Egyptian Journal of Sheep & Goat Sciences, Vol. 6 (2),1 – 13, 2011

Evaluation of fungal treatment of some agricultural residues

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ABSTRACT

Two low quality roughages, namely rice straw (RS) and corn stalks (CS) were subjected to biological treatment under solid state fermentation by *Trichoderma Viride* to improve their nutritive value. Four tested rations were allotted randomly on four groups of crossbred lambs (Rhamani×Ossimi) as following, two groups fed concentrate feed mixture (CFM) plus ad lib untreated either rice stalk (RS) (T1), or corn stalk (CS) (T3) and two groups fed concentrate feed mixture (CFM) plus ad lib treated either rice stalk (RS) (T2), or corn stalk (CS) (T4).

Treatment of rice straw and corn stalk with *Trichoderma Viride* decreased contents of OM and CF, while contents of CP, EE and ash increased than those of untreated one.

Nylon bags technique by fistulated bull's buffalo show that, actual washing loss (W), intercept representing solubilized at initiation of incubation (a) and effective degradability (ED) kinetics of DM and OM degradability were significantly ($P<0.05$) increased for either treated rice straw (TRS) or treated corn stalk (TCS) compared to untreated. No significant differences were found between TRS and TCS for the fraction that potentially degradable in the rumen (b) for DM and OM, while values of PD of DM and OM for TRS were significantly ($P<0.05$) higher than TCS substrate.

Total feed intake (TFI) for T2 and T4 were higher than T1 and T3, while TFI for T4 was the highest one and T3 was the lowest one. Crude protein intake and CP ($g/kgw^{0.75}$) for T2 or T4 were higher compared to T1 or T3. The differences of ADG for different treatments were not significant. No significant difference among groups were noticed for feed conversion.

Apparent digestion coefficient of CP for T2 and T4 were significantly ($P<0.05$) higher compared to T1 and T3, while no significant differences between T2 and T4. Crude fiber digestibility for T4 was significantly ($P<0.05$) higher than T2. At the same time, CF digestibility of ration containing TRS or TCS (T2 or T4) were significantly ($P<0.05$) higher than that untreated (T1 or T3). Digestibilities of NDF and NDF for treated RS or CS were significantly ($P<0.05$) higher than untreated one, except NDF digestibility in T3 which was not significantly different. The digestibility values of cellulose were significantly ($P<0.05$) higher for T2 and T4 compared to untreated, while adverse effect was shown with hemicellulose. The nutritive values as TDN was insignificantly differed among tested ration. The values of DCP were significantly ($P<0.05$) higher with ration containing either TRS or TCS, while DCP values of ration containing TCS was significantly ($P<0.05$) higher than that containing TRS. Nitrogen balance (NB) was significantly ($P<0.05$) higher for both T2 and T4 compared to T1 and T3.

It can be concluded from this study that *Trichoderma viride* treatment for rice straw and corn stalks can improve their feeding values without adverse effect on animal performance.

Key words: Degradability, digestibility, rice straw, cornstalks, *Trichoderma viride*.

INTRODUCTION

The shortage of feeds in general and protein in particular attract attention of many researchers to manipulate the unconventional sources of feeds. In Egypt, only 4.15 million tons of crop residues out of 33.477 million tons produced are used for feeding ruminants **(Ministry of Agriculture, Egypt 2006)**. Though other part used for processing industrial materials, the higher ratio still wasted and mostly burned, hence lead to environmental pollution and consequently health hazards. The primary factors limit utilization of crop residues are low digestibility, low protein content, high crude fiber and low palatability. Their low digestibility due generally to the high fibrous contents consist mainly of 30-40% cellulose,25-35% hemicelluloses and 10-15% lignin on DM base **(Theander and Aman,**

1984). Thus, to increase digestibility of crop residues, it is important to release the linkage between cellulose, hemicellulose and lignin or to modify the compact nature of these tissues, so that lignified tissue might separated from non-lignified one. There have been attempts to do that by mechanical, chemical or biological treatments **(Abo-Donia *et al*. 2005, Sazzad and Sabita 2008 and Abedo *et. al.* 2009)**. Recent years, much interest has been forwarded to develop new biotechniques for improving the nutritive value of lignocelluloseics fibrous using biological treatment in solid substrate fermentation (SSF) under non-sterile conditions **(Leopold *et. al*. 2008).** This study was conducted to evaluate the effect of fungal treatment in solid state on chemical composition and nutritive values of rice straw and corn stalks.

MATERIALS AND METHODS

Microbiological studies and Chemical composition were carried out at laboratory of By-products Utilization Research Department, Animal production Research Institute. In-situ studies were carried out in Research Unit, Animal Nutrition, Regional Research Station, Ismailia. Whilefeeding and digestibility trials were carried out, at Research Station, Sids, Beniswef Governorate. Rice straw and corn stalks were chopped at length 2-3 cm according to recommendations of **(Smail, et al., 1995)** and treated with *Trichoderma viride* (ATCC 336) which obtained from Microbiology Research Center (MIRCEN), Faculty of Agric., Ain Shams University, Egypt. Facultative fungal strain was chosen according to the studies of **Raimbault, (1998) and El-Ashry *et al*, (2002)**. Three days old slant (examination tube 20*200mm) of *Trichoderma viride* was placed into a flask containing 25 ml of sterilized water. The inoculums were used to inculcate 500 ml capacity conical flasks containing 20g of cooled sterilized residue by autoclaving at 121°C for 30 minute, moistened by basal medium containing 4% molasses, 0.4% urea, 0.2% KH2PO4 and 0.03 $Mgso_4$(7H2O) in solid liquid ratio 1:2 by 10% (v/w). The inoculated flasks were incubated in adjusted temperature incubator at 30°C ± 2 for 5 days according to **El-Ashry *et al*, (2002)**. The chemical composition and total count (TC) of microorganisms are shown in Table (1). Total count of fungi in treated rice straw (TRS) as spawn fungi per gram was $200*10^8$ used for inoculate untreated rice straw (URS), while was $306*10^8$ /g in treated corn stalk (TCS) as spawn fungi used for inoculate untreated corn stalk (UCS). Inocula were employed to inoculate poly ethylene bags containing 200g of the demanded residues moistened at 55% with the use of the above basal medium. Bags were incubated at 30 ± 2 °C. Samples of inoculate (spawn fungi) were oven dried to constant weight for chemical analysis according to **A.O.A.C. (1995).** Large scale application of one ton of either URS or UCS milled (3-5 cm) were moistened at (55%) and inoculated by (15%) of TRS or TCS as spawn fungi. Treatments were conducted in clean room padded with ceramic sterile chemically by Dettol and Formalin. Crop residues were incubated in chamber at 33 ± 2°C and humidity 95% . At the end of incubation period, lasted for 21 days, the treated materials were solar dried to stop activity of fungi. Samples of the biodegraded materials were oven dried to constant weight for chemical analysis and *in situ* degradability. PH values of the tested ingredients were measured immediately after sampling.

Total count of fungi was accounted according to **Collins, (1995)**. Exactly 39 gram was suspended in one liter sterilized at 121°C for 20 minutes. One ml of feed crops (diluted content, 10^8) was poured in 10cm Petri dish filled by 15 ml of the previous media, then dishes were incubated at 30 ± 2°C for 24 hours, to be counted.

Nylon bags technique was used to determine the degradability of dry matter, organic matter and crude protein contents in the tested ingredients according to the methods described by **Mehrez and Orskov (1977)**. Two fistula were installed in rumen of buffalo bull. Seven-gram samples were placed in nylon bags (10×20 cm with a pores size 53±15 µm) to be incubated and anchored with a 30-cm length braided fishing line. All bags were clamped to a 540-g weight, which will tie to a 60-cm long mainline tied outside the fistula. Duplicate bags were introduced in the rumen of each two buffalo bulls over time to have incubation periods of 6, 12, 24, 48 and 72 h. Dry matter, organic matter and crud protein content were estimated according to methods of **A.O.A.C (1995)**. All bags were removed at once and washed under a gently flowing steam of tap water until the rinsing water becamed clear. Two unfermented bags were washed in running water for 15 m to determine the initial soluble fraction (W). All washed bags were dried in a forced-air oven at 55°C until constant weight was reached.

The kinetics of DM, OM and CP disappearances in the rumen were calculated using the non- linear non-lagged model by fitting the individual values to the following equation of **Ørskov and McDonald (1979):** **$P = a + b (1 - e^{-ct})$,** where P =percentage of disappearance at time t, a = the intercept representing the portion solubilizes at time 0, b = the fraction of that protein degraded in the rumen, c= the constant rate of disappearance of fraction b, and t=time of incubation. The nonlinear parameters a, b, and c were estimated by an iterative least-squares procedure **SAS (2004)**. The effective degradability (ED) is the amount that actually degraded in the rumen and was calculated with the following equation **Ørskov and McDonald (1979)**: **$ED= a + [(b - c)/(c + k)]$,** where k is the estimated rate of solid outflow from the rumen and the others are the same as described above. Effective degradability was estimated for each ingredient assuming rumen solid outflow rates of 5%/h.

Twenty healthy growing crossbred lambs (Rhamani×Ossimi) about four months old were allotted randomly in four groups (5 lambs each) to test the experimental rations as follow; the 1st and 3rd groups were fed concentrate feed mixture (CFM) with either untreated RS or CS ad-lib, respectively. While the 2nd and 4th groups were fed CFM with either treated RS or CS ad-lib, respectively. Rations were offered at rate 4% of live body weight (70% concentrate: 30% roughage) according to NRC (1985). Feed mixture was composed of (soybean meal 23%, yellow corn 34%, wheat bran 30%, rice bran 20% and common salt 1%). Body weights of lambs were recorded biweekly. Four digestibility trials were carried out with twelve adult rams (three in each group) which collected from the experimental groups. Each trial lasted for 25 days (15 days as a preliminary period and 7 days as collection period). The daily collected urine samples mixed with 50 ml diluted sulfuric acid 10% and stored for nitrogen determination. The daily N-balance was estimated by subtracting the amount of daily faecal and urinary N from daily feed N consumed. Samples were collected and oven dried to constant weight for chemical analysis according to **A.O.A.C.(1995).** Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined according to **Goering** and **Van Soest (1970**). Hemi-cellulose and cellulose were calculated as the difference between NDF and ADF, ADL orderly. The data were analyzed using the **SAS, (2004)** statistical package.

RESULTS AND DISCUSSION

Chemical composition of treated RS and CS with *TV* are shown in Table (1). Contents of OM, CF, NFE, ADF, ADL, cellulose and hemicellulose were decreased with treating TRS or TCS with *TV*. Treating with *TV* increased OM content on CS than RS with the same conditions. **El- Ashry *et al.*, (2002)** found that OM was decreased as a result of the fungal treatment, which is working to breakdown fibers while not affecting NFE. **El-Menniawy (2008)** reported that treatment of sugar cane bagasse by *TV* resulted in decrease of NFE. Fungal treatment of RS with *TV* produce sufficient amount of cellulolytic enzymes namely exo, endo-gluconases and ß- glycosidase (**Fadel, 1983)**. The lower fiber fractions content noticed agrees with those reported by **Deraze and Ismail (2001)**. The treated RS or CS with *TV* increased CP, ASH and EE contents compared to blank substrate. Content of CP either TRS or TCS were increased to 9.45 % and 10.28 % compared to blank which were 3.90 and 4.95, respectively. The highest CP could reflect on decreasing CF (**Subhash *et al.*, 1991)** and increasing total count fungi per gram substrate (**Gray and Neelakantan, 1981)**. **Chawla and Kundu, (1987a)** reported that CP content of wheat straw fermented by *TV* was higher (from 3.5 to 13.2% and and increase to about 18.3%. EE and Ash % were increased with TRS or TCS.

Total count of *TV* fungi in TRS and TCS, pH and recovery rate (Rr) are presented in Table (1). The total count of *TV* per gram in TRS and TCS increased during incubation period. The treated CS showed more count of fungi than treated RS with the same fungi. A similar total count of fungi has shown in the study of **Raimbalut, (1998)**. RS and CS treated with *TV* showed resemble pH values, while by the end of incubation period both had lower pH values. This result is similar to those obtained by **EL-Ashry *et al.*, 2003 and EL- Menniaway, 2008)**. Recovery rate (Rr) of TRS and TCS were of the same trend noticed for pH. These results agree with **Penaloza *et al.*, (1985)** whom used *Aspergillus niger* in solid state fermentation on coffee pulp to improve the nutritive value. The total count of *TV* agree with **Raimbault, (1998)**. He measured that concentration of spores / products in the solid state fermentation were 100- 300 cell/g.

The data in Table (2) show the effect of feeding RS or CS treated with *TV* on rumen kinetics of DM, OM and CP degradability, Washing losses (W), intercept representing solubility at initiation of incubation (a) and effective degradability (ED). Kinetics of DM and OM degradability were significantly ($P<0.05$) increased for either TRS or TCS compared to untreated. This result was expected due to the losses of both ready soluble material and small particles that leave the bag through pores. In addition, some soil particles could contribute, as part of the soluble fraction of the sample. The differences between forages could be due to the individual characteristic of each one, species and maturity (**Blümmel and Ørskov, 1993)**.

No significant difference was found between TRS and TCS for the potential fraction degradable in the rumen (b) of DM and OM, while values of PD of DM and OM for TRS was significantly ($P<0.05$) higher than that of TCS substrate. The degradation rate may be affected by factors related to the animal, such as the rate of particle-size reduction by rumination, microbial activity and ruminal condition (pH, osmotic pressure and mean retention time of digesta), which have a profound effect on microbial degradation activity **López, *et al*., (1995).**

The values of undegraded content (UND) of DM were not significantly differ between treated or untreated of both substrate, except UND of TRS which was significantly ($P<0.05$) lower compared to TCS and UCS. Washing value (W), a, A, ED and UND kinetics for DM and OM of TCS were significantly ($P<0.05$) higher than TRS, while b and potential degradability (PD) kinetics for DM and OM of TCS were significantly ($P<0.05$) lower than TRS. The values of c kinetic of DM for both RS and CS were numerically resembled. While OM degradability for TCS at c kinetics was significantly ($P<0.05$) decreased while was not significantly ($P<0.05$) decreased for TRS. Rice straw and corn stalk are particularly rich in lignin and poor in cell content. It seems had the same phenomenon of "protection" of carbohydrates related to lignin. In fact, when the tested ingredients were treated with fungi its *in vitro* degradability was almost four times higher **(Goering and Van Soest, 1970 and Abo-Donia *et al*., 2005)**.

The value of CP degradability for both TRS and TCS were insignificantly differ from c kinetic. Lower protein degradability may be due to the fact that 75 to 90% of the N is linked to the ligno-cellulose fraction, thereby resulting in low N solubility which is only 2.3% (soluble N % of total N) in the case of roughages and about 0.2 to 0.4% in that of screened olive cake **(Mehrez *et al.*, 2008).**

Table (1): Chemical composition and fungi count of treated rice straw and corn stalks with TV during the incubation period (on DM basis)
*Solution containing g/L (4% molasses, 0.4%urea, 0.2%KH2PO4 and 0.03 $Mgso_4$(7H2O) in solid liquid ratio 1:2 by 10 %(v/w),

SAMPLE	DM	OM	CP	CF	EE	NFE	ASH	NDF	ADF	ADL	Cell	H-cell	TC*10^8 , cell/g	pH	Rr
Treated with Solution (Blank)*				-	-	-	-	-	-	-	-	-			
RS	45.42	83.05	3.9	37.83	0.97	40.35	16.95	69.21	45.93	12.15	33.61	23.16	-	7.3	-
CS	45.42	88.99	4.95	34.97	0.85	48.22	11.01	66.07	46.49	10.15	36.34	19.58	-	7.2	-
Inoculate															
Rice straw	46.43	76.07	9.33	30.23	1.48	35.03	23.93	57.15	37.74	11.45	26.29	19.41	200	6.13	-
Corn stalks	46.25	80.08	8.31	27.85	1.65	42.27	19.92	57.93	38.46	9.24	29.22	19.47	306	6.23	-
Incubation periods															
Initial week (w0)															
TRS	44.65	82.01	4.75	37.65	1	38.61	17.99	66.41	43.75	11.75	32	22.66	16	6.55	0.98
TCS	45.48	88.44	6.52	34.5	0.95	46.47	11.56	64.27	44.49	9.71	34.58	19.78	14	6.7	0.99
Final week (w4)															
TRS	45.78	76.14	9.45	29.46	1.27	35.96	23.86	56.7	36.98	10.96	26.02	19.72	88	6.09	0.91
TCS	44.75	79.04	10.28	28.32	1.56	38.88	20.96	55.38	37.37	8.88	28.49	18.02	103	5.98	0.89

Inoculate: rice straw (RS) or corn stalks (CS) treated by (solution + *Trichoderma viride* treatment)
TC**:** Total count, **Rr:** Recovery rate

Chemical composition of tested ingredients and rations in Table (3) show that, CP content of T2 and T4 were higher compared to T1 and T3. At the same time content of CP of T4 was higher than T2. Content of CF for T2 and T4 were decreased than untreated, while both treatments (T2&T4) were nearly resembled. Content of NDF and ADF were higher for untreated substrate compared to T2 and T4. The value of NDF and ADF for T3 and T4 were lower compared to T1 and T2. Cellulose and hemicellulose content of T2 and T4 were of the same trend of CF content. These results are in agreement with **El-Ashry *et al.*, (2002) and El-Menniaway, (2008).**

Table (2): Rumen kinetics of DM, OM and CP degradability for tested ingredients

Item		W	a	b	c	PD	ED	UND
DM	**URS**	5.73^{b}	5.45^{b}	60.84^{ab}	60.56^{ab}	22.29^{d}	39.44^{ab}	22.29^{d}
	TRS	10.55^{a}	10.54^{a}	67.98^{a}	67.97^{a}	26.61^{b}	32.03^{b}	26.61^{b}
	UCS	6.02^{b}	5.89^{b}	55.22^{b}	55.09^{b}	25.26^{c}	44.91^{a}	25.26^{c}
	TCS	12.46^{a}	12.40^{a}	59.05^{ab}	58.99^{b}	30.07^{a}	41.01^{a}	30.07^{a}
± SE			0.82	2.73	0.002	2.64	0.28	2.64
OM	**URS**	6.78^{b}	5.99^{b}	50.57^{b}	49.78^{c}	24.20^{d}	50.22^{b}	24.20^{d}
	TRS	11.30^{a}	11.44^{a}	55.48^{a}	55.62^{a}	29.64^{b}	44.38^{d}	29.64^{b}
	UCS	7.16^{b}	7.11^{b}	46.46^{c}	46.41^{d}	27.04^{c}	53.59^{a}	27.04^{c}
	TCS	12.78^{a}	12.67^{a}	51.13^{b}	51.03^{b}	31.82^{a}	48.97^{c}	31.82^{a}
± SE			0.76	0.34	0.001	0.32	0.27	0.32
CP	**URS**	6.36^{b}	6.30^{b}	40.98^{ab}	40.92^{b}	25.63^{b}	59.08^{a}	25.63^{b}
	TRS	9.92^{a}	9.97^{a}	42.24^{ab}	42.28^{ab}	29.90^{a}	57.72^{ab}	29.90^{a}
	UCS	6.36^{b}	6.24^{b}	40.67^{b}	40.56^{b}	27.14^{b}	59.44^{a}	27.14^{b}
	TCS	10.34^{a}	10.60^{a}	45.38^{a}	45.63^{a}	31.51^{a}	54.37^{b}	31.51^{a}
± SE		0.99	0.99	1.33	0.004	1.35	0.71	1.35

W: Washing loss, PD**:** Potential degradability and UND**:** Undegradable content

a: intercept representing solubility at initiation of incubation.

b: the potential fraction degradable in the rumen

c: kinetic of DM for both RS and CS

Table (3): Chemical composition of ingredients and tested rations

Item	CFM	Ingredients				Treatment			
		URS	TRS	UCS	TCS	T1	T2	T3	T4
Chemical composition (%)									
DM	91.00	92.23	92.18	92.25	92.05	91.39	91.58	91.36	91.33
OM	92.83	83.89	76.87	89.14	80.28	90.15	88.01	91.72	89.07
CP	16.07	3.30	10.45	4.54	13.25	12.24	14.37	12.61	15.22
CF	8.31	31.72	25.43	34.36	26.24	15.33	13.48	16.12	13.69
EE	4.50	0.95	2.12	0.55	1.36	3.43	3.78	3.32	3.56
NFE	63.95	47.92	38.87	49.69	39.43	59.14	56.38	59.67	56.60
ASH	7.17	16.11	23.13	10.86	19.72	9.85	11.99	8.28	10.93
Cell wall constituents (%)									
NDF	30.65	69.56	59.15	66.40	58.39	42.33	39.26	41.37	38.97
ADF	18.05	46.16	39.75	46.27	39.43	26.48	24.60	26.51	24.46
ADL	2.56	11.21	10.45	11.19	10.24	5.16	4.94	5.15	4.86
Cell	15.49	34.95	29.30	35.08	29.19	21.33	19.66	21.36	19.60
H-cell	12.60	23.40	19.40	20.13	18.96	15.84	14.65	14.86	14.51

URS and UCS are untreated RC and CS. TRS and TCS are treated RS & CS.

The digestibility coefficients of DM, OM, CP, EE, CF and NFE for treated and untreated ration are shown in Table (4). Digestibility of DM and OM were not significantly differ for T2 and T4 compared to T1 and T3. Also there is no significant differences between T2 and T4. Apparent digestion coefficient of CP for T2 or T4 were significantly (P<0.05) higher compared to T1 or T3. There is no significant differences among CP digestibility of T2 and T4. These results agree with **El-Menniawy, (2008)** who reported that the biological treatment of straws as well as other fibrous roughage resulted in an increase of CP content and digestibility, when used *TV* fungus with corn cobs as they attained increase in digestibility of OM and NFE.

The significantly (P<0.05) higher CF digestibility was shown with T4 compared with other treatments. Crude fiber digestibility for T4 was significantly (P<0.05) higher than T2. **Bhumibhomon *et al.*, (1988)** suggested that improvement of digestion coefficient of both CF and CP might due to enzymes produced by microbes (specially amylase and protease) which were involved indirectly in the digestion of carbohydrate and protein. Digestion coefficient of EE of T2 was significantly (P<0.05) lower than that of T1, while there were no significant difference among other treatments. No significant difference was found about NDF and ADF digestibility between T2 and T4 or T1 and T3, except T1 and T3 where the content of ADF was significantly (P<0.05) different. The digestibility values of cellulose was significantly (P<0.05) higher for T2 and T4 compared to T1 and T3, while the adverse effect was shown with hemicellulose. The improve in digestibility values might due to solubilization or increased biodegradability of cell wall components (**Eduaredo *et al.*, 1986)**. Exogenous enzymes enhance fiber degradation by rumen microorganisms *in vitro and in situ* (**Feng *et al.*, 1996)** and *in vivo* (**Yang** *et al.*, **1999)**. The nutritive values as TDN was insignificantly differed among tested rations. The values of DCP were significantly (P<0.05) higher with T2 and T4, while DCP values of T4 was significantly (P<0.05) higher than that T2. These results agree with those reported by **Abd El- Gawad *et al.*, (2002) and Shakweer (2003)**. (

Table (4): Effect of feeding treated rice straw or corn stalk with fungi on digestion coefficient, nutritive value and NB.

Item	T1	T2	T3	T4	± SE
Nutrient digestibility (%)					
DM	70.05	72.00	71.00	72.31	0.88
OM	72.37	73.66	73.23	74.52	0.96
CP	60.77^{b}	65.86^{a}	61.45^{b}	65.61^{a}	0.48
CF	50.28^{c}	54.33^{b}	53.12^{b}	56.07^{a}	0.51
EE	71.88^{ab}	70.01^{b}	74.32^{a}	72.74^{ab}	1.15
NFE	81.30	81.51	82.04	82.41	1.16
Cell wall digestibility (%)					
NDF	65.43^{b}	67.82^{a}	66.99^{ab}	67.87^{a}	0.66
ADF	37.79^{c}	44.88^{a}	42.14^{b}	45.96^{a}	0.40
ADL	4.27^{d}	4.60^{c}	5.43^{b}	6.02^{a}	0.05
Cell	33.04^{c}	40.06^{a}	36.80^{b}	39.99^{a}	0.36
H- cell	27.61^{a}	23.07^{c}	24.62^{b}	22.29^{c}	0.27
Nutritive values (%)					
TDN	73.43	72.68	76.02	74.74	0.99
DCP	7.14^{d}	9.87^{b}	7.64^{c}	10.71^{a}	0.08
NB (g/h/d)	0.55^{d}	1.38^{b}	0.69^{c}	1.50^{a}	0.02

NB: Nitrogen balance

They suggested that the increase in DCP may be attributed to better digestibility of most nutrients due to this treatment or the increase in fermentation capacity of the rumen (**Hungate, 1975)**. Nitrogen balance (NB) was significantly ($P<0.05$) higher for both T2 and T4 compared to T1 and T3. The improved nitrogen balance is in agreement with **Walli *et al.***, **(1991)** who reported a positive N-balance when they fed caves on fungal treated wheat straw.

Table (5) presents mean values of feed intake, growth performance and feed conversion of treated RS and CS with *TV*. The average concentrate and roughage intake were comprised ration containing either TRS (T2) or TCS (T4) and also comprised untreated RS (T1) or CS (T3). Total feed intake and total dry mater (TDM) of rations containing either TRS or TCS were higher than intake of either URS or UCS. Total feed intake and TDM of ration contained TCS were the highest compare to other treatments, while ration contained UCS (T3) was the lowest. The removal of digesta from rumen is one of the major processes controlling the intake **(Dijkstra & France, 1996)**. **El-Ashry *et al.*, (1997)** found that the total DM intake of untreated corn stalks and untreated rice straw were significantly ($P<0.05$) higher than fungi treated rice straw and corn stalks. The same trend was shown with crude protein intake (CPI) and crude protein ($g/kgw^{0.75}$) of both rations containing treated or untreated substrate. Crude protein intake and CP ($g/kgw^{0.75}$) for ration containing either TRS or TCS were higher compared to ration containing URS or UCS. **Ibrahim, (2002)** found that DCP as kg/ h/day or g/ kg $w^{0.75}$ of untreated bean straw were significantly ($P<0.01$) higher than those of untreated and treated rice straw and bean straw with either *Pleurotus ostreatus* or *Pleurotus sajor caju*.

No significant differences were noticed among groups consumed rations containing those treated or untreated roughages concerning initial weight, final weight and gain. In spite of the slight improved in average daily gain, but the differences were not significant (Fig.1). The improvement in daily gain as a result of adding biological treatments may be due to its effect on microbial efficiency and organic matter digestibility. It is interest to note that the present results of live body weight and average daily gain are in parallel with the results obtained in digestibility trial which show that most of the nutrients were digested more by biologically treated rations than the control ration. **Gado, (1997)** reported that increasing the concentration of cellulase enzyme had a positive ($P<0.05$) reflection on average body gain in bagasse treatment in comparison with control treatment. In spite of the non significant difference among groups in feed conversion expressed as dry mater intake (DMI kg/ kg gain), TDN, crude protein intake (CPI) and digestible crude protein intake (DCPI) the groups consumed rations containing either TRS or TCS were the best compared to those fed ration containing URS or UCS. These results agree with **Ibrahim, (2002). El- Menniawy, (2008)** reported that treating corn stalks with *TV* had less effect than the control in the relative TDMI to body weight. Results in Table (6) show that least feed cost/Kg body weight gain and economic efficiency were in favor to TRS and TCS compared to URS and UCS. These results are in agreement with Deraz, (1996) and Ibrahim, (2001) whom found that the chemical and biological treatments of rice straw and corn stalks decreased the cost of feeds used to produce one kg live body weight gain by 15.54 and 16.82% for rations including corn stalks, respectively.

Table (5): Mean values of feed intake, growth performance and feed conversion of treated rice straw and corn stalk with *TV*.

ITEM	T1	T2	T3	T4	± SE
Feed Intake (g/kg LBW)					
Concentrate	1004	1010	955	1025	-
Roughage	430	437	409	440	-
Total feed intake	1434	1447	1364	1470	-
Crud protein intake	175	208	172	220	-
Feed Intake (g/kg $w^{0.75}$)					
Total dry mater	96.20	96.2	95.20	96.20	-
Crud protein	11.60	13.80	11.80	14.60	-
Growth Performance					
Initial weight	27.40	27.60	27.00	27.40	1.82
Final weight	43.00	44.60	42.00	46.20	2.01
Gain	15.60	17.00	15.20	18.80	1.20
Average daily gain	129.80	141.60	126.60	156.60	9.97
Feed conversion					
Dry mater intake (kg/kg gain)	11.10	10.52	10.83	9.57	0.82
TDNI kg/kg gain (kg/kg gain)	8.15	7.65	8.24	7.15	0.61
Crud protein intake (kg/kg gain)	1.36	1.51	1.37	1.46	0.12
DCPI kg/kg gain (kg/kg gain)	0.83	0.97	0.84	0.955	0.05

DCPI: Digestible crude protein. TDNI: Total digestible nutrients.

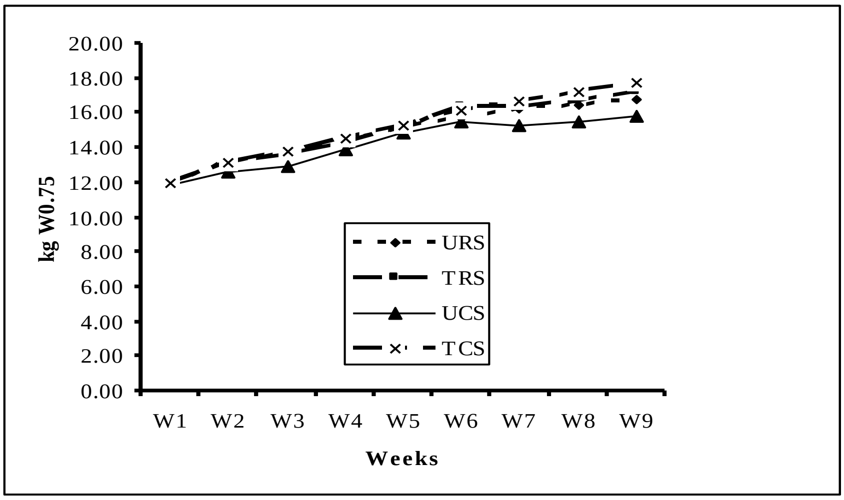

Fig. (1): Changing in body weight ($W^{0.75}$) during experimental periods

Table (6): Economical efficiency of experimental diets for growing lambs as affected by different treatments.

Item	URS	TRS	UCS	TCS
Price roughage (LE /kg)	0.11	0.25	0.21	0.39
Feed roughage cost /animal (LE)*	6.15	14.22	11.17	22.37
Price concentrate (LE / kg)	2.00	2.00	2.00	2.00
Feed concentrate cost /animal (LE)*	264.13	265.71	251.24	269.65
Total feed cost /animal (LE)[1]	270.28	279.93	262.41	292.02
Average gain (kg)	15.60	17.00	15.20	18.80
Total revenue/animal (LE)[2]	468	510	456	564
Net revenue/animal (LE)[3]	197.72	230.07	193.59	271.98
Gain of pound[4]	0.73	0.82	0.74	0.93
Economical efficiency % [5]	73.15	82.19	73.77	93.13

* During whole experimental period
(1)Total feed cost = Price roughage (LE /kg) + Price concentrate (LE / kg)
(2) Total revenue/animal (LE) = Average gain × price of live weight (30 L.E/ kg LBW)
(3) Net revenue/animal (LE) = (2) – (1)
(4) Gain of pound = (3) / (1)
(5) Economical efficiency (EE) % = (2) / (1) *100

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تقيم جودة المخلفات الزراعية المعالجة بالفطريات لرفع قيمتها الغذائية

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المستخلص

فى هذا البحث تم معاملة إ ثنان من المواد الخشنة المنخفضة الجودة وهي قش الأرز و حطب الذرة بيولوجيا تحت تقنية تخمر الحالة الصلبة بإستخدام فطرالترايكوديرما فيردى لتحسين قيمتها الغذائية كأعلاف للحيوانات المجترة. إستخدمت أكياس النايلون بواسطة فستيولا فى كرش عجول ال جاموس لتحديد معدل إختفاء الماده الجافه والعضويه والبروتين للمواد الخشنة المختبره .وقد تم توزيع عشرون حمل نامى خليط (رحمانى × أوسيمى) عشوائيا على أربع ة مجموعات (خمس حملان / المجموعة) على النحو التالي : المجموعة الاولى (T1) والثالثة (T3) تتغذى على علف مركز + قش أرز أوحطب ذرة غير معامل تغذية مفتوحة ,على التوالي ، في حين كانت تتغذى المجموعة الثانية (T2) والرابعة (T4) على علف مركز+ قش أرز أوحطب ذرة معامل تغذية مفتوحة،على التوالي والجميع لمدة أربعة أشهر لاختبار علائق التجربة.كما تم إجراء أربعة تجارب هضم على العلائق المختبرة السابقه. وإستخدم لكل تجربة هضم ثلاث حيوانات من ذكور الاغنام.

إنخفض محتوى المادة العضوية والالياف لكلا من قش الارز وحطب الذرة المعامل بينما ارتفع محتوى البروتين والدهن والرماد للمواد المعاملة مقارنة بالمواد غير المعاملة. أما قيم W, a, A, ED لأختفاء الماده الجافه والعضويه فزادت معنويا لكلا من قش الارز وحطب الذره المعامل مقارنة بالمواد غير المعاملة . ولا توجد إختلافات معنويه بين قش الارز وحطب الذره المعامل فى قيم c, b للماده الجافه والعضويه، بينما قيم PD للماده الجافه والعضويه لقش الارز المعامل تزيد معنويا عن حطب الذره المعامل. إرتفاع المأكول الكلى للعلائق المحتوية على قش أرز معامل أو حطب ذرة معامل عن العلائق المحتويه على مواد غير معامله و أقل قيمه كانت للمجموعه المغذاة على حطب ذره غير معامل. إرتفع المأكول من البروتين الخام و البروتين الخام المنسوب لوزن الجسم للمجموعتين الثانية والرابعة مقارنة بالمجموعة الاولى والثالثة وتفوقت المجموعه الرابعة عن المجموعه الثانية. لا يوجد إختلاف معنوى فى هضم المادة الجافة والعضوية للمج موعة الثانية والرابعة مقارنة بالمجموعة الاولى والثالثة. كما إرتفع معامل هضم البروتين الخام معنويا للمجموعة الثانية والرابعة مقارنة بالمجموعة الاولى والثالثة ولا يوجد إختلافات معنوية فى هضم البروتين الخام بين المجموعة الثانية والرابعة .إزداد معامل هضم الالياف الخام معنويا للمجموعة الثانية والرابعة مقارنة بالمجموعة الاولى والثالثة وكذلك ارتفع معنويا معامل هضم الالياف الخام بالمجموعه الرابعة مقارنة بالمجاميع الأخرى.ولا توجد إختلافات معنوية فى معامل هضم NDF و ADF بين المج موعة الثانية والرابعة وبين المجموعة الاولى والثالثة و يوجد إختلافات معنوية فى معامل هضم ADF للمجموعة الاولى والثالثة .أما قيم هضم السيليلوز فإنها ترتفع معنويا للمجموعة الثانية والرابعة مقارنة بالمجموعة الاولى والثالثة. وكان التأثير عكسى بالنسبه للهيمسيليلوز.

لا توجد إختلافات معنوية فى القيم الغذائية المعبر عنها بـــ (TDN) بين العلائق المختبرة فى حين حدث ارتفاع معنوى فى قيم DCP للمجموعة الثانية والرابعة كما أن المجموعة الرابعة ترتفع معنويا عن المجموعة الثانية. يزداد ميزان النيتروجين معنويا لكلا من المجاميع الثانية والرابعة مقارنة بالمجوعتين الاولى والثالثة.

من هذا نستنتج ان معاملة قش الارز أو حطب الذرة بهذا الفطر تؤدى إلى تحسين القيمة الغذائية لهما دون تأثير سلبي على أداء الحيوانات .

 ISSN : 2090-0368 - Online ISSN : 2090-0376 (Website : http://www.easg.eg.net)