–products must searched in order to decrease the relay on traditional resources to fill the gap and to decrease feeding costs (Zaza, 2005).

Most legumes are used for human consumption, while the by-products are usually utilized as animal feeds. Despite the high amount of legume by-products produced, information about their nutritive value is scarce. Feedstuffs consumed by ruminants are exposed initially to a fermentative activity in the rumen prior to gastric and intestinal digestion.

The main components of agro-industrial residues (cellulose, hemicellulose and lignin) are complex and its biodegradability is low, due to their resistance to degradation by ruminal microorganisms (Jarrige *et al.* 1995). Nevertheless, biotechnology could offer opportunities to modify the chemical structure of these substrates and to improve their digestion. Some efforts have been made to apply biotechnological processes to the improvement of the nutritious quality of agro-industrial residues like ruminant feed. Villas-Boas *et al*. (2003) treated apple pomace using *Candida utilis* in submerged culture, followed by *Pleurotus ostreatus* in solid substrate fermentation (SSF). They found that after *C. utilis* fermentation, protein and mineral content increased 100 and 60%, respectively, accompanied by an 8.2% increase in digestibility, while sequential fermentation with *C. utilis* and *P. ostreatus* achieved a high protein level with 500% of crude protein enrichment after 60 days of fermentation, as well as a considerable increase in the mineral content. Bauer *et al*. (2003) evaluated the effect of enzymatic treatments on several substrates rich in carbohydrates, showing that the fermentabilities of the enzyme-treated and untreated substrates were different. Thus, the utilization of SSF(solid state fermentors), which requires sophisticated technology and is of low cost offers the potential of improving the nutritional value of agro-industrial residues (Ghydal *et al.,* 1992). SSF has been defined as the growth of the micro-organisms on (moist) solid material in absence or near-absence of free water (Pandey, 2003). Under these conditions, the favored microorganisms are filamentous fungi, due to its capacity to grow in media with low water activity (Cannel and Young 1980).

In the extensive Mediterranean production systems, fibrous feeds, particularly cereal straws and stubbles, are the most important diet ingredients for ruminants. Therefore, it is necessary to evaluate the non-conventional feed resources that can use as animal feeds. A wide variety of arable legume crops are grown on Upper Egypt. Many of these crops have residues which can form an important source of livestock feed, following grain harvest, such as bean straw.

Although quantitatively less important, legume straws can represent a valuable feed resource for those animals. The available information on the nutritive value of legume straws is scarcer in case of cereal straws or grass hays (Bruno-Soares *et al.* 2000). So, the objective of this study was to evaluate the nutritive value of treated bean straw with two kind of bacteria as well as estimate effect of its inclusion in ration on goat productive performance.

2. Material and Methods

The present study was carried out at Agriculture Experimental and Research Center, Ain Shams University, Faculty of Agriculture and Department of Animal Nutrition, Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture.

Bacterial cultures:

Two strains of cellulolytic bacteria were isolated from rumen fluid of goats and were grown as pure cultural. Rumen fluid was collected by stomach tube. The separated strains were *Bacillus sp.* and *Ruminococcus albus* . The isolation of species used the pour-plate technique for pure preparation of cultures according to A.T.C.C. (1992).

Ensiling (small scale silo study):

Bean straw was sun dried to 90% DM, chopped to 2-5 cm and mixed with 2 water: 1 air dry roughages. It was mixed with (5% w/w) molasses, (1% w/w) urea and (0.3% w/w) formic acid and (0.5% w/w) acetic acid according to Abd El-Galil (2000). The samples were subjected with one of the following treatments by at 1.5 liters (5.8×105 viable anaerobes/kg of wet silage) /ton:

T1: Untreated bean straw (Control).

T2: Bean straw treated with *Bacillus sp*.

T3: Bean straw with *Ruminococcus albus*.

Treated samples were pressed in 2 liters jars for laboratory use or barrels (200 liters capacity) for farm use and incubated for 8 weeks.

Animals and feeding:

Twenty baladi kids with mean initial live body weight of 16.20 ±0.52 kg (four months age) were divided into four equal groups, five animal each (for 90 day). The animals were randomly assigned to receive one of the four rations as following.

R1= 50% Commercial concentrate feed mixture (CFM) +50% rice straw. (control ration)

R2= 50% CFM + 50% bean straw without treatment

R3=50% CFM + 50% bean straw treated with *Bacillus sp.*

R4=50% CFM + 50% bean straw treated with *Ruminococcus albus.*

The concentrate portion was offered to animals in two equal meals twice daily (8.00 am and 3.00 pm), the amount of offered CFM and bean straw was adjusted biweekly for each group according to NRC (1981).

Each group was kept in separate shaded pen and feeding as group. Fresh water and salt blocks were available for each group all the day. Animals were weighed biweekly. Feed consumption, live weight gain and feed efficiency were determined. The chemical compositions of feed ingredients used in the experiment are shown in Table (1).

Metabolism trials:

At the end of the experimental period, four digestion trials were carried out to determine nutrients digestibility, feeding values and nitrogen balance of tested ration using metabolic cages. Three kids were randomly chosen from each group were subject to the digestion trials. Sample of rumen fluids were collected from each animal at zero, 3 and 6 hrs post feeding by stomach tube at the end of the digestibility trial.

The kids were fed individually in metabolism cages, water was available free. The trial extended for 21 days, adaptation period lasted for 14 days and collection period lasted for 7 days. Feces and urine were daily collected quantitatively during the collection period as described by Maynard *et al.* (1979). Solution of 10% H_2So_4 was added to the representative feces samples before drying in oven at 60 °C for 24 hrs. Dried samples were ground and kept for chemical analysis. 50 ml diluted sulfuric acid (10%) was put in urine collect containers each day. A representative samples (10%) of urine volume stored for nitrogen determination.

Blood samples:

The blood samples were taken at zero, 3 and 6 hrs post morning feeding from 3 animals of each treatment. The blood plasma was obtained by centrifuging the blood samples soon after collection at 4000 rpm for 15 minutes. Blood plasma was transferred into a clean dried glass vials and then stored in deep freezer at -20º C for subsequent specific chemical analysis.

Analytical methods:

Samples of feedstuffs and feces were taken and air dried at 55 °C for 48 hrs in forced air oven up to about 10 -12 % moisture, then kept to subsequent analysis. Dried samples were ground through a Wiley Mill fitted with a 1 mm screen and chemically analyzed according to A.O.A.C (1995), while NFE content was calculated by difference. Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined according to Van Soest *et al*. (1991). Hemicellulose was calculated as (NDF-ADF) and cellulose as (ADF- ADL). Urine samples were subjected to N determination according to A.O.A.C (1995). Ruminal pH was immediately determined before rumen liquor was stored with a digital pH meter (pH ep®, pocket-sized pH meter Hana instruments, Italy). Concentration of NH_3-N was immediately determined using micro-diffusion method of Conway (1963). Frozen rumen liquor samples were analyzed for total volatile fatty acids (TVF's) by steam distillation according to Warner (1964).

Blood plasma was analyzed using special kits for urea (Patton and Crouch, 1977), total protein (Henry, 1964) and Creatinine (Henry, 1974).

Statistical Analysis:

Data were statistically analyzed by using system User's Guide, (SAS, 1998). Separation among means was carried out by using Duncan's multiple range test (Duncan, 1955). The model used was as follows:

$Yij = \mu + Ti + eij$

Where: Yij = The observation on the I^{th} treatment

μ = Overall mean

Ti = Effect of the I^{th} treatment

eij = Random experimental error

3. Results and Discussion

Chemical composition and cell wall constituents:

The data of Table (1) indicated that untreated bean straw (T1) had high content of DM, OM, CF, ADF, ADL and cellulose and lower content of CP, EE, NFE and ash compared with those of treated straws (T2 and T3). Bean straw treated with *Bacillus sp*. (T2) was lower hemicellulose than other straws (T1 and T2).

Data in Table (1) showed that microbial treatments (T2 and T3) used in the present study increased CP and minerals percentage but decreased CF% consequently fiber fraction percentage of bean straw compared with untreated bean straw (T1). Reasons of increasing CP with microbial treatment may be due to the nitrogen content of the microbial treatment and ensiled with 1% urea. This results confirmed with Dahanda *et al.* (1994) and Soliman *et al.* (2009) who mentioned that CP content of spent biologically treated straw increased from 3.42% to 6.1% and CP content of bean straw increased from 5.96 % to 10.71%.

Table (1): Chemical composition of tested feed ingredients

Item	CFM	Rice straw	T1	T2	T3
Dry matter (DM)	**92.10**	**89.00**	**91.68**	**90.12**	**89.40**
Chemical analysis (%) on DM basis:					
Organic matter (OM)	**91.91**	**85.56**	**90.28**	**88.91**	**87.55**
Crude protein (CP)	**15.70**	**1.92**	**7.33**	**14.56**	**15.22**
Crude fiber (CF)	**14.50**	**45.09**	**41.94**	**30.54**	**28.35**
Ether extract (EE)	**3.22**	**2.24**	**2.19**	**3.23**	**2.98**
Nitrogen free extract (NFE)	**58.49**	**36.31**	**38.82**	**40.58**	**41.00**
Ash	**8.09**	**14.44**	**9.72**	**11.09**	**12.45**
Cell wall constituents (%):					
Neutral detergent fiber (NDF)	**42.32**	**79.09**	**59.79**	**48.65**	**49.87**
Acid detergent fiber (ADF)	**20.10**	**48.28**	**42.98**	**33.72**	**30.59**
Acid detergent lignin (ADL)	**5.93**	**10.55**	**12.07**	**10.36**	**9.58**
Hemicellulose	**22.22**	**30.81**	**16.81**	**14.93**	**19.28**
Cellulose	**14.17**	**37.73**	**30.91**	**23.36**	**21.01**

*Ingredients of CFM: Concentrate feed mixture contained un decorticated cotton seeds 35%, yellow corn 34%, wheat bran 21%, rice bran 4% , molasses 2% , lime stone 2% , common salt 2%

T1: (Control) untreated bean straw. T2: bean straw treated with *Bacillus sp*. T3: bean straw treated with *Ruminococcus albus*.

Hemicellulose= NDF-ADF Cellulose= ADF-ADL

On the other hand, chemical composition of tested ration indicated that group of animals which fed treated bean straw with *Ruminococcus albus* (R4) and *Bacillus sp*.(R3) were higher CP, NFE than other rations (R1 and R2). So, R4 and R3 were the lowest value of CF, ADF, ADL and cellulose than those of control ration (R1) and untreated bean straw (R2). This may be due to microbial treatment which convert complex fiber to simple fiber (easy digestion). The improvement in the chemical composition of lignocellulosic residues may be a result of the action of enzymes secreted by *Ruminococcus albus*. and *Bacillus sp*. .

Table (2): Chemical composition of experimental rations

Item	R1	R2	R3	R4
Dry matter (DM)	**90.55**	**91.89**	**91.11**	**90.75**
Chemical analysis (%) on DM basis:				
Organic matter (OM)	**88.74**	**91.10**	**90.41**	**89.73**
Crude protein (CP)	**8.81**	**11.52**	**15.13**	**15.46**
Crude fiber (CF)	**29.80**	**28.22**	**22.52**	**21.43**
Ether extract (EE)	**2.73**	**2.71**	**3.23**	**3.10**
Nitrogen free extract (NFE)	**47.40**	**48.66**	**49.54**	**49.75**
Ash	**11.26**	**8.91**	**9.59**	**10.27**
Cell wall constituents (%):				
Neutral detergent fiber (NDF)	**60.70**	**51.05**	**45.49**	**46.10**
Acid detergent fiber (ADF)	**34.19**	**31.54**	**26.91**	**25.35**
Acid detergent lignin (ADL)	**8.24**	**9.00**	**8.15**	**7.76**
Hemicellulose	**26.52**	**19.52**	**18.58**	**20.75**
Cellulose	**25.95**	**22.54**	**18.77**	**17.59**

Where:

R1=50% CFM +50% rice straw (control ration) R2= 50%CFM +50% control bean straw

R3=50%CFM + 50% bean straw treated with *Bacillus sp.* R4= 50%CFM +50% bean straw treated with *Ruminococcus albus*

These results are coincide with those obtained by Fadel (2001) who illustrated that these enzymes hydrolyses the biopolymer to fermentable sugars used as carbon source for fungal growth to produce biomas enriching the treated crop residues. Similar results were recorded by El-Ashry *et al.* (2002), Kholif *et al.* (2005) and Mahrous (2005). Abd El-Galil (2008) found that using bacterial treatments (*Ruminococcus albus* and *Clostridium cellulovorans)* caused increase in crude protein (from 1.45 to 15.16%) and decrease in crude fiber (from 44.08 to 28.44%) of rice straw. The two treatments significantly ($P<0.05$) decreased NDF, ADF, cellulose and hemicellulose.

Feed intake:

No significant differences were observed in total dry matter intake DMI (kg/ h/d) among R2, R3 and R4. Which mean that untreated bean straw and treated straws have approximately the same palatability (Table 3). While, R1 had a significantly (P<0.05) lower DMI (kg/ h/d) than other rations contained bean straw treated or untreated.

On the other hand, crude protein intake (CPI; 128.32 g/h/d) was significantly (P<0.05) higher for R4 than R3 followed by R2 then R1 (123.31, 93.23 and 68.72; respectively). This results were agreement with El-Banna *et al.* (2010) who found that total intake of CP decreased with inclusion of bean straw either biologically treated or supplemented with probiotic in sheep rations compared with control ration (concentrate feed mixture plus berseem hay). The same trend was observed for total gain, average daily gain (ADG) and feed efficiency (kg gain/kg DMI) with no significant differences between R4 and R3 (Table3). This results due to high level of protein in R4 and R3 than other rations (R2 and R1). The same trend was observed in CP intake. This in agreement with Mekasha *et al.* (2002) who observed that the high DM intake could result from the lower fiber content and high CP content in basal diet. These results are disagreement with El-Banna *et al.* (2010) who reported that control ration was higher ADG and total gain than bean straw biologically treated this contrast may be due to the control ration that containing berseem hay plus CFM, while in the present study the control ration was containing rice straw plus CFM or due to type of microorganisms which used in treated bean straw.

Table (3): Effect of feeding experimental rations on feed intake, total gain, average daily gain and feed efficiency by kids.

Item	R1	R2	R3	R4	±SE
Experimental Period	90	90	90	90	-
No. of Animal	5	5	5	5	-
Average initial weight(kg)	16.00	16.50	16.00	16.25	-
Average final weight(kg)	23.00	24.00	24.75	25.25	-
Dry matter (DMI; kg/ h/d)	0.780[b]	0.810[a]	0.815[a]	0.830[a]	0.12
Crude protein (CPI; g/h/d)	68.72[d]	93.32[c]	123.31[b]	128.32[a]	0.24
Total gain(kg)	7.00[c]	7.50[c]	8.75[b]	9.00[a]	0.19
Average daily gain (ADG; kg/ h/d)	0.078[c]	0.083[b]	0.097[a]	0.100[a]	0.23
Feed efficiency (kg gain/kg DMI)	0.100[b]	0.102[b]	0.119[a]	0.120[a]	0.48

a,b,c and d, Means with different superscripts within each row for each parameter are significantly different. (P < 0.05).

Where:

R1=50% CFM +50% rice straw (control ration) R2= 50%CFM +50% control bean straw

R3=50%CFM + 50% bean straw treated with *Bacillus sp.* R4= 50%CFM +50% bean straw treated with *Ruminococcus albus*

SE: standard error

Digestion coefficients and nutritive values:

Data of digestibility trials (Table 4) showed that the highest (P<0.05) values of DM and hemicellulose digestibility were found for R4 than those for the other rations. Bean straw treated with *Bacillus sp.* Or *Ruminococcus albus* had significantly (P<0.05) higher digestibilities of OM, CP, CF, EE, NFE, NDF, ADF and cellulose than bean straw ration without treatment (R2) or control ration (R1). These results may be resulting from the increasing in the numbers of bacteria, especially cellulolytic bacteria and fungi in the rumen (Ali, 2005).

The estimated *In vivo* OM digestibility for bean straw was in the 60-70% range calculated by Shem *et al.* (1995) and are slightly higher than cereal straw OM digestibility (C.I.H.E.A.M, 1990). In this study the results coincided with the results of El-Banna *et al.* (2010) who reported that highest digestibilities of CF, CP, NDF, ADF and cellulose were recorded for rations containing biologically treated (*T. reesei plus S. cervisiae or T. reesei* alon) bean straw compared with rations containing berseem hay, and agreement also, with those obtained by Mahrous (2005) and Al-Asfour (2009) who found that sheep rations containing either cotton stalk or wheat straw treated with *Trichoderma sp.* increased the digestibilities of CF, CP, NDF, ADF and cellulose.

Nutritive values as TDN for ration (R4) was significantly higher (67.76%) than R3 (66.88%) then R2 (63.55%) and the lowest value was recorded in R1(62.15%).

Table (4) : Effect of feeding experimental rations on digestion coefficients and nutritive values in kids .

Item	R1	R2	R3	R4	±SE
Digestion coefficients %					
Dry matter (DM)	**63.59 [d]**	**66.47 [c]**	**71.69 [b]**	**73.36 [a]**	**0.31**
Organic matter (OM)	**65.28 [c]**	**69.33 [b]**	**70.94 [a]**	**71.31 [a]**	**0.33**
Crude protein (CP)	**60.86 [c]**	**63.17 [b]**	**66.43 [a]**	**66.78 [a]**	**0.34**
Crude fiber (CF)	**52.37 [c]**	**57.21 [b]**	**59.61 [a]**	**60.36 [a]**	**0.30**
Ether extract (EE)	**68.38 [c]**	**70.72 [b]**	**71.83 [a]**	**72.11 [a]**	**0.26**
Nitrogen free extract (NFE)	**72.27 [c]**	**74.56 [b]**	**76.34 [a]**	**77.12 [a]**	**0.25**
Neutral detergent fiber (NDF)	**62.24 [c]**	**63.99 [b]**	**65.51 [a]**	**65.89 [a]**	**0.22**
Acid detergent fiber (ADF)	**73.57 [c]**	**76.70 [b]**	**77.11 [a]**	**78.32 [a]**	**0.23**
Hemicellulose	**80.32 [d]**	**82.22 [c]**	**84.68 [b]**	**85.61 [a]**	**0.24**
Cellulose	**75.58 [c]**	**78.93 [b]**	**79.44 [a]**	**80.55 [a]**	**0.22**
Nutritive value %					
TDN*	**62.15 [d]**	**63.55 [c]**	**66.88 [b]**	**67.76 [a]**	**1.80**
DCP**	**5.36 [c]**	**7.28 [b]**	**10.05 [a]**	**10.32 [a]**	**0.87**

a,b,c and d; Means with different superscripts within each row for each parameter are significantly different. ($P < 0.05$).
*Total digestible nutrient **digestible crude protein
Where: R1=50% CFM +50% rice straw (control ration) R2= 50%CFM +50% control bean straw
R3=50%CFM + 50% bean straw treated with *Bacillus sp.* R4= 50%CFM +50% bean straw treated with *Ruminococcus albus*

On the same trend, DCP had significantly ($P<0.05$) higher values for R4 (10.99%) and R3 (10.75%) than R2 (9.89%) then R1(8.65%). These results were compatible with CP contents in the rations. These results were harmony with results of El-Banna *et al.* (2010) who found that DCP was higher in rations containing bean straw biologically treated than ration containing berseem hay as control.

Abd El-Galil (2008) found that using bacterial treatments (*Ruminococcus albus* and *Clostridium cellulovorans)* caused increase digestibility ($P<0.05$) compared with the untreated rice straw. Gado *et al.* (2009) reported that *Cellulomonas* and *Bacillus* isolated from camel had the highest *In vitro* fermentation of cellulose of bagasse (44.17% and 30.5%, respectively). Also, *Cellulomonas* and *Bacillus* isolated from sheep origin recorded *In vitro* fermentation of cellulose of bagasse (42.50% and 30.84%, respectively).

Rumen parameters:

Rumen parameters which recorded were illustrated in Table (5). Ruminal pH value is one of the most important factors, which affect microbial fermentation in the rumen and influenced its functions. It is apparent that, the pH values were within the normal range with no significant differences among the experimental rations at mean of zero, 3 and 6 hours post feeding. Meanwhile, the pH values tend to decrease by prolongation of time post-feeding, reaching lowest at 3hrs post-feeding then increased after 6 hrs feeding. Baker *et al.* (1959) reported that the rumen pH values were between 6.39 and 7.57 at the different sampling time after feeding. Such range is suitable for growth and activity of cellulolytic bacteria (Prasad *et al.* 1972).

While, TVFA's mean value for R4 was significantly higher (12.97 m.equ./100ml) than R3 then R2 and the lowest value was recorded with R1. In the present study, greater TVFA's concentration in rumen liquor for kids which fed ration containing bean straw treated with *Ruminococcus albus.* may be due to the increase in all, OM, CP and CF digestibilities than the control ration (Table 4).

Further more, rumen NH_3-N (mg/100ml) was recorded higher significant values for R4 and R3 than R2 and R1. Over all observation, TVFA's (m.equ./100ml) and NH_3-N (mg/100ml) values were higher after 3 hrs and then decreased after 6 hrs morning feeding for all of rations.

The rumen bacteria change qualitatively and quantitatively in response to the changes in chemical composition of diet of the animals (Maklad and Mohamed, 2001). These values were similar to that reported by Abd El-Galil (2000 and 2006), who found the highest ammonia-N concentration after 4 hrs. These differences in ammonia-N concentration are referred to difference in treatments. However, it is well recognized that the ammonia-N concentration found in the rumen at any given time presented the net concentration value of its production, utilization by rumen microbes and absorption across the rumen wall, the dilution by other factor and passage to the lower gut. Ruminants utilize VFA as an energy source, allowing the production of meat and/or milk. Van Houtert (1993) indicated that relatively large amounts of propionic acid are reported when easily digestible substrates are supplied to rumen microbes

Table (5): Effect of feeding experimental rations on Rumen parameters in kids

Item	R1	R2	R3	R4	±SE
pH					
0hr	7.1	6.9	6.8	6.7	
3hrs	6.4	6.6	6.7	6.5	
6hrs	6.9	6.8	6.9	6.8	
Overall Mean	6.80	6.76	6.80	6.67	± 0.11
NH3-N(mg/100ml)					
0hr	10.62	11.76	11.98	12.21	
3hrs	13.75	14.54	16.71	16.90	
6hrs	11.55	12.10	12.67	12.75	
Overall Mean	11.37 [c]	12.80 [b]	13.79 [a]	13.95 [a]	±1.04
TVFA's(m.equ./100ml)					
0hr	9.7	9.6	10.20	10.7	
3hrs	12.8	13.5	14.9	15.1	
6hrs	11.6	12.3	12.8	13.1	
Overall Mean	11.37[d]	11.80 [c]	12.63[b]	12.97 [a]	±1.04

a,b,c and d, Means with different superscripts within each row for each parameter are significantly different. ($P < 0.05$).
where
R1=50% CFM +50% rice straw (control ration) R2= 50%CFM +50% control bean straw
R3=50%CFM + 50% bean straw treated with *Bacillus sp.* R4= 50%CFM +50% bean straw treated with *Ruminococcus albus*

Blood parameters:

Data in Table (6) showed blood plasma total protein, urea and creatinine levels. Blood plasma total protein was higher record (12.07 mg/100ml) for animals fed ration containing bean straw treated with *Ruminococcus albus* (R4) than ration containing bean straw treated with *Bacillus sp.(*R3) and the last ration had no significant difference with untreated bean straw (R2). All of rations had significantly ($P<0.05$) higher than control ration (R1). This was reflects on total body gain (Table 3). In addition, blood plasma urea (mg/100ml) values for R4 and R3 were significantly ($P<0.05$) higher than those in R2 and R1. This was the same trend with rumen ammonia-N, while creatinine had no significant differences ($P>0.05$) among all treatments. These mean that treated bean straw not affected on kidney function as creatinine. The increase in blood plasma studied constituents may be due to the role of *Ruminococcus albus* as biological treatment in improving all nutrient digestibility (Table 4) and rumen parameters (Table 5) of kids fed bean straw treated with *Ruminococcus albus*, and also may be probably led to an increase in the absorption rate from the digestive tract, thus blood constituents of the supplemented animals reflected a corresponding increase of these values. These results came on line with those obtained by Abd El-Galil (2000, 2006 and 2008).

Table (6) Effect of feeding experimental rations on Blood parameters in kids .

Item	R1	R2	R3	R4	±SE
Total Protein (mg/100ml)					
0hr	9.90	10.80	10.67	10.92	
3hrs	10.32	11.54	11.62	11.87	
6hrs	12.68	12.99	13.20	13.41	
Overall Mean	10.96 [c]	11.78 [b]	11.83 [b]	12.07 [a]	0.64
Urea(mg/100ml)					
0hr	6.60	7.90	8.10	8.22	
3hrs	8.25	9.89	10.70	10.85	
6hrs	11.32	11.60	12.50	12.83	
Overall Mean	8.72[c]	9.79 [b]	10.43 [a]	10.63 [a]	0.68
Creatinine (mg/100ml)					
0hr	1.00	0.95	0.98	0.99	
3hrs	1.30	1.20	1.35	1.40	
6hrs	1.20	1.00	1.10	1.10	
Overall Mean	1.17	1.05	1.14	1.16	0.059

a,b,c Means with different superscripts within each row for each parameter are significantly different. ($P < 0.05$).
where
R1=50% CFM +50% rice straw (control ration) R2= 50%CFM +50% control bean straw
R3=50%CFM + 50% bean straw treated with *Bacillus sp.* R4= 50%CFM +50% bean straw treated with *Ruminococcus albus*

4. Conclusion

It can be concluded that under this study the bacterial treatments with *Ruminococcus albus* and *Bacillus sp*., isolate from rumen liquid of goat, had the highest effect on chemical composition, cell wall constituents and digestibility of treated bean straw. These results exhibited that *Ruminococcus* and *Bacillus* were more effective on cellulose, total gain, average daily gain and feed efficiency for bean straw compared with untreated one.

The bacterial treatments with *cellulolytic bacteria* could be used successfully to improve the quality of bean straw (as roughage) with increased protein, nutrients digestibility and nutritive value. In addition to decrease fibrous fraction of rations without any side effects on animal performance, health and decreased of pollution.

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