Chemical, Biological and Biochemical Treatments to Improve the Nutritive Values of Sugarcane Bagasse (SCB): 2- *In Vivo* Studies to Evaluate the Nutritive Values of Untreated and Treated SCB

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Abstract: Twenty five Ossimi male growing lambs were randomly assigned into five treatments each of 5 animals to receive concentrate feed mixture plus one of the following roughages for 120 days feeding period: $R_{1,}$ berseem hay; $R_{2,}$ untreated sugarcane bagasse; $R_{3,}$ 3% urea treated bagasse; R_4, fungi treated bagasse and $R_{5,}$ bagasse treated with fungi + bacteria + 3% urea. Results obtained showed as a general evidence that, different treated bagasse rations indicated higher NH_3-N and TVFA's values compared with untreated bagasse ration. All estimated values of blood parameters in the present study were within the normal range. Animals given rations containing biological or biochemical treated bagasse showed higher DM intake, average daily weight gain and best feed conversion (Kg DMI or TDNI/ Kg gain) compared with those given rations containing untreated or urea treated bagasse. It could be concluded the possibility of replacing berseem hay (30% of the rations) by fungi treated bagasse in sheep ration without any adverse effect on lambs growth performance or feed utilization parameters.

[Salama, R.; Fatma M. Salman; M. A. Safwat; S. M. Soliman and Y. A. El-Nomeary **Chemical, Biological and Biochemical Treatments to Improve the Nutritive Values of Sugarcane Bagasse (SCB): 2- *In Vivo* Studies to Evaluate the Nutritive Values of Untreated and Treated SCB**. Life Science Journal, 2011; 8(4):327 -337] (ISSN: 1097-8135). http://www.lifesciencesite.com.

Key words: Sugarcane bagasse, chemical and biological treatments, lambs performance and economic efficiency.

1. Introduction

In Egypt, there is a wide gap between animal requirements and the available feedstuffs, although, there are about 26 million tons of agricultural plant by-products produced annually in Egypt **(Agriculture Economic and Statistics Institute, 2000)**. Approximately two thirds of the crop residues are burned or wasted, hence lead to environmental pollution and consequently health hazards. The poor quality roughages include; rice straw, wheat straw, bean straw, corn stalks and cobs, rice hulls, sugarcane bagasse and etc. Among these roughages, sugarcane bagasse represents about 4.13 million tons per year according to **Agriculture Economic and Statistics Institute (1995)**.

Sugarcane bagasses are secondary by-products derived during the industrial process of sugar production; its main components are cellulose, hemicellulose and lignin. As a result of its high lignin content, ruminal digestion is inhibited and thus, the nutritive value of bagasse and pith is low for ruminants.

The primary factors limiting the utilization of crop residues are its higher crude fiber and low protein contents, low digestibility and palatability. To improve the nutritive value of such agriculture residues, it is important to breakdown the linkages among cellulose, hemicellulose and lignin by mechanical, chemical or biological and /or biochemical treatments.

The possibility of biological treatment to deal with agricultural wastes has a great appeal as an alternative method to another expensive one; in terms of money and energy (chemicals) and to avoid the pollution hazards. Biological treatments are an alternative method to modify the fibrous materials by ruminants. The mode of fungal decay on roughages using the white rot fungi was shown to improve *in vitro* dry matter digestibility of the decayed substrate **(Dawson *et al.,* 1990)**. **Shoukry *et al.* (1985)** reported that CF content decreased while, CP content increased in sugarcane bagasse when treated with different fungi species, as a successive solution for the shortage in animal feeds.

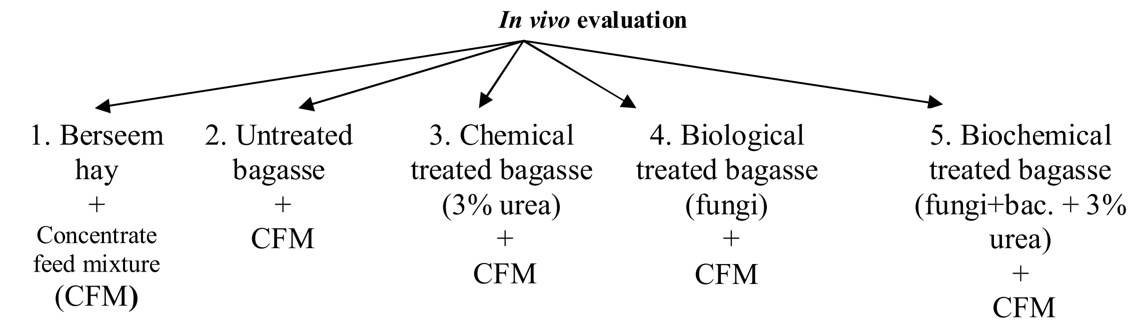
Many scientists suggested the use of ammonia and urea to increase the crude protein contents of the poor quality roughages **(Fouad *et al*., 1998)**. Biological treatments such as *Trichoderma viride* **(Khorshed, 2000, Villas-Boas *et al*., 2002 and El-Ashry *et al.,* 2003)** were used to improve the nutritive value and digestibility of poor quality roughages. Increasing the digestibility of the diet by using exogenous feed enzymes obtained from fungal treatment would lead to beneficial effects on animal performance. Yeast treatment was also used to improve rumen digestibility of nutrients, especially crude fiber, elevation the ruminal fermentation and for more activation of the rumen microorganisms **(Dawson, 1992)**. The previous work **(Salman *et al*., 2011)** suggested the possibility of improving the chemical composition and nutritive value of sugarcane bagasse by chemical, biological and biochemical treatments in ration for lambs.

Therefore, the main objective of the present study was to investigate the effect of replacing conventional roughages (berseem hay) by untreated or chemical, biological and biochemical treated sugarcane bagasse in rations of growing lambs, some ruminal and blood parameters along with growth performance were also investigated.

2. Materials and Methods

The present study was carried out at the Experimental Farm Station belongs to Faculty of Agriculture, Animal Production Department, Al-Azhar University, Nasr City, Cairo, Egypt and Laboratories of Animal Production Department, National Research Center, Dokki, Giza, Egypt, during the period from 2006 to 2009.

The scheme of the study is shown in the following diagrams:



This study was carried out to perform the best treatments detected in the previous work to be applied in feeding trials with growing lambs **(Salman *et al.*, 2011).** Rumen liquor and blood parameters were determined. Economic efficiency was also calculated. Sugarcane bagasse was purchased from Edfo Sugar Company, Aswan, Egypt. All sugarcane by-products were sun dried to 90% DM and bagasse was chopped to approximately 1-3cm.

Microorganisms:

a. White rot fungi (*Phanerochaete chrysosporium* NRRL-6361).

b. Bacteria (*Cellulomonas uda* NRRL-404).

The tested microorganisms were provided through the Genetic and Cytology Department, National Research Center, Dokki, Giza, Egypt.

Biological treatment:

Fungal propagation:

White rot fungi (*Phanerochaete chrysosporium* NRRL-6361) was maintained on potato dextrose agar medium (PDA), grown at 28°C for 72 hrs, then stored at 4°C and recultivated every two months.

Bacterial treatment:

Cellulomonas uda strain NRRL-404 was available from the same resource as mentioned before.

Procedure of bacteria inoculation:

The prepared inoculum was mixed well with the tested crop residues at the rate of 1:10 (v/w). The moisture content was adjusted to 65% then bagged and incubated at 30°C for the fermented period (up to 4 weeks).

Combined biological treatments:

The same procedure of fungal and bacteria treatments were used but the bags were inoculated with a mixture media containing 50% of fungi and 50% of bacterial media and continued to ferment till 10 days at 30 ± 2°C.

Chemical treatment (urea):

The required amount of urea (30g) was dissolved in 500 ml water and sprayed on 1kg bagasse. The treated bagasse was thoroughly mixed to be homogenous and the moisture content was adjusted to 65%, then ensiled (up to 3 weeks). At the end of incubation period, the chemical treated bagasse was taken out to be aerated for 2 days to get rid of the free ammonia and smell. Then samples were ground and stored in a glass bottles for later chemical analysis.

Biochemical treatment:

At the end of the fermented period of biological treated by-products, it was aerated overnight, mixed well with 3% urea then bagged, and stored up to 15 days.

***In vivo* evaluation:**

Animals and their managements:

Twenty five Ossimi male lambs with an average live body weight 32.7 kg and 180 days age were randomly assigned into five nutritional treatments (each of 5 animals) to receive one of the following roughages for 120 days feeding period: R_1: berseem hay; R_2: untreated bagasse; R_3: bagasse treated with 3% urea; R_4: bagasse treated with fungi and R_5: bagasse treated with fungi + bacteria + 3% urea. The composition of the five experimental rations are presented in Table (1).

Rations were offered to lambs *ad lib*, while, water and salt blocks were freely available all day time. Animals were fasted weighed at biweekly intervals, while changes in average live body weight, average daily gain, daily feed intake, feed conversion (kg DMI or TDNI/ kg gain), feed costs (LE/kg gain) and economic evaluation were estimated. Feeding costs of different experimental rations and net profit value were estimated according to current market price in 2007. Samples from experimental ingredients and rations were taken for chemical analysis according to **A.O.A.C. (1990)** and cell wall constituents according to **Goering and Van Soest (1970).**

Table (1): Composition of experimental rations

Item	Experimental rations, %					*Price L.E. /ton
	R_1	R_2	R_3	R_4	R_5	
- Berseem hay	30	-	-	-	-	750
- Untreated bagasse (Unt.B.)	-	30	-	-	-	200
- Bagasse treated with 3% urea (Urea Tr. B.)	-	-	30	-	-	300
- Bagasse treated with fungi (F Tr. B.)	-	-	-	30	-	300
-Bagasse treated with fungi + bacteria + 3% urea (F +B + urea Tr. B.)	-	-	-	-	30	300
- Ground corn grains	51	51	51	51	51	930
- Sunflower meal	7	7	7	7	7	1800
- Wheat bran	7	7	7	7	7	770
-Limestone, sodium chloride and minerals & vit. mix.	5	5	5	5	5	816
Total	100	100	100	100	100	-
*Current price of ration (L.E /ton, 2006-2007)	920	755	785	785	785	-

*Price of 1 ton bagasse = 200 L.E., besides 100 L.E./ ton of bagasse as cost for biological and chemical treatment + manufacture. Market price of 1 kg live body weight of sheep in (2007) = 17 L.E.

Rumen liquor measurements:

At the end of 2nd month from the feeding trial, 100 ml of rumen liquor were individually withdrawn by rubber stomach tube before feeding 0, 3 and 6 hrs after the morning meal, to determine pH, NH_3-N and TVFA's**.**

pH values of rumen liquor were immediately measured using Orion Research Digital pH meter, model 201. **Ammonia –nitrogen concentration,** was measured according to **Conway (1962),** while **total volatile fatty acids concentration**s were determined according to **Warner (1964).**

Blood parameters:

At the same time, blood samples were individually collected from the jugular vein in heparinized test tubes at 3hrs after feeding, to assess total protein, albumin, globulin, alanine aminotransferase (ALT), aspartate aminotransferase (AST), urea and creatinine contents. All the biochemical constituents of blood serum were measured colorimetrically using a specific kit by the Chemistry Auto-analyzer (Olympus AU 400). **Total protein,** was determined according to **Witt and Trendelenburg (1982); Albumin**, was determined according to **Tietz (1986),** while globulin and fibrinogen was calculated by subtracting the albumin value from the corresponding total protein value. **Albumin/ globulin ratio,** was calculated by dividing the albumin value on the corresponding globulin value. **Alanine aminotransferase (ALT)** and **aspartate aminotransferase (AST)** were measured according to **Reitman and Frankel (1957). Urea** was estimated according to **Coulombe and Favrean (1963),** while **creatinine** in blood serum was measured according to **Husdan (1968).**

Economic efficiency:

Based on free market prices of feed ingredients in (2006), while the cost of experimental ration was estimated as the total cost of concentrate feed mixture and berseem hay or sugarcane bagasse, in addition to the cost of chemical, biological and biochemical treatments of treated sugarcane bagasse (Table 1). Economic efficiency was calculated as the ratio between income (income from gain) and cost of feed consumed by experimental animals.

Statistical analysis:

Data were statistically analyzed according to **SAS (1998).** The significance among treatment means was tested by Duncan's Multiple Range Test **(Duncan, 1955)**. The statistical model used was:

$$Yij = u + Ti + eij$$

Where:
Yij: the observation.
u : the overall mean .
Ti: the treatment effect.
eij: the experimental error .

Chemical composition of the experimental ingredients:

Data presented in Table (2) showed the chemical composition of the experimental ingredients. It is obvious that the chemical composition of all ingredients was within the normal range.

3. Results and Discussion

Table (2): Chemical composition of the experimental ingredients (on DM basis, %)

Item *	DM	OM	CP	CF	EE	NFE	Ash
Berseem hay	87.10	82.20	12.41	39.00	2.68	28.11	17.80
Ground corn grain	90.72	97.94	10.81	7.82	4.55	74.76	2.06
Sunflower meal	92.35	94.42	28.73	31.72	3.72	30.25	5.58
Wheat bran	90.08	97.84	12.23	9.39	4.77	71.45	2.16
Unt. B.	91.90	94.70	1.80	49.50	1.16	42.24	5.30
Urea Tr. B.	96.20	92.30	5.20	43.70	1.30	42.10	7.70
F Tr.B.	93.80	90.65	4.60	43.20	1.26	41.59	9.35
F+B+urea Tr. B.	96.10	91.10	6.50	42.90	3.43	38.27	8.90

* Unt. B. = (untreated bagasse) * Urea Tr. B. = (3%urea treated bagasse) * F Tr. B. = (fungi treated bagasse)
* F + B + urea Tr. B. = (fungi + bacteria+urea treated bagasse).

As a general evidence, different treatments led to decrease OM and CF content but increased CP, EE and ash contents of sugarcane bagasse.

Data obtained in Table (3) showed the chemical composition of different treated and untreated rations. Data obtained indicated similar DM content of different experimental rations. Higher OM, CF and NFE contents were detected for different untreated and treated bagasse rations compared with the berseem hay ration (R_1). Lower CP content (9.75 to 10.32%) was recorded for different treated bagasse ration compared with the hay group (12.09%), but higher than that of the untreated bagasse ration (8.91%). Similar EE and NFE values for different rations, with lower ash content of untreated and treated bagasse rations than the hay ration (R1).

Table (3): Chemical composition of the experimental rations (on DM basis, %)

Item	Experimental rations				
	R_1	R_2	R_3	R_4	R_5
DM	91.79	91.48	91.18	90.70	90.73
OM	93.41	96.35	95.57	95.20	96.65
CP	12.09	8.91	9.93	9.75	10.32
CF	18.24	23.86	21.83	21.66	21.55
EE	3.69	3.23	3.27	3.27	3.91
NFE	59.39	60.35	60.54	60.52	60.87
Ash	6.59	3.65	4.43	4.80	3.35

Results of Table (4) illustrated cell wall constituents of different experimental rations. Data obtained indicated similar NDF values for different treated bagasse rations and hay ration (R_1). Lower NDF value was noticed with untreated bagasse ration (38.34%).

Table (4): Cell wall constituents of experimental rations (on DM basis, %)

Item	Experimental rations				
	R_1	R_2	R_3	R_4	R_5
NDF	42.76	38.34	41.65	42.93	40.22
ADF	19.14	16.85	25.49	25.50	26.30
ADL	5.99	2.68	7.76	8.76	9.12
Hemicellulose*	23.62	21.49	16.16	17.43	13.92
Cellulose**	13.15	14.17	17.73	16.74	17.18

* Hemicellulose = NDF – ADF ** Cellulose = ADF -ADL

Higher ADF, ADL and cellulose values were observed for different treated bagasse rations, but lower ones with both of $R_1$and R_2. In contrast, higher hemicellulose content was noticed with both of R_1 and R_2, in compare with different treated bagasse rations.

Effect of different treatments on rumen liquor parameters of growing lambs:

Data presented in Table (5) indicated that pH values at 0 time was 6.22 and declined gradually 3hrs after feeding to 5.54 and tended to increase again to 6.76 and more than the corresponding value at 0 time (6.22). Lower (P<0.05) pH values were shown by lambs fed the biological and biochemical treated bagasse rations. Higher (P<0.05) pH values were shown by lambs fed R_1 (hay control) or R_2. These results agree with those obtained by **Abd El-Kareem (1990) and Tawila (1991)** who noticed that the ruminal pH values decreased gradually reaching the lowest values at 2-4 hrs after feeding and tended to increase again after 6 hrs.

Data presented in Table (5) indicated lower (P<0.05) NH_3-N values before feeding, increased to the maximum level 3hrs after feeding and tended to decline (P<0.05) again at 6 hrs after feeding. **Reddy *et al* (1989)** reported that the peak concentration of ammonia nitrogen being at 3hrs after feeding. Similar results were reported by **Williams and Newbold (1990)**, who concluded that the reduction of ammonia-N in the rumen liquor appear to be the result of increased incorporation of ammonia-N onto microbial protein and it was considered as a direct result to stimulated microbial activity. These results may be due to the change in fermentation rate with advancing time after feeding in which ruminal NH_3-N would satisfy microbial needs and hence maximize rate of fermentation in rumen.

As a general evidence, different treated bagasse rations indicated higher insignificant NH_3-N values, but without significant differences with the hay ration. Untreated bagasse ration led to lower (P<0.05) NH_3-N values at different time of sampling. Similar evidences were reported by **El-Ashry *et al.* (1997) and Khorshed (2000)** who noticed that NH_3-N concentration were increased in rumen of sheep and goats fed rations treated with white rot fungi or yeast culture. Moreover, ruminal ammonia-N concentration values were higher for lambs fed banana plant wastes silage treated by either urea or sodium hydroxide than the control or untreated **(Kropp *et al.*, 1977 and Mohamed, 1998)**.

Data presented in Table (5) indicated lower (P<0.05) TVFA's concentration (meq/100ml) values before feeding and tended to increase (P<0.05) 3 hrs after feeding and declined at 6 hrs after feeding.

Table (5): Ruminal parameters of lambs fed rations containing untreated and treated sugarcane bagasse

Item	Sampling time (hours)	Experimental rations					Overall mean for time	±SE	Sig.
		R_1	R_2	R_3	R_4	R_5			
pH	0	6.93^a	6.40^b	6.27^b	6.03^c	6.17^{bc}	**6.22^C**	0.887	*
	3	5.73^a	5.67^{ab}	5.70^{ab}	5.27^b	5.50^{ab}	**5.54^B**	0.496	*
	6	6.17^c	7.03^a	6.63^b	6.53^b	6.83^{ab}	**6.76^A**	0.304	*
	Overall of mean	**6.28^a**	**6.37^a**	**6.20^a**	**5.94^b**	**6.17^a**	-	0.562	*
NH_3_N (mg/100ml)	0	16.74^b	12.11^c	19.01^a	19.78^a	20.31^a	**17.80^C**	1.004	*
	3	24.48^a	17.5^b	25.96^a	26.21^a	24.81^a	**23.62^A**	1.317	*
	6	19.24^b	14.3^c	20.76^b	20.28^b	22.67^a	**19.50^B**	0.835	*
	Overall of mean	**20.15^a**	**14.64^b**	**21.91^a**	**22.09^a**	**22.60^a**	-	1.052	*
TVFA's (meq/100 ml)	0	4.00^{ab}	4.17^a	3.67^b	3.57^b	3.57^b	**3.75^C**	0.125	*
	3	8.20^a	6.77^c	7.07^c	7.57^b	7.17^{bc}	**7.15^A**	0.143	*
	6	7.33^a	4.83^e	6.53^c	7.00^b	5.53^d	**5.97^B**	0.250	**
	Overall of mean	**6.51^a**	**5.26^c**	**5.76^b**	**6.05^b**	**5.42^b**	-	0.173	*

*: Significant differences at (P<0.05) **: Significant differences at (P<0.01)

a,b,c,d and e : Means at the same row and capital letters in the same column with different superscripts are different at (P<0.05)

As a general evidence and regardless of time of sampling, the hay group (R_1) recorded higher (P<0.05) TVFA's values in compare with different treated bagasse rations, which indicated insignificant differences between each other. While, the untreated bagasse ration, recorded the lower TVFA's value among different rations as an overall mean. **Fouad *et al.* (1998)** found that, the higher ruminal TVFA's concentration was associated with increased NFE intake. The TVFA's values were high in rations R_1, R_3, R_4 and R_5 which may be due to a higher microbial activity in the rumen of sheep fed these rations than those received the untreated (R_2). Similar results were obtained by **Singh and Gupta (1984)**; they found that the TVFA's production rate in rumen of lambs fed ammoniated roughage was higher than those fed untreated roughage. This improvement in TVFA's concentration in R_4 and R_5 may be attributed to alteration in chemical composition of bagasse by the biological and biochemical treatments. Results of biological treatments might be related to the more efficient utilization of the dietary energy and the positive fermentation activity in the rumen. It was also worthy to note that, the lowest pH values were recorded after 3 hrs after feeding for the different rations. These results are in agreement with those obtained by **Reddy and Reddy (1986)** who reported that pH was inversely related to TVFA's concentration at different periods of incubation.

Effect of different treatments on blood parameters of growing lambs:

Data of hemato-biochemical parameters are presented in Table (6). Results obtained indicated that the biologically and biochemically treated bagasse (R_4 and R_5) led to increase ($P<0.05$) serum total protein and without significant difference with R_3 (ureated bagasse) compared with the other rations. However, albumin, globulin, urea and creatinine parameters indicated insignificant difference among different treatments. Such effects varied from being negative to positive one. These results agree with those obtained by **Khorshed (2000), Deraz and Ismail (2001) and Kholif *et al*. (2001)** who found that serum total protein and albumin concentration were higher with biological treatment than with the control groups. **Shehata *et al.* (2003)** reported that total protein concentration ranged from 6.30 to 7.53 g/l for growing lambs fed rations containing maize silage and CFM.

It is of interest to note that rumen liquor ammonia-nitrogen (Table 5) showed higher ($P<0.05$) NH_3 – N for such groups. Matching of both the two evidences led to suggest a positive correlationship between ruminal NH_3-N and serum total protein content of these groups. According to **Kumar *et al.* (1980)**, total protein reflects the nutritional status of the animal and it has a positive correlation with dietary protein.

Results of urea and creatinine as an indicator to protein metabolism, liver and kidney functions showed insignificant differences among different nutritional groups. However, it was of interest to note relatively higher insignificant values for R_3 (ureated bagasse ration); a result which may probably referred to urea treatment. In general, different treated bagasse rations did not indicate any significant differences in compare with the hay group as a standard conventional ration. Values of urea and creatinine however were within the normal ranges of the species and the performance of animals of different treated groups was the more pronounced truth.

Table (6): Blood parameters of lambs fed rations containing untreated and treated sugarcane bagasse

Item	Experimental rations					±SE	Sig.
	R_1	R_2	R_3	R_4	R_5		
Total protein (g/dl)	7.36^{b}	6.90^{c}	7.60^{ab}	7.81^{a}	7.85^{a}	0.101	*
Albumin (g/dl)	3.71	3.70	3.90	4.01	4.00	0.75	NS
Globulin (g/dl)	3.65	3.20	3.70	3.80	3.85	0.71	NS
A:G ratio	1.02	1.16	1.05	1.06	1.04	0.030	NS
Urea (mg /dl)	34.50	33.03	38.20	32.5	36.88	0.876	NS
Creatinine (mg /dl)	1.18	0.80	1.22	0.98	1.00	0.057	NS
ALT (U/L)	23.60^{c}	33.40^{b}	39.80^{a}	35.70^{ab}	34.87^{ab}	1.589	*
AST(U/L)	21.30^{c}	22.03^{c}	25.89^{ab}	23.40^{b}	27.30^{a}	0.726	*

NS: Non significant differences
*: Significant differences at ($P<0.05$)
a, b and c : Means in the same row with different superscripts are different at ($P<0.05$).

GOT (ALT) and GPT (AST) activity were found to be significantly increased due to chemically, biologically and biochemically treated bagasse compared with R_1 and R_2. Higher ($P<0.05$) ALT and AST values were detected with different treated bagasse rations, however R_3 (ureated bagasse rations) surpassed both of R_4 and R_5, while R_5 surpassed both of R_3 and R_4 for AST. Different treated bagasse rations, recorded higher estimates ($P<0.05$) than the hay group (standard conventional ration). Such results may suggest that, different chemical, biological and biochemical treatments led to exert to somehow, the liver functions. Although, all values obtained for blood biochemical parameters in the present study were within the normal ranges.

El-Ashry *et al*. (1997) stated that the serum GOT and GPT showed higher values with biological treatment than with untreated group. These results agree with **Khorshed (2000)** who reported that the use of biological treated sugar beet pulp in goat ration is useful and did not cause any abnormal condition on rumen activity, liver, kidney functions and animal performance.

Effect of different treatments on the performance of growing lambs:

Growth performance:

The average of body weight gain, feed intake and feed conversion are presented in Table (7).

Average daily weight gain was significantly ($P<0.05$) higher for sheep fed R_1 followed by R_4 and R_5 groups compared with R_2 group. However, no significant difference was detected between R_3 (urea treated bagasse) and the R_2 (untreated bagasse). **Deraz (1996) and Allam *et al.* (2006)** found that animals fed biologically treated roughages were the most efficient group followed by those fed chemically treated roughages. The average daily weight gain was considerably higher for lambs fed rations contained biological and biochemical treated sugarcane bagasse (R_4 and R_5, 193 and 183g, respectively), than those fed untreated bagasse (R_2, 151g). This is due to the higher nutritive value **(Salman *et al.*, 2011)** and intake of fermented sugarcane bagasse than untreated one. **Fazaeli *et al.* (2002)** showed that the improvements in the animal performance could reflect the use of more available nutrients due to the substitution of untreated wheat straw by the fungal treated wheat straw. Growth and feed conversion were all significantly affected by type of roughage and treatment besides intervals of the study period. Also, **Marghany *et al.* (2004) and Abdelhamid *et al.* (2007)** gave better daily body weight gain and **Mohamed (2005)** reported better feed conversion by feeding the biological fermented roughages.

No significant differences were detected in total dry matter intake (TDMI) and concentrate intake (g/h/d) due to different treatments, while a slight increased intake was noticed with R_1 (1330g/h/d) compared with R_2 (untreated bagasse, 1102g/h/d), followed by treatments R_5, R_4 and R_3 (1150, 1130 and 1113g/h/d, respectively). These results may be due to that (berseem hay) has more palatability than untreated bagasse ones. Roughages intake (g/h/d) was significantly differed ($p<0.05$) among R_1 (581g/h/d) and other treatments R_5, R_4, R_2 and R_3 (402, 395, 386 and 382g/h/d, respectively).

Table (7): Effect of chemical, biological and biochemical treatments on growth performance and feed conversion of growing lambs

Item	Experimental rations					±SE	Sig.
	R_1	R_2	R_3	R_4	R_5		
Days	120	120	120	120	120	-	-
No.of animals	5	5	5	5	5	-	-
Initial body wt.(kg)	32.7	32.6	32.8	32.7	32.8	0.405	NS
Final body wt.(kg)	58.65^a	50.7^c	51.92^c	55.8^b	54.76^b	0.642	**
Total body gain (kg)	25.95^a	18.1^c	19.12^c	23.1^b	21.96^b	0.609	**
Daily gain (g)	216^a	151^c	159^c	193^b	183^b	0.005	**
Metabolic body size(BW $^{0.75}$)	11.58^a	8.78^c	9.15^c	10.54^b	10.14^b	0.283	**
Growth rate (%)* **	79.36	55.52	58.29	70.64	66.95	-	-
DM intake,g/h/d:							
Concentrate	749	716	731	735	748	0.026	NS
Roughage	581^a	386^b	382^b	395^b	402^b	0.023	*
Total	1330	1102	1113	1130	1150	0.043	NS
TDN,% ** **	81.00^a	68.99^c	72.16^c	76.52^b	76.29^b	0.823	*
DCP,% ** **	8.75^a	5.18^c	6.05^b	6.32^b	6.47^b	0.281	*
TDNI, g/h/d	1076.4^a	760.27^c	801.79^c	866.21^b	877.34^b	29.84	**
DCPI, g/h/d	116.38^a	57.17^c	67.22^{bc}	71.54^{bc}	74.41^b	5.666	**
DM intake, g/Kg w$^{0.75}$	114.85^{bc}	125.51^a	121.64^{ab}	107.21^c	113.41^{bc}	2.054	**
TDNI, g/Kg w $^{0.75}$	92.95	86.59	87.63	82.18	86.52	1.458	NS
DCPI, g/Kg w $^{0.75}$	10.05^a	6.51^b	7.35^b	6.79^b	7.34^b	0.428	*
Feed conversion ratio:							
kg DM intake/kg gain	6.16^b	7.30^a	7.00^a	5.85^b	6.28^b	0.165	**
TDNI/ kg gain(kg)	4.98^a	5.03^a	5.04^a	4.49^b	4.79^{ab}	0.075	*
DCPI/ kg gain(kg)	0.54	0.38	0.42	0.37	0.41	0.042	NS

NS: Non significant differences *: Significant differences at ($P<0.05$) ** Significant differences at ($P<0.01$)
a,b and c : Means at the same row with different superscripts are different at ($P<0.05$)
Total B .W. gain (Kg)/ Initial B. W. (Kg) x 100 * From **Salman *et al.* (2011)**

Biochemical and biological treatments increased total dry matter intake (g/h/d/). However, biochemical treatment showed the highest intake value followed by the biological treatment compared with urea and untreated bagasse groups. These results were in harmony with those obtained by **Lewis *et al*. (1999)** who suggested an increase in dry matter intake with fungal or enzymatic treatment. **Kamra and Zadrazil (1988)** found that during microbial processes for conversion of lignocellulosic wastes into food, at least one of three objectives must be reached: an increase in the protein level, an increase in the digestibility of the lignocellulosic material and an improvement in the dry product palatability, although this last factor can be easily improved by ensiling or mixing the substrate with other more palatable food. **Bouattour (2004); Flores (2004); Titi (2004); Gonzalez (2004) and El-Kady *et al*. (2006)** reported that fungal or enzymatic treatments obtained from fungal were not altering dry matter intake. In contrast **Lewis *et al*. (1999) and McAllister *et al*. (1999)** reported that feed intake was increased by biological treatment. **Deraz (1996)** stated that chemical and biological treatments increased markedly voluntary DM intake of corn stalks of growing lambs by 63.3 and 33.8%, respectively, when compared with mechanically treated corn stalks.

Feed conversion:

Feed conversion in different terms i.e. Kg dry matter intake/ kg gain and as kg TDNI/ Kg gain indicated significant differences (P<0.01&P<0.05) among different nutritional groups, and the best values were recorded with R_1, R_4 and R_5, while no significant difference in feed conversion was shown between R_3 and R_2. These results were in harmony with those obtained by **Mahrous and Abou-Ammo (2005) and Bassuny *et al.* (2003 and 2005)**. **Mohamed *et al*. (1998)** indicated that the feed conversion of treated rice straw was better compared with untreated one. The improvement in term of Kg TDNI /Kg gain for rations contained biologically treated bagasse might be due to the improvement occurred in the chemical composition and the digestibility coefficients of such rations and consequently its nutritive values. Similar results were obtained by **Titi (2004); Plata *et al*. (2004); Haddad and Goussous (2005) and El-Kady *et al*. (2006)** who found that exogenous fibrolytic enzymes obtained from *Trichoderma viride* resulted in improved (P<0.05) feed conversion ratio and daily gain of fattened Awassi lambs and buffaloes, with no effect on feed intake. They added also that, fibrolytic enzymes could enhance the growth of fattened lambs and improve their conversion ratio, mainly through improving digestibility of rations nutrients. **El-Marakby (2003)** recorded better feed conversion values for lambs fed rations where 25 and 50% CFM proteins was replaced with biologically wheat straw.

Economical study:

Results of economical study (Table 8) showed that feed cost/ kg weight gain (L.E) of the R_1 ration showed the highest value while, the lowest cost was for that of R_4. The best relative economical efficiency was detected with (R_4). These results are in agreement with the result obtained by **Deraz (1996)** who indicated that the chemical and chemo-fungal treatment decreased the cost of feed used to produce one kg live body weight gain. In addition, **Abd El-Aziz (2002)** observed that replacing 40% of the CFM by biologically treated rice straw reduced the cost of feeding by 28.8%, while, **Allam *et al*. (2006)** reported that the biologically treated sugar beet pulp was to replace 0, 60, 75 or 100 % of corn grains for growing lamb groups, indicating that the feed cost /kg gain decreased with increasing replacing level.

Table (8): Effect of chemical, biological and biochemical treated sugarcane bagasse on economical efficiency of growing lambs

Item	Experimental rations					±SE	Sig.
	R_1	R_2	R_3	R_4	R_5		
Concentrate (DMI), g	749	716	731	735	748	0.026	NS
Roughage (DMI), g	581^a	386^b	382^b	395^b	402^b	0.023	*
Total DM intake, g	1330	1102	1113	1130	1150	0.043	NS
Feed conversion Kg DM intake/ kg gain	6.16^b	7.30^a	7.00^a	5.85^b	6.28^b	0.165	**
Av. daily gain (g/h/d)	216^a	151^c	159^c	193^b	183^b	0.005	**
Av. feed cost /Kg weight gain (L.E.)	6.17	6.02	6.03	5.06	5.43	-	-
Net feed revenue (L.E.)	10.83	10.98	10.97	11.94	11.57	-	-
Economic feed efficiency (%)	175.5	182.4	181.9	236.0	213.1	-	-
Relative economic efficiency	100	103.9	103.6	134.5	121.4	-	-

NS: Non significant differences

*: Significant differences at (P<0.05) ** Significant differences at (P<0.01)

a,b and c : Means at the same row with different superscripts are different at (P<0.05).

Results of the present study indicated that, replacement of berseem hay by 30 % untreated sugarcane bagasse in lambs rations adversely affected both of growth rate and feed utilization i.e. 216g/h/day and 6.16 kg DMI /kg gain vs 151g/h/day and 7.30 kg DMI /kg gain, inspite of the lower feed cost /kg gain, which may probably referred to the lower cost of untreated bagasse 200 L.E/ ton vs 750 L.E for berseem hay, respectively. However, replacement of treated sugarcane bagasse instead of berseem hay in sheep rations, particularly biologically and biochemically treated ones led to comparable values like that of hay ration, but at lower feed costs and more efficient utilization of feed (R_4 and R_5). The best treatment was that of R_4 (fungi treated-sugarcane bagasse) instead of berseem hay which significantly improved feed utilization parameters and also reduced feed cost/ kg diet and feed cost/ kg weight gain. The improvement in economic feed efficiency for groups fed bagasse treated with fungi compared with that of R_1 (hay + CFM) could be related to the low price of bagasse compared with the corresponding price of berseem hay, as well as the positive effect of biological treatment in improving the nutritive value and utilization of bagasse. Biological treatment reduced the feed cost by 16.82% **(Deraz, 1996)** to about 36% **(Belewu and Ademilola, 2002)**. However, biological treatments yielded the best economic efficiency **(Marghany *et al.*, 2004 and Hamza *et al.*, 2006)**.

Conclusion

According to the results obtained in the present study it could be concluded the possibility of replacing berseem hay (30% of the ration) by fungi-treated bagasse in sheep rations without any adverse effect on growth or feed utilization parameters, but relatively at lower feed costs.

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10/28/2011