USING SOME BIOCHEMICAL TREATMENTS TO IMPROVE NUTRITIVE VALUE OF SOME POOR QUALITY ROUGHAGES (*IN VITRO* AND *IN VIVO* STUDIES)

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SUMMARY

The objective of the present study was to evaluate the effect of some biochemical treatments on the chemical composition *in vitro*, *in vivo* digestibility and nutritive values of some poor quality roughages, i.e. sugar cane bagasse (SCB) and corn cobs (Ccb). The experimental treatments were either 3 liter ZAD compound (Liquor) or 5 kg ZADO powder compound (a biotechnical powder product made from natural sources of cellulose enzyme from anaerobic bacteria) added to 500 litter water + 50 kg molasses and 20 kg urea / ton roughages. Sugar cane bagasse (SCB) and corn cobs (Ccb) treated with biological treatments (ZAD and/or ZADO compounds) and/or chemical treatment (urea) were ensiled for 30 days (*In vitro*). Five biochemical treatments for both of the two tested roughages were conducted as follows; Untreated SCB or Ccb and served as a control (T1 & T6), SCB or Ccb treated with 3 litter ZAD compound (liquor)/ton +5% molasses (T2 & T7), SCB or Ccb treated with 3 litter ZAD compound (liquor)/ton + 2% urea + 5% molasses (T3&T8), SCB or Ccb treated with 3 litter ZAD compound (liquor)/ton + 5 kg ZADO compound (Powder)/ton + 5% molasses (T4 & T9), SCB or Ccb treated with 3 litter ZAD compound (liquor)/ton + 5 kg ZADO compound (Powder)/ton + 2% urea + 5% molasses (T5 & T10). On the light of *in vitro* results, 10 complete mixed rations, consisted of 75% concentrate feed mixture (CFM, 14% CP) and 25% untreated roughage (control) or ensiled treated ones were used in a digestibility trail (*In vivo*). Results obtained showed that: ensiling untreated roughages (SCB & Ccb) for 30 days incubation period with ZAD and ZADO compounds led to increase ($P<0.05$) DM, OM, CP and NFE and decreased ($P<0.05$) CF and ash contents and led to an obvious improvement in their fiber fractions; *i.e.* decreased ($P<0.05$) NDF, ADF, ADL, acid ash and hemicellulose, and showed insignificant effect on both of cellulose and lignin contents for both the two treated materials. However, variable significant responses were evident in the changes occurred in fiber fractions for both the two treated roughages. Adding ZAD and ZADO compounds to untreated roughages led to improve ($P<0.05$) nutrients coefficients digestibility and nutritive values in compare with the untreated materials. However, both the two complete mixed rations indicated similar TDN, SE and DCP values i.e. 60.75% and 62.57%, 56.55% and 58.16% and 9.48% vs. 9.28% for both of SCB and Ccb rations, respectively. On the light of the present results, it could be concluded that, treating poor quality roughages (SCB & Ccb) with the natural biological additives (probiotics ZAD & ZADO compounds) led to improve roughage chemical composition, digestibility of their nutrients, roughage palatability and in turn might contribute to the marginal field of available roughage resources.

Keywords: *Sugar cane bagasse, corn cobs, ZAD and ZADO, biochemical and probiotics.*

INTRODUCTION

Low quality roughages are inefficiently utilized by ruminants. This is due to low digestibility and poor nutritive value associated particularly with cereal straw. These materials supply no more energy than poor quality hay, TDN is less than 50% and starch value (SV) is less than 29% (Balch, 1976).

In Egypt about 610.000 tons of corn cobs (Ccb) are wasted yearly, which equal about 146.40 tons starch value and 32000 tons crude protein (EL-Khimsawy, 1990) .Sugar cane bagasse (SCB) is a secondary by-product of sugar cane extraction factories. Bagasse represents 30-32 % of the sugar cane plant (Barnes, 1980). The annual production of SCB in Egypt is in the order of one million metric tons / year (Ministry of Agriculture, 1996 and 2000). There is a possibility of using bagasse in livestock feeding. During the past century, continuous efforts had been made to improve the efficiency of utilization of the lignoceellulose crop residues through physical, chemical and biological treatments.

Enzymes have been also used in ruminant rations to degrade fiber contents, to make it more easier for digestion, to be more useful for the micro-organisms and flora which are the main source of the microbial protein in the ruminal media and to reduce the costs of the ration. Colombatto *et al.,* (2003) reported that enzymes were more efficient in degrading fibers without increasing methane production in the rumen of the animal. It is well known that some microorganisms, including ZAD and ZADO compounds (probiotics), can degrade lignin in the cell walls, and attempts had been made to improve digestibility of plant residues by adding ZAD and ZADO compounds *(*Gado*, 1997*; Gado, *et al.*, 2013 *)* to ruminant rations.

The objective of the present study was to evaluate the effect of some chemical treatments; using urea and biological treatments (ZAD and ZADO compounds) to improve chemical composition and nutritive value of some poor quality roughages *i.e.* sugar can bagasse (SCB) and ground corn cobs (Ccb) as ruminant feeds.

MATERIALS AND METHODS

The present study was carried out in the experimental farm station belongs to faculty of Agriculture, Animal Prod. Department, Al-Azhar University, Nasr City, Cairo, Egypt through the period from September 2017 to January 2018.

Biological treatment:

ZAD (patent on: 22155) is a bio-technical product made from natural sources to justify the level of cellulase enzymes from anaerobic bacteria, which can convert the polysaccharide into monosaccharide by specific enzymes, such as cellulase 8.2 u/gm and hemicellulase 6.2 u/gm, in addition of activated amylase 64.4 u/mg and protease 12.3 u/gm, ***(Gado et al.*, 2006 and Rmadan, 2007)** . ZADO compound is similar to ZAD, but the former one enzymes are much higher per gm fed and its anaerobic nature are found in hyperanation phase. ZAD and ZADO components are presented in Table (1). ZAD is live anaerobic bacteria with their enzymes, while, ZADO is a coated material of enzymes and bacteria.

Table (1): Enzymes concentration in ZAD and ZADO used in the experiment.

Sample	Xylanase	α-amylase	Cellulase	Protease
ZAD (U/g)	6.93	64.4	8.2	12.3
ZADO	.058 U/g	3.39 U/ml	.892 U/ml	1.56 U/ml

Crop residues preparation: Two different types of low quality roughages were used *i.e.* sugar can bagasse (SCB) and ground corn cobs (Ccb), which were chopped or crushed to 1-3 and 0.5 cm, respectively. Control sample of each SCB and Ccb were sun dried to approximately 95% dry matter. The experimental samples were composted with 3 litter ZAD compound (liquor) and 5 kg ZADO compound (Powder) to 500-litter water for 1 ton SCB or ground (Ccb).

Laboratory treatments (In Vitro):

Each of SCB and Ccb roughage was distributed into 5 treatments as follows:-

1- Untreated SCB and served as a control (T1).
2-SCB treated with 3 litter ZAD compound (liquor)/ton +5% molasses (T2).
3- SCB treated with 3 litter ZAD compound (liquor)/ton + 2% urea + 5% molasses (T3).
4- SCB treated with 3 litter ZAD compound (liquor)/ton + 5 kg ZADO compound (Powder)/ton + 5% molasses (T4).
5- SCB treated with 3 litter ZAD compound (liquor)/ton + 5 kg ZADO compound (Powder)/ton + 2% urea + 5% molasses (T5).
6- Untreated Ccb and served as a control (T1).
7- Ccb treated with 3 litter ZAD compound (liquor)/ton+ 5% molasses (T2).

8- Ccb treated with 3 litter ZAD compound (liquor)/ton + 2% urea + 5% molasses (T3).
9- Ccb treated with 3 litter ZAD compound (liquor)/ton + 5 kg ZADO compound (Powder)/ton; + 5% molasses (T4).
10- Ccb treated with 3 litter ZAD compound (liquor)/ton + 5 kg ZADO compound (Powder)/ton + 2% urea + 5% molasses (T5).

Treated materials were incubated for three different periods, (10, 20 and 30 days).

Chemical and biological treatment parameters:

1-Proximate chemical analysis.

2-Fiber fractions (NDF, ADF, ADL, hemicellulose, cellulose and lignin).

Digestibility trials:

Forty adult Ossimi rams were divided into ten similar groups and used to carry out ten metabolic trials, using four animals / each group, according to El-shazly et al. (1963).

Experimental rations consisted of 75% concentrate feed mixture (CFM, 14% CP) and 25% (SCB) or ground (Ccb) .Experimental animals were fed CFM (14% CP) to cover their maintenance requirement *(*N.R.C., 1989). The chemical composition and fiber fractions of CFM (on DM basis%) during the digestibility trial are shown in Table (2) .

Table (2): Chemical composition of CFM (% on dry matter basis) .

Item	DM	OM	CP	CF	EE	Ash	NFE	NDF	ADF	ADL
CFM	90.67	90.27	14.16	11.1	4.07	9.73	60.94	46.06	22.33	11.42

Proximate chemical analysis:

Proximate chemical analysis of untreated and biochemically treated sugar cane bagasse, ground corn cobs and feces were done according to the standard procedures of A.O.A.C. (2005). Cell wall constituents of untreated and biochemically treated sugar cane bagasse and ground corn cobs were determined according to *Goering and Van Soest (1982).*

Statistical analysis:

Data were analyzed using the general linear models procedure adopted by SAS *(1996).* Differences among means were tested for significancy by *Duncan's multiple range test (*Duncan*, 1955).* Analysis of variance with repeated measurements and least square means were carried out using the following equation:

$$Y_{ij} = \mu + T_i + R_J + E_{iJ}$$

Where:

Y_{IJ} = the observation of the parameter measured.

μ = overall means.

T_i = the effect of dietary treatment.

R_j = the effect of replication.

E_{iJ} = the random error term.

RESULTS AND DISCUSSION

Data presentd in Table (3) showed the effect of ZAD and ZADO compounds on the changes occurred in the chemical composition of both of SCB and Ccb at different incubation periods *i.e.* after 10, 20 and 30 days, respectively .

Chemical composition of both the two untreated roughages at 0 time i.e. before treatments, indicated higher DM, CF, EE and ash contents for SCB, but lower OM, CP and NFE contents in compare with untreated (Ccb) material.

After 10 days incubation period, it was noticed higher ($P<0.05$) DM, CF and ash contents for treated SCB, but lower ($P<0.05$) OM, CP and NFE contents, with almost similar EE percentages.

The lower OM content of SCB before and after 20 days incubation period and the higher ($P<0.05$) corresponding one for treated Ccb may be related to the higher ash content in treated SCB. However, ash content for both the two treated roughages tended to decrease due to biological and/or biochemical treatments.

It was also of interest to note that, although CP and NFE tended to be increased due to different applicable treatments; CF, EE and ash contents tended to be decreased. However, EE still maintaining almost similar insignificant values after 20 days incubation period. It was also worthy to note that nutrients of both the two treated roughages responded relatively to different biological and/or biochemical treatments. More pronounced changes were detected in treated SCB rather than the corresponding treated Ccb *i.e.* higher decrease in both of EE and ash contents.

Table (3): Mean of changes in chemical composition of treated sugar cane bagasse and corn cobs with ZAD and ZADO compounds after 10, 20 and 30 days incubation periods.

Incubation periods (days)	Item	DM	OM	CP	CF	EE	Ash	NFE
0	Control (SCB)	94.95	94.25	2.49	53.89	3.01	5.75	34.86
	Control (Ccb)	89.54	95.66	2.60	39.96	1.53	4.34	51.57
10	SCB	95.20^{A}	96.60^{B}	2.72^{B}	52.77^{A}	1.36	3.33^{A}	39.80^{B}
	Ccb	91.88^{B}	98.09^{A}	3.0^{A}	38.40^{B}	1.41	1.90^{B}	55.27^{A}
20	SCB	96.03^{A}	96.58^{B}	2.72^{B}	51.17^{A}	1.31	4.41^{A}	41.37^{B}
	Ccb	93.34^{B}	98.08^{A}	4.13^{A}	36.98^{B}	1.28	1.91^{B}	55.67^{A}
30	SCB	97.39^{A}	96.54^{B}	4.31^{B}	49.48^{A}	1.26	3.45^{A}	41.47^{B}
	Ccb	96.30^{B}	98.05^{A}	4.84^{A}	34.59^{B}	1.28	1.94^{B}	57.33^{A}

A & B different capital letters in the same column indicated significant difference ($P<0.05$) .

After 20 days incubation period the similar trends in nutrients decrease and increase were also noticeable for both the two treated roughages with also relative responses to different applicable biological and/or biochemical treatments, with almost similar insignificant EE contents for both the two treated materials.

Changes in nutrients of both of treated SCB and Ccb after 30 days incubation period in percentage indicated 2% increase in DM content or treated SCB vs. 7% for treated Ccb ; similar increase in OM and CP contents 2.4% *vs.* 2.39% and 7.3% *vs.* 8.6% and 8% *vs.* 13% decrease in CF content, higher significant decrease in EE of SCB (58%) vs. (16%) for treated Ccb and (40% *vs.* 55%) decrease in ash contents with higher increase in NFE for treated SCB (18% *vs.* 11%) for treated Ccb, respectively . Such results confirmed the previous finding, as 1) nutrients of both the two treated roughages responded relatively to different biological and/or chemical treatments; 2) elongation of the incubation period for both the two treated roughages led to more significant improvement in the chemical composition of both the two treated roughages, although some of nutrients in both the two treated materials indicated either higher positive or negative changes due to the elongation of incubation period i.e. positive CP content (7.3 – 8.6%), but negative CF, EE and ash contents (8 - 13 %, CF), (58 – 16%, EE) and (40 – 50 %, ash) for both of treated SCB and Ccb, respectively .

It was also worthy to note variable differences in the chemical composition and/or nutrients percentages for both the two treated roughages either before or after chemical and/or biochemical treatments with ZAD and ZADO compounds, regardless of different applicable treatments .

It was obvious from data presented herein, that the main positive improvement was in the CP content which increased significantly in both the two treated materials with ZAD (liquor and Powder) compounds. Values of CP were linearly increased as the time of ensiling increased. The effects were mainly due to nitrogen content of the added ZAD compounds or urea (about 20 kg/ton) and microbial nitrogen content of the prolific bacteria in silage of the two tested roughages. It may be explained on the basis that bacterial growth (the increase in single cell protein) was on the expense of EE as an energy source which significantly decreased in an opposite direction to that of CP increment. Abd El-Aziz *et al. (*1997) found that the biological treatment of straw and other fibrous roughages resulted usually in a marked increase in their CP content when the treatment condition was appropriate. Also, Dhanda *et al.* (1994) fermented wheat straw with white rot fungi sp. and noticed that CP content of the straw increased from 3.42 to 6.81 %, while Khorshed *(2000)* reported that biological treatments decreased (P<0.01) CF contents and increased (P<0.01) CP content of some crop residues.

Data presented in Table (4) showed the mean of changes in fiber fractions of treated SCB and Ccb with both of ZAD and ZADO compounds after different incubation periods, *i.e.* 10, 20 and 30 days , respectively. Data obtained at 0 time (before the biological treatments and ensiling), indicated similar NDF values, but higher ADF, ADL, cellulose and lignin for the untreated SCB with lower hemicellulose content in *vice versa* trend to untreated (Ccb) .

After 10 days of incubation with different ZAD and ZADO compounds; it was noticed, lower (P<0.05) decrease for both the two treated roughages in most of fiber fractions, except lignin which tended to increase slightly after 10 days incubation period . Bakshi *et al.*, (1985) and Beauchemin *et al.*, (1995) reported that the spent wheat straw by *pleurotus sp.* lowered CF, NDF, ADF, cellulose and hemicellulose content than untreated wheat straw. Also, Gado *et al.*, (2006) reported a decrease in cell wall from 92.2% to 77.3% for untreated wheat straw (by white rot fungi), respectively.

Twenty days later, both the two treated roughages showed the same trend like that after 10 days incubation period, since different terms of fiber fractions tended to decrease (P<0.05) due to different applicable treatments, except lignin which continued to increase .

However, significant differences were detected between both the two treated roughages, due to the nature of its raw chemical structural and composition.

Table (4): Mean of changes in fiber fraction of treated SCB and Ccb with ZAD and ZADO compounds after 10, 20 and 30 days incubation periods.

Incubation periods (days)	Item	NDF	ADF	ADL	Acid ash	Hemic-ellulose	Cellul-ose	Lignin
0	Control (SCB)	83.17	65.01	17.21	4.58	18.16	47.80	12.63
	Control (Ccb)	84.53	48.67	11.49	5.07	35.86	37.18	6.42
10	SCB	82.41^{B}	64.27^{A}	17.12^{A}	3.49^{B}	18.14^{B}	47.14^{A}	13.62^{A}
	Ccb	83.28^{A}	47.76^{B}	10.92^{B}	4.02^{A}	35.52^{A}	36.83^{B}	6.90^{B}
20	SCB	81.30^{B}	63.57^{A}	17.08^{A}	3.42^{B}	17.72^{B}	46.50^{A}	13.65^{A}
	Ccb	81.66^{A}	47.38^{B}	10.47^{B}	3.76^{A}	34.28^{A}	36.91^{B}	6.71^{B}
30	SCB	79.95^{B}	62.59^{A}	16.95^{A}	3.37^{B}	17.37^{B}	45.64^{A}	13.58^{A}
	Ccb	79.98^{A}	47.05^{B}	9.82^{B}	3.63^{A}	32.92^{A}	37.24^{B}	6.19^{B}

A & B different capital letters in the same column indicated significant difference (P<0.05) .

After 30 days incubation, different terms of fiber fractions still maintained the lower (P<0.05) decrease including, the lignin content. It was of interest to note that; neither the decrease nor the increase in different terms of fiber fractions was pronounced, but tended to have a slower visible rate either decrease or increase mechanism and regardless of the effect of incubation period and the effect of biological treatments, both of the two treated roughages continued to maintain its variable differences due to its nature of raw chemical structural and composition.

Elongation of ensiling and incubation period from 10 to 30 days, showed an effective role in the changes and improvement occurred in the chemical composition of both the two treated roughages, in spite of the slower changing rate.

After 30 days incubation period, treated SCB still maintained lower ($P<0.05$) NDF, acid ash and hemicellulose values, but higher ($P<0.05$) ADF, ADL, cellulose and lignin contents, in compare with treated Ccb.

The decline in CF value in the tested roughages could be a result of the enzymes secreted by the growing prolific bacteria. El-Ashry *et al.* (2002*)* reported that cellulose contents of the silages were significantly reduced due to the biological treatments at the higher rate of enzymes. While, Mahrous and Abou Ammou (2005*)* showed that microbial treatments for rice straw increased CP contents significantly and decreased CF, ash NDF, ADF, ADL and cellulose content than the control group.

Digestibility coefficient and nutritive values of the different experimental rations:

Data presented in Table (5) showed insignificant differences among different experimental groups in DMI. Dry matter intake of SCB ranged between 1181-1415 g/h/d . The higher DMI was shown by both of (T2 and T3) *i.e.* 1338 and 1415 g/h/d for both groups, respectively. Dry matter intake of Ccb ranged between 1140-1436 g/h/d. The higher DMI was shown by both of corn cobs treated with 3 litter ZAD compound (liquor)/ton + 5kg ZADO compound (powder)/ton + 2% urea + 5% molasses and SCB treated with 3 litter ZAD compound (liquor)/ton + 2% urea + 5% molasses ration *i.e.* 1436 and 1425 g/h/d for both groups, respectively . The higher DMI depended in general on ration palatability, ingredients digestibility, besides the nutritive value of the ration. The higher DMI, in the present results may be due to the better palatability of treated (SCB and Ccb) than the untreated ones and the better utilization by the host animals. Increased intake due to enzyme treated roughage, had been reported by several investigators (Oji and Mowat, 1979 and El-Kamisi, 2008). On the other hand, the control groups (T1 untreated SCB and T6 untreated Ccb) showed the lower DMI, (1181 and 1140 g/h/d), respectively. However, insignificant DMI was detected for both of the SCB and Ccb treated rations, as an overall means.

Digestibility coefficients of nutrients for both the two complete mixed rations *i.e.* SCB and Ccb rations, irrespective of different applicable treatments are shown in Table (5). Dry matter digestibility of of SCB rations ranged between 92.6% to 93.1% for T4 and T5, respectively. Dry matter digestibility of Ccb rations ranged between 92.92% and 93.63% for T8 and T9, respectively. DM digestibility of both the two treated roughages indicated significant differences ($P<0.05$) among different treated rations, however, DM digestibility of treated and untreated Ccb rations indicated higher ($P<0.05$) values in compare with the corresponding SCB rations i.e. 93.21% vs. 92.87%, respectively. As for OM, CP and CF digestibility, data obtained indicated significant differences among different experimental rations, while T5 (treated SCB) and T10 (treated Ccb) showed the highest ($p<0.05$) OM, CP & CF values (67.78 and 66.67%), (78.32 and 77.33%) and (40.72 and 35.20%), respectively. On the other side, the tow control rations (T1 and T6) recorded the lowest values among the different experimental rations (56.07 and 56.1%), (26.34 and 33.19%) and (16.2 and 13.24%) for OM, CP & CF, respectively. The higher CF digestibility of (T5 and T10) may interpretative the higher DMI of such rations, besides its relatively lower NDF and ADL, (Table 4). According to several authors, *(*Gado, 1997*;* Fouad *et al., 1998* and Deraz and Ismail, 2001*;* Mahrous and Abou Ammou, *2005* and Gado*, et al.,* 2009) CP and CF digestibility coefficients showed a wide range for low quality roughages treated by either ZAD or ZADO + urea treatments.

Data presented in Table (5) indicated, however insignificant difference between both the two treated and untreated SCB and the corresponding Ccb rations, irrespective of different biochemical treatments. The overall means of digestibility coefficients for both the two rations, regardles of different treatments were 62.78% *vs*. 63.04% OM, 61.08 *vs*. 60.96% CP and 29.69% *vs*. 26.21% CF, respectively, indicating in general similar and insignificant digestibility coefficient values due to roughage source.

Results of EE and NFE showed in general, similar digestibility coefficient values for all experimental rations, however (T2 and T8) indicated insignificant higher values, with almost similar an overall means and insignificant values, regardless of treatments and roughage source .

Table (5): Digestion coefficients and nutritive value of tested rations during the digestion trial.

Item	Control SCB (T1)	(T2)	(T3)	(T4)	(T5)	Overall Mean	Control Ccb (T6)	(T7)	(T8)	(T9)	(T10)	Overall Mean
DM intake. g/h/d												
	1181 ±31.72	1338 ±89.49	1415.75 ±85.71	1189.75 ±103.30	1280.75 ±143.88	1281	1140.75 ±24.97	1182.5 ±64.89	1425.25 ±31.53	1333.5 ±118.80	1436.5 ±168.36	1303
Digestibility Coeff. %												
DM	92.94^{f} ±0	92.85^{i} ±0	92.89^{h} ±0	92.6^{j} ±0	93.1^{e} ±0	92.87^{b}	93.23^{b} ±0	93.14^{d} ±0	92.92^{g} ±0	93.63^{a} ±0	93.17^{c} ±0	93.21^{a}
OM	56.07^{b} ±1.54	64.08^{a} ±2.58	65.3^{a} ±3.52	60.69^{ab} ±0.85	67.78^{a} ±2.88	62.78	56.1^{b} ±1.23	63.02^{ab} ±1.0	66.44^{a} ±2.21	62.95^{ab} ±3.04	66.67^{a} ±2.58	63.04
CP	26.34^{d} ±8.18	64.6^{bc} ±2.10	73.35^{ab} ±2.31	62.77^{bc} ±2.0	78.32^{a} ±2.54	61.08	33.19^{d} ±5.71	62.15^{bc} ±2.49	73.3^{ab} ±3.06	58.83^{c} ±2.74	77.33^{a} ±1.53	60.96
CF	16.2^{cd} ±3.38	26.66^{abcd} ±5.96	33.25^{abc} ±6.93	31.61^{abc} ±7.31	40.72^{a} ±5.86	29.69	13.24^{d} ±2.245	20.61^{bcd} ±2.37	33.29^{abc} ±4.68	28.71^{abcd} ±5.77	35.2^{ab} ±4.61	26.21
EE	78.08^{b} ±2.76	83.01^{ab} ±2.85	80.88^{ab} ±3.48	76.93^{b} ±0.93	81.17^{ab} ±1.56	80.08	83.25^{ab} ±1.13	81.95^{ab} ±3.26	88.6^{a} ±2.53	78.94^{ab} ±5.47	80.85^{ab} ±2.79	82.72
NFE	66.76 ±1.29	70.99 ±2.15	69.03 ±3.26	66.48 ±1.13	69.2 ±2.64	68.49	68.55 ±1.01	71.36 ±0.44	70.12 ±1.61	70.0 ±2.64	68.76 ±2.78	69.76
NDF	24.9^{bc} ±3.15	34.38^{abc} ±7.42	43.55^{a} ±5.85	30.15^{abc} ±1.40	22.12^{bc} ±7.35	31.02	20.61^{c} ±2.04	32.49^{abc} ±2.13	41.12^{a} ±3.86	32.91^{abc} ±5.23	37.67^{ab} ±4.51	32.96
ADF	6.99^{cd} ±2.67	23.83^{abc} ±5.93	35.26^{a} ±10.30	7.7^{cd} ±1.89	17.64^{bcd} ±6.70	18.29	3.48^{d} ±1.40	15.72^{bcd} ±2.63	25.58^{ab} ±4.90	14.27^{bcd} ±5.31	14.11^{bcd} ±5.94	14.63
ADL	48.53^{b} ±6.20	32.61^{b} ±10.38	55.42^{b} ±15.58	48.48^{b} ±2.97	88.84^{a} ±17.64	54.78	45.17^{b} ±3.62	46.75^{b} ±4.47	64.6^{ab} ±10.76	53.42^{b} ±12.06	53.77^{b} ±11.09	52.74
Himi-cellulose	45.12^{bc} ±2.39	54.66^{ab} ±3.60	56.18^{a} ±4.50	49.8^{abc} ±0.98	47.19^{abc} ±5.02	50.59	41.43^{c} ±1.63	49.6^{abc} ±1.67	56.11^{a} ±2.85	51.14^{abc} ±3.80	56.8^{a} ±3.09	51.01
Cellulose	25.41^{de} ±3.10	43.45^{abc} 3.60	53.87^{a} ±4.84	30.64^{cde} ±1.42	17.85^{e} ±7.78	34.25	19.46^{e} ±1.95	37.52^{bcd} ±1.92	49.23^{ab} ±3.37	35.86^{bcd} ±4.97	36.47^{bcd} ±4.64	35.71
Nutritive Value %												
TDN	53.83^{c} ±1.34	62.59^{ab} ±4.38	63.12^{ab} ±3.25	58.93^{abc} ±1.29	65.28^{a} ±2.68	60.75	56.81^{bc} ±1.36	61.64^{ab} ±1.96	66.32^{a} ±2.17	62.15^{ab} ±2.97	65.96^{a} ±2.38	62.57
DCP	3.65^{c} ±1.28	9.36^{ab} ±0.30	11.77^{ab} ±3.23	9.11^{abc} ±1.27	13.5^{a} ±2.64	9.48	3.66^{bc} ±1.32	8.75^{ab} ±1.84	11.91^{a} ±2.11	8.73^{ab} ±2.93	13.33^{a} ±2.34	9.28
SE	49.95^{d} ±0.31	58.92^{c} ±2.31	58.52^{b} ±0.37	54.53^{c} ±0.29	60.81^{a} ±0.43	56.55	52.59^{d} ±0.63	57.19^{c} ±0.50	61.72^{b} ±0.49	57.75^{c} ±0.40	61.54^{a} ±0.26	58.16
C/P ratio	14.95^{a} ±0.82	6.67^{b} ±0.05	5.35^{b} ±0.13	6.47^{b} ±0.12	4.83^{b} 0.08	7.65	16.73^{a} ±2.50	7.07^{b} ±0.22	5.57^{b} ±0.09	7.11^{b} ±0.06	4.94^{b} ±0.12	8.28

a, b, c, d, e, f , g , h , i & j different small letters in the same row indicated significant difference (P<0.05)

In general, it can be concluded that all species of cellulolytic bacteria as biological treatments, had a significant positive effect on increasing crude fiber digestibility (CF) (from 16.2% and 13.24% to 29.69% and 26.21% as an overall mean of treated SCB and Ccb) and increasing crude protein digestibility (CP) values(from 26.34% and 33.19% to 61.08% and 60.96%, as an overall mean of treated SCB and Ccb) respectively.

Digestibility data obtained in the present study are within those obtained in many previous studies (Newbold *et al.,* 1995*;* Putnam *et al.,* 1997 and El Badawi *et al.,* 1998).

Digestibility of NDF for T3 of SCB ration and that of T8 Ccb were significantly higher (P<0.05) than those of their corresponding control groups. However, insignificant difference was detected between the overall mean of both the two complete mixed rations *i.e.* 31.02% and 32.96%, respectively. ADF digestibility for T3, of SCB and T8 of Ccb ration were significantly higher (P<0.05) than their corresponding control ones; with an overall means of 18.29% and 14.63%, indicating higher (P<0.05) ADF for the SCB rations. Values of cellulose digestibility coefficient of untreated SCB was 25.41% while, that of (T3) treated SCB was (P<0.05) higher by 53.87%, the other treatments fall in between (17.85 to 53.87%). Values of cellulose digestibility coefficient of untreated Ccb (the control) was 19.46%, which differed (p<0.05) from that of T8 (49.23%); the other treatments fall in between (19.46 to 49.23%). However, similar overall mean and insignificant values were recorded for both the two complete mixed rations i.e. 34.25% and 35.71% cellulose, respectively.

The higher (P<0.05) hemicellulose digestibility values of SCB and Ccb rations were (56.18 and 56.80%) for T3 and T10, respectively, while the lowest values were recorded for the controls (untreated SCB and Ccb rations) *i.e*. 45.12 and 41.43% respectively, and almost similar insignificant hemicellulose values for the overall means of both the two rations *i.e.* 50.69% and 51.01%, respectively, irrespective of the biochemical treatments and source of roughage. Similar results were obtained by Mohamed (2001) who reported that, NDF, ADF, ADL, hemicellulose and cellulose digestibilities were increased (P<0.05), when SCB was treated with fungi and acid plus urea. Abd-El-Aziz and Ismail *(*2001); Bassuny *et al., (*2003) and (2005*)* reported that ZAD and ZAD+urea treatments showed a significant positive effect of loosening lignucelluloletic bonds and solubilize some of the hemicellulose content of treated roughages .

Nutritive value of the complete mixed rations in terms of TDN, showed higher significant values (65.28 and 66.32%) with T5 and T8 , respectively and both the two rations indicated significantly higher values (P<0.05) than the two control groups (T1 and T6). However, different experimental rations indicated higher TDN values in compare with the control group. Also, DCP showed higher values for T3 and T5 (SCB) and T8 and T10 treated Ccb, respectively and were significantly higher (P<0.05) than the two control rations (T1 and T6) and surpassed (P<0.05) the other treated rations.

However, the nutritive values for different (treated and untreated complete mixed rations), irrespective of biochemical treatments, indicated insignificant and almost similar TDN (60.75% and 62.57% TDN) and (9.48% and 9.28% DCP), for SCB and Ccb rations, respectively. Similar results were reported by Gado *et al.,* (2009).

The similar trend was also observed with SE values, as it was noticed significant differences among different experimental rations in favor of T5 and T10 , but lower insignificant SE values with untreated SCB and Ccb rations (49.95% and 52.59%), respectively . However, both the two complete mixed rations indicated insignificant SE values (56.55% and 58.16%), respectively.

On the light of the present results, it was concluded that, biochemical treatments led to improve (P<0.05) nutrients digestibility for both the two treated roughages and their fiber fractions and enriched their nutritive values in terms of DCP and caloric values , however relative responses were detected between both the two treated roughages for different applicable treatments, which is mainly related to the chemical and structural composition of both the two raw materials and its lignification nature.

CONCLUSION

On the light of the present results, it could be concluded that, treating poor quality roughages (SCB & Ccb) with the natural biological additives probiotics (ZAD & ZADO compounds) led to improve roughage chemical composition, digestibility of their nutrients, roughage palatability and in turn might contribute to the marginal field of available roughage resources.

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إستخدام بعض المعاملات البيوكيميائية فى تحسين القيمة الغذائية لبعض مواد العلف الخشنة (دراسات معملية وحقلية)

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تهدف هذه الدراسة إلى تقييم أثر استخدام بعض المعاملات البيوكمائية معمليا وهضميا (*In vivo & In vitro*) على رفع القيمة الهضمية لبعض المخلفات الزراعية الخشنة الفقيرة غذائيا (مصاصة القصب وقوالح الذرة) ، تمت معاملة هذه المخلفات باستخدام بعض المركبات الإنزيمية الحيوية Probiotics (زاد و/أو زادو) ضمن 10 معاملات بيوكيميائية بمعدل 5 معاملات لكل مخلف على النحو التالى :

1- مصاصة القصب أو قوالح الذرة غير معاملة (معاملة رقم 1&6) كنترول.
2- مصاصة القصب أو قوالح الذرة معاملة بـ 3 لتر زاد + 5% مولاس /الطن (معاملة 2&7)
3- مصاصة وقوالح معاملة ب 3 لتر زاد سائل +2% يوريا +5% مولاس (معاملة 3&8)
4- مصاصة قصب وقوالح معاملة بـ 3 لتر زاد سائل + 5كجم زاد بودر + 5% مولاس لكل طن مخلف (معاملات 4&9).
5- مصاصة قصب وقوالح ذرة معاملة بـ 3 لتر زاد سائل +5 كجم زادو بودر +2% يوريا + 5% مولاس / الطن (معاملة 5&10) .

على ضوء نواتج معاملة المخلفات السابق ذكرها ـ تم استخدام 25% من كل مخلف مع 75% علف مصنع (14% بروتين خام) فى تركيب 10 علائق متكاملة ضمن 10 تجارب هضم لتقييم التركيب الكيماوي والقيمة الهضمية والغذائية لهذه المخلفات. وقد أظهرت النتائج المتحصل عليها ما يلى :

أدى تحضين هذه المخلفات (مصاصة القصب وقوالح الذرة المطحونه) مع مركبات الزاد والزادو لمدة 30 يوم إلى تحسين معنوى (5%) فى المادة الجافة ، المهضومه والبروتين الخام والكربوهيدرات الذائبة صاحبه إنخفاض معنوى (5%) فى نسبة الألياف والرماد. مع تحسن كيميائى واضح فى تركيب جدر الخلايا Fiber fraction بانخفاض معنوي ظاهر فى نسب الـ ADF & NDF ، الرماد والهيميسليلوز مع الأخذ فى الإعتبار وجود تباين معنوي بين كل من المخلفين فى مدى استجابتها للمعاملات البيوكيميائية.

أدت المعاملات البيوكيميائية لتحسين القيمة الهضمية والغذائية لكلا المخلفين بصورة معنوية وأن أظهرت النتائج المتحصل عليها عدم وجود فروق معنوية بين المخلفين فى محتواها من المركبات المهضومة الكلية أو قيمتها النشوية أو محتواها من البروتين الخام المهضوم وإن تباين كلا من المخلفين على صورة فردية فى مدي استجابتها للمعاملة البيوكيميائية المستخدمه .

وعلى ضوء هذه الدراسة يمكن استخلاص أن سيلجة بعض المركبات الخشنة الفقيرة غذائيا (مصاصة القصب وقوالح الذرة) مع المركبات الإنزيمية الحيوية (البروبيوتيك زاد و زادو) بالاضافة إلى اليوريا ـ قد أدى إلى تحسن معنوى ملموس فى قيمتها الهضمية والغذائية مما ينعكس مردوده ايجابيا على توسيع قاعدة مواد العلف الخشنة المتاحه والممكن استخدامها فى تغذية المجترات بصوره آمنه.