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Improving the Nutritive Value of Watermelon Vines and Its Effect on Productive Performance of Growing Lambs

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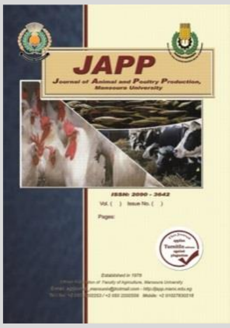

ABSTRACT

This experiment was conducted to study the effect of using biological treatment by (*Trichoderma reesei*), to reduce the content of antinutritional factors in watermelon vines and improvement their nutritive value and the possibility of using it in animal nutrition and its effect on productive performance of growing lambs. Fifty male Barki lambs at 6 to 8 months of age with an average live body weight 24.49 ±0.2 Kg were divided into five similar groups according to their live body weight (10 lambs for each). They were randomly assigned to receive the five experimental rations where control group was fed 50% concentrate feed mixture (CFM) plus 50% berseem hay (BH) on dry DM basis (R1) and the other four groups R2, R3, R4 and R5 were fed rations containing 25 or 50 % untreated watermelon vines hay (WMVH) and treated with *Trichoderma reesei* fungi (WMVF), respectively. Animals were fed the five respective rations in groups. The growth experiment lasted for sex months. Results showed that degradation of antinutritional factors was more efficient when WMV hay biologically treated with fungi (*Trichoderma reesei*). The values of antinutritional factors of the watermelon vines reduced as follows: total phénols by 53.43%, total tannins 71.38%, saponins 63.67%, alkaloids 44.02% and flavonoids 16.98%, compared with untreated vines. Control ration (R1) and the tested ration (R4) had higher DM intake than the other tested ones (R2, R3 and R5), being ration R3 had the lowest value. Animal fed R4 showed more soluble, degradable, less undegradable fractions and more effective degradability. The values of final body weight, total body weight gain and daily gain were significant lower for tested rations R2, R3 and R5 than those of control one (R1), while the tested ration R4 was similar in these values with those of control one, being the highest values among all tested rations. The feed conversion as (g DMI/g gain) was worse with all tested rations related to that of control one, whereas R4 had the best feed conversion value among all tested ones. The values of feed conversion recorded 6.93 and 7.05 for R1 & R4 and 8.22 & 8.73 for R2 and R5, respectively, while the worst value was recorded with R3 (8.96). The feed cost was decreased by 11.98 and 25.62 for R2 & R3 (rations which contained 25 or 50% untreated watermelon vines) and 11.78 & 24.59 for R4 and R5 (rations which contained 25 or 50% watermelon vines treated with fungi) respectively, compared with the figure of control one (R1). The economic efficiency improved by 23.64% for R4 compared with control group (R1) and the other tested rations (R2, R3 and R5). The results could be indicated the possibility of introducing biologically treated watermelon vines with fungi in growing lambs rations up to 25% (i.e. 50% in replacing of berseem hay) to reduce the feed costs without harmful effects on their performance and health.

Keywords: *Biological treatment, watermelon vines, growth performance, digestibility, degradability, nutritive value, antinutritional factors, lambs.*

INTRODUCTION

Livestock production is one of the important activities in most developing countries especially Arab countries, which could play an important role in the economics of these countries. Feed is the most important cost item for livestock production, which represent about 70% of total production cost. On practical and economic scales including local crop by–products into ruminant diets could reduce feed cost (Borhami and Yacout, 2001).

Various formulations for animal feed have been developed, but the cost of production of feeds has been major threat to animal production. Use of cheaper and lesser-known and conventional feed supplement may represent the low-cost route to improve animal performance (Pin Xu *et al.*, 1992). Oloyo and Ilelaboye (2001) reported that the nutritive quality of by-products of some crops were potentially good sources of dietary energy and protein supplement for ruminants. There are still many by-products available in Egypt, not used as feed for animals due to lack of information on their nutritional values and yet economic return if using them. Most of crop residues are disposing by burning it causing environmental pollution and health hazard. One of by-products is watermelon vine. Annual quantity of watermelon vine is about 190,000 tons producing from 180,000 feddans of watermelon crop (Agric. Economics, 1998). Bassiouni (2001) reported that watermelon vine hay (WMVH) had higher nutritive value, dry matter and protein degradability, as well as, it was better utilized than both wheat straw and rice straw by ruminants. Saleh *et al.* (2003) reported that lactating buffaloes fed rations containing 25 and 45% of watermelon vine hay (WMVH) had better economic efficiency than control one.

The seeds and vines crops contain some antinutritional factors as total phenols, saponin, total

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tannins, nitrite and nitrate (Ilelaboye and Pikudea, 2009) and Amal Fayed *et al*. (2012). Polyphenolic compound like tannins are known to interfere with digestion and absorption of protein in animals (Eggum *et al*., 1983 and Back *et al*., 1988). They form strong complexes with dietary protein in foods (Singh and Eggum, 1984). Cheeke (1983) showed that saponin is a group of substances that occur in plant and can produce soapy lather with water. The saponin in a forage crop has been shown to affect palatability and intake of nutrients. Ilelaboye and Pikudea (2009) reported that the natural toxicants aseptically the saponin content of the crop residues are too high and will present a potential health hazard to the animal. In order to improve the nutrient quality potential of the crop by-products further studies should be done to clear the effect of processing on the nutrient composition of the crop by-products. Khorshed, (2000) mentioned that biological treatments using some fungi were tested to improve the nutritive value and digestibility of poor quality roughages. El-Ashry *et al*. (2003) showed that enzymatic hydrolysis by fungi and biological conversion of cellulosic materials improves the nutritive value of residues especially crude protein and crude fiber. Gowda *et al*. (2007) showed that biological treatments are essential for improving the nutritive value of such by-products and they were used to reduce antinutritional factors by using certain fungi.

Biological treatment with fungi (*Trichoderma reesei*) is reported to be highly effective in reducing the level anti- nutritional factors. Amal Fayed *et al*. (2012) indicated that antinutritional factors as the glycoalkaloids content of potato vines as affected by biological treatment by fungi (*Trichoderma reesei*), reduced from 218. 34 mg/100g to be 75.22 mg/100g dry vines. Khattab *et al*. (2011 and 2013) ; Alsersy *et al*. (2015); Elghandour *et al*. (2015); Liu *et al*. (2015) and Salem *et al*. (2015) reported that biological treatment of poor quality roughages usually result in marked increases in their CP digestibility. The increase of CP in treated materials may be due to the presence of microorganisms. Akinfemi and Ogunwole (2012), Khattab *et al*. (2013) and Kholif *et al*. (2014) showed that the capture of access nitrogen by aerobic fermentation was occurred by fungus and the proliferation of fungi during degradation.

This study was carried out to evaluate:

1- The possibility of reducing antinutritional factors in some vegetable crop residues (watermelon vines) by using biological treatments.
2- The possibility of introduced of watermelon vines in ration of growing lambs at two ratio 25 or 50% either as dried or biological treated with fungi (*Trichoderma reesei)* and examines its impact on digestibility coefficients, degradability, productive performance of growing lambs and its economic efficiency.

MATERIALS AND METHODS

The present study was carried out at Noubria Experimental Station, Animal Production Research Institute, Agriculture Research Center belonging to Ministry of Agriculture, Egypt. This study aimed to evaluate the possibility of replacing berseem hay either partially or completely with sun dried watermelon vine by-product either untreated or biologically treated with fungi (*Trichoderma reesei*) on digestibility, degradability and productive performance of growing lambs. The watermelon vine (WMV) was collected from Noubria area, Egypt and after harvesting the biomass was chopped (1 to 3 cm in length) and left to sun-dry for a period of 7-10 days to be reached moisture content of 10-12%.

Biological treatment:

The fungus of *Trichoderma reesei* ATCC 28217 (RS) was obtained from the Microbiological Chemistry Center (MIRCEN), Faculty of Agric.,-Ain–Shams University, Egypt. The organism was propagated and maintained on potato dextrose agar medium and the organism was grown and maintained on nutrient agar medium (Difco Manual, 1984). The optimal growth temperature for all organisms was 35 ± 1^0C. For maintenance of microorganisms agar slants of stock culture of microbial strains were kept in a refrigerator at 4^0C, and subculture was carried out every month. The purity of the cultures was regularly, microscopically tested.

Cultivation Procedures:

For preparation of fungi inoculum, *Trichoderma reesei* was first grown in a flask containing 500 ml of basal mineral medium with 1% glucose as described by Hesseltine *et al.* (1966). The flask was shaking for 72 hours in a water bath adjusted at 37^0C. Mycelium of the fungi was collected and broken into small hyphae bits using a warming blender. Inoculum, was used to inoculate a fermentor containing 50 liters of the sterilized medium (10% v/v) and adjusted at 37 ^{0}C for 72 hours. The fifty liters of fungal culture was transferred into 250 liters of a solution containing 2% molasses and 2 % urea (46.5%N). The above 250 liters were mixed well with about 250 Kg watermelon vines hay and left for 15 days as fermented period. The moisture of materials was adjusted to approximately 70%. During the fermentation period, samples were taken biweekly to determine C/N ratio to evaluate success of the biological treatment, then samples of fermented watermelon vines were oven dried to constant weight at 60 ^{0}C overnight and ground for chemical analysis. After the fermentation period, the biologically treated watermelon vines hay was dried for 5 days, before formulating the tested rations.

Fifty male Barki lambs at 6 to 8 months of age with an average live body weight 24.49 ±0.2 Kg were arranged to five groups according to live body weight (10 lambs for each). They were assigned at random on the five experimental rations. The control group was fed 50% concentrate feed mixture (CFM) plus 50% berseem hay (BH) on dry DM basis (R1). The other four groups (R2, R3, R4 and R5) were fed ration containing 25 and 50 % WMV either untreated or treated with *Trichoderma reesei*, respectively. Chemical analysis and cell wall constituents of berseem hay, untreated and treated WMV with fungus are presented in Table (1). The concentration of pesticides residues of watermelon vines was shown in Table (2), it was determinated according to method described by Kadenczki *et al*. (1992).

Animals were fed the five respective rations in two equal meals /day. The CFM was offered twice a day at 7:00 am and 2: 00 pm, while BH, untreated WMV and treated WMV with fungi were offered at 9:00 am and 4:00 pm. The feed allowances were calculated according to

NRC (2007) for sheep. The CFM used in this experiment consisted of (%) 20 Yellow corn, 19 Soybean meal, 26 Wheat bran, 25 Barely, 6 Molasses, 2 Limestone, 1.5 Salt and 0.5 Mineral premix. Its chemical compositions (%, on DM basis) was 89.36, 93.46, 15.75, 6.68, 2.96, 68.07, 6.54, 36.85, 19.55, 6.57, 17.30 and 12.98 for DM, OM, CP, CF, EE, NFE, Ash, NDF, ADF, ADL, Hemi cellulose and cellulose respectively.

Table 1. Chemical analysis and cell wall constituents of berseem hay, untreated and treated WMV with fungi (% of DM basis).

Item	BH	WMVH	WMVF
DM	88.12	87.86	86.51
OM	92.67	91.45	89.08
CP	12.76	8.63	14.57
CF	24.81	28.62	24.66
EE	1.62	1.36	1.02
NFE	53.48	52.84	48.83
Ash	7.33	8.55	10.92
NDF	56.26	63.39	59.57
ADF	37.82	47.86	45.06
ADL	8.16	11.87	9.98
Hemi-cellulose	18.44	15.53	14.51
Cellulose	29.66	35.99	35.08

BH: Berseem Hay, WMVH: Watermelon vines hay (untreated watermelon vines). WMVF: Watermelon vines treated with fungi

Table 2. Concentration (mg/kg) of pesticides residues of watermelon vines.

Item	WMVH	WMVF
Permethin	0.86	0.17
Malathion	0.69	0.14
Acetamiprid	0.36	0.06
HCB*	0.16	0.02
Lindine**	0.23	0.06
p,p' DDE ***	0.11	0.01

WMVH: Watermelon vines hay (untreated watermelon vines). WMVF: Watermelon vines treated with fungi.- * Hexachlorobenzene -gamma-hexachlorocyclohexan(γ-HCH)**
*****Dichlorodiphenyldichloroethylene**

The lambs were weighted at the start of the feeding trial and biweekly in the morning before feeding and drinking during the experimental period. Fresh water was available all time. At the end of experimental period three adult male Barki sheep for each group were housed in metabolic crates for each treatment to carry out the digestibility trials. Sheep were kept on rations for a preliminary period of 21 days followed by 7 days for total feces and urine collection. Sub samples (20%) of feces and urine were taken once daily then stored at 18 ˚C until analysis. Fecal samples were dried at 60˚C for 72 hrs. Feed and fecal samples were ground and a sample (50 gm./sample/treatment/ sheep) was taken for analysis.

Samples of feed and feces were analyzed for crude protein (CP), crude fiber (CF), ether extract (EE) and ash, while the urine samples were analyzed to determine its content of nitrogen (N) according to AOAC (2005). Cell wall constituents were determined for neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) using Tecator Fibretic System according to Van Soest *et al.* (1991). Hemicellulose and cellulose were calculated by differences. Values of the total digestible nutrients (TDN) were calculated according to the classic formula of Maynard *et al.* (1979) on a dry matter basis (DM).

Nylon bags technique was used to determine the degradability of DM, OM, CP and CF for the tested roughages by using three fistulated ewes. Approximately, each bag containing 5g of ground samples of each roughage and incubated in the ventral part of the rumen and were removed after 3,6,12, 24, 48 and 72 h. Two bags (6 cm×12 cm and 53 µm pore size) were used for each incubation time. After removal from the rumen, they were washed by tap cold water with gentle squeezing until the water become clear. Zero time disappearance values obtained by washing unincubated bags in similar fashion (Ash, 1990). Bags were dried in oven at 60˚C for 48h., and DM loss was recorded for each time. Nitrogen content was also determined.

In Situ degradation data for DM, OM, CP and CF were fitted to the equation of Ørskov and McDonald (1979): $P = a + b\ (1^{-e-ct})$ where p is degradation rate at time t, a is the intercept representing the soluble fraction of DM, OM, CP or CF (time 0), b is the portion of DM, OM, CP and CF potentially degraded in the rumen, c is the rate constant of degradation of fraction b. The ruminally underrated U= 100-(a+ b). The effective degradability (ED) for tested roughages was estimated from the equation of Ørskov and McDonald (1979) as follow: ED = a + b c/ (c + k) where, k is the outflow rate assumed to be 0.03/h under the feeding condition in the current study.

Statistical analysis

Data of growth were statistically analyzed according to Snedecor and Cochran (1980) using SAS (2003).The difference between means was tested by Duncan' s Multiple Range Test (Duncan, 1955). The used model was as follows:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where:

Y_{ij}= The obsvation on the 1[th] treatment.
µ= Overall mean.
T_i= Effect of the1[th] treatment.
e_{ij} = experimental error.

RESULTS AND DISCUSSION

The biological treatment of watermelon vines with *Trichoderma reesei* was markedly reduced the contents of antinutritional factors of watermelon vines as shown in Table (3). Similar results have been reported by Walaa Attia (2011). Also, Amal Fayed *et al.* (2012) indicated that antinutritional factors as the glycoalkaloids content of potato vines was affected by biological treatment by fungi (*Trichoderma reesei*) which reduced from 218.34 to be 75.22 mg/100g dry vines.

Table 3. Concentration (mg/100g) of antinutrional factors of watermelon vines.

Item	WMVH	WMVF
Total phénols	4.66	2.17
Total tannins	2.97	0.85
Saponins	2.78	1.01
Alkaloids	38.85	21.75
Flavonoids	1.06	0.88

WMVH: Watermelon vines hay (untreated watermelon vines).
WMVF: Watermelon vines treated with fungi.

Digestibility and Feeding values:

Dry matter intake, digestion coefficients, feeding values and nitrogen utilization of experimental rations fed to sheep are illustrated in Table (4). Groups fed R1 and R4 had higher (P<0.05) DM intake than those fed R2 and R5, while animal fed R3 showed the lowest value. This may be due to the negative effect of pesticides residues and antinutritional factors in vines. The obtained results are in agreement with Hassan *et al.* (2010). The same trend was resulted for digestion coefficients in which R1 and R4 recoded higher (P<0.05) values for DM, OM, CP, EE and NFE than those of the other experimental rations. Hassan *et al.* (2010) reported that rations containing tomato haulms hay treated with fungi (*Trichoderma reesei*) fed to dairy cows recorded higher values of digestion coefficients for DM, OM, CP, EE and NEF than those fed rations contained untreated ones.

Control ration (R1) had higher values of digestion coefficients of CF, NDF, ADF and ADL than those of tested rations (R2, R3, R4 and R5), being the lowest values were associated with tested ration (R3). Also, the two tested rations whose have the two levels of treated watermelon vines (WMVF) (R4 and R5) were higher significantly in digestibilities of CF, NDF, ADF and ADL than those of tested rations that formulated with the two levels of untreated WMV (R2 and R3). Nsereko *et al.* (2002) and Hassan *et al*. (2010) they showed that the improvement in fiber fraction digestibility as a result of biological treatment may be due to the effect of cellulase enzyme of fungi, which may be responsible for the stepwise hydrolysis of cellulose to glucose. The lower (P<0.05) values of feeding values (TDN and DCP %) were recorded with R2, R3 and R5 than those of rations R1 and R4 which related to the less digestion of cellulose accompanied with of alteration of bacterial population. Significant differences with TDN and DCP % were found among some different treatments, while the difference between R1 and R4 was not significant as shown in Table (4). Data of nitrogen balance showed that group R3 had the lowest (P<0.05) value (1.93g), while in R1 and R4 had the highest values (5.95 and 4.85g, respectively). This means that treatment of WMV improved nitrogen balance.

This was reflected in better (P<0.05) N- utilization of sheep fed the tested rations. Similar results obtained by Hassan *et al*. (2010) who reported that rations containing tomato haulms hay treated with fungi (*Trichoderma reesei*) fed to dairy cows recorded higher values of nitrogen balance than those fed rations contained untreated ones.

Table 4. Feed intake, digestion coefficients, feeding values and nitrogen utilization of experimental rations fed to sheep.

Item	R_1	R_2	R_3	R_4	R_5	SEM	*P Value*
Feed intake, g/h/d:							
CFM	446.80	448.20	449.60	445.90	444.60		
Hay	488.19	194.93	-	270.64	-		
WMV	-	173.84	338.39	211.12	413.70		
TDMI	934.99^{a}	816.97^{b}	787.99^{c}	927.66^{a}	858.30^{b}	8.93	0.004
Digestion coefficients, %							
DM	63.33^{a}	57.62^{b}	53.81^{c}	64.02^{a}	58.63^{b}	0.39	0.002
OM	66.33^{a}	61.02^{b}	57.57^{c}	66.93^{a}	61.83^{b}	0.34	0.006
CP	65.27^{a}	56.89^{c}	49.20^{d}	65.32^{a}	56.30^{c}	0.45	<0.001
CF	60.67^{a}	50.01^{c}	43.75^{d}	57.73^{b}	51.31^{c}	0.61	<0.001
EE	68.78^{a}	64.22^{b}	59.24^{c}	68.30^{a}	59.26^{b}	0.29	0.016
NFE	68.05^{b}	64.88^{d}	62.91^{e}	70.06^{a}	66.13^{c}	0.33	<0.001
NDF	65.50^{a}	58.31^{c}	52.97^{e}	61.94^{b}	56.28^{d}	0.47	<0.001
ADF	57.98^{a}	50.28^{c}	43.11^{c}	53.26^{b}	47.99^{b}	0.31	0.011
ADL	54. 33^{a}	52.13^{c}	41.87^{e}	53.41^{b}	44.70^{d}	0.51	<0.001
Feeding values, (%)							
TDN	63.65^{a}	58.50^{b}	54.96^{c}	63.63^{a}	52.95^{d}	0.31	0.001
DCP	9.25^{a}	7.68^{c}	6.23^{d}	9.37^{a}	8.64^{b}	0.05	0.001
Nitrogen utilization, g/day							
NI	21.39^{a}	17.66^{c}	15.97^{d}	19.60^{b}	21.24^{a}	0.15	0.001
N urine,	7.97^{b}	6.71^{d}	6.93^{d}	7.55^{c}	8.56^{a}	0.13	0.001
N feces,	7.49^{dc}	7.61^{c}	8.11^{b}	7.19^{d}	9.20^{a}	0.09	0.001
NA	13.96^{a}	10.05^{d}	7.86^{e}	12.41^{b}	11.96^{c}	0.42	<0.001
NB	5.95^{a}	3.32^{c}	1.93^{d}	4.85^{b}	3.27^{c}	0.13	0.001
NB/NI	27.99^{a}	18.89^{c}	12.09^{d}	24.77^{b}	16.02^{c}	0.96	<0.001
NB/NA	42.89^{a}	33.16^{b}	24.55^{d}	39.11^{a}	28.45^{c}	1.47	<0.001

a,,b,c,d and e Means within rows with different superscripts are significantly different (P<0.05).
TDMI: Total feed intake during digestibility trials.- R1: 50% CFM + 50% BH as control ration.
R2: 50% CFM + 25% BH+25% WMVH (untreated WMV)
R3: 50% CFM + 50% WMVH (untreated WMV)
R4: 50% CFM + 25% BH+25% WMV treated with fungi (Trichoderma reesei).
R5: 50% CFM + 50% WMV treated with fungi (Trichoderma reesei)

Degradation kinetics:

Estimates of ruminal degradation constants (a, b and c) and effective degradability (ED) fitted with rates of DM, OM, CP and CF disappearance of tested roughages are presented in Table (5). Results demonstrated that predicted constants were considerably the lowest for R3 in comparison with control (R1) and the other tested rations R2, R4 and R5 for DM, OM, CP and CF degradability.

Though R1 and R4 had more soluble, degradable fractions (a & b), lower undegradable fraction (u) and more effective degradability (ED) than those found with R2, R3 and R5 rations. The great degradation effect of rumen microorganism helps the animal to tolerate considerable concentrations of the pesticides and antinutritional factors, Hassan *et al*. (2010) reported that rations contain tomato haulms hay treated with fungi (*Trichoderma reesi*) had more soluble and degradable fraction (a & b), lower undegradable fraction (u) and more effective degradability (ED) than in untreated one. Generally, R4 which contained 25% WMV treated with fungi appeared to higher ruminal degradation constant and higher effective degradability (ED) with lower undegradable fraction. The current results are in harmony with the finding s obtained by Yacout *et al.* (2016) concluded that inoculated sweet potato vines with lactic acid bacteria could be overcome the harmful effect of antinutritional compounds and consequently improving the performance pregnant Barki ewes.

Table 5. Degradations kinetics of DM, OM, CP and CF for experimental watermelon vines for sheep fed the experimental rations.

Item	R_1	R_2	R_3	R_4	R_5	SEM	*P Value*
DM							
a %	10.72^{a}	9.25^{b}	8.07^{c}	10.21^{ab}	9.24^{b}	0.36	0.027
b%	72.89^{a}	70.28^{b}	63.84^{c}	71.77^{ab}	70.51^{b}	0.42	0.036
a +b%	83.61^{a}	79.80^{b}	71.91^{c}	81.98^{ab}	79.75^{b}	0.68	0.029
c %	0.046^{a}	0.036^{b}	0.031^{b}	0.045^{a}	0.043^{a}	0.002	0.043
U	16.39^{c}	20.20^{b}	28.09^{a}	18.02^{bc}	20.25^{b}	0.83	0.011
ED DM%	54.65^{a}	47.69^{d}	41.99^{e}	53.29^{b}	50.61^{c}	0.20	<0.001
OM							
a %	13.80^{a}	10.21^{c}	8.94^{d}	12.03^{b}	10.74^{c}	0.16	0.019
b%	71.53^{a}	65.92^{b}	64.93^{c}	66.44^{b}	65.96^{b}	0.29	0.025
a +b%	85.33^{a}	76.13^{c}	73.87^{d}	78.47^{b}	76.70^{c}	0.36	0.033
c %	0.046^{b}	0.051^{a}	0.035^{c}	0.052^{a}	0.052^{a}	0.01	0.013
U	14.67^{d}	23.87^{b}	26.13^{a}	21.53^{c}	23.30^{b}	0.30	0.018
ED OM%	59.66^{a}	52.37^{b}	44.07^{c}	54.21^{b}	52.31^{b}	1.28	0.009
CP							
a %	9.58^{a}	8.54^{b}	7.02^{c}	9.35^{a}	8.97^{ab}	0.20	0.045
b%	46.41^{a}	43.95^{c}	42.10^{d}	45.71^{b}	44.49^{ab}	0.43	0.012
a +b%	56.15^{a}	52.48^{c}	49.11^{d}	55.06^{b}	52.91^{c}	0.31	0.036
c %	0.044	0.045	0.045	0.045	0.044	0.001	0.744
U	43.85^{c}	47.52^{b}	50.89^{a}	44.94^{c}	47.09^{b}	0.32	0.015
ED CP%	37.28^{a}	34.96^{c}	32.30^{d}	36.58^{b}	35.25^{c}	0.48	0.005
CF							
a %	6.45^{a}	5.96^{b}	4.58^{c}	6.25^{b}	5.93^{b}	0.13	0.024
b%	45.80^{a}	42.68^{c}	39.01^{e}	44.29^{b}	40.97^{d}	0.28	0.002
a+b%	52.28^{a}	48.64^{c}	43.59^{e}	50.54^{b}	46.91^{d}	0.25	0.001
c %	0.053^{a}	0.047^{b}	0.053^{a}	0.054^{a}	0.047^{b}	0.001	0.008
U %	47.72^{e}	51.36^{c}	56.41^{a}	49.46^{d}	53.09^{b}	0.31	0.002
ED CF%	35.79^{a}	32.04^{c}	29.68^{e}	34.79^{b}	31.31^{d}	0.14	0.001

a,b, ,c ,d and e Means within rows with different superscripts are significantly different (P<0.05).
a= soluble fraction (%) - b= potentially degradable fraction (%)- c= rate of degradability (% h- 1) - u = rumen undegradable fraction {100-(a+b)} – ED=effective degradability(%)

Growth performance:

Data in Table (6) showed that the final body weight (FBW), total body weight gain (TBWG) and average daily gain (ADG) of lambs fed R1 and R4 recorded the highest values, showing significantly (P<0.05) higher values than those of the other experimental dietary treatments (R2, R3 and R5), non-significant differences between the control ration (R1) and the tested ration (R4) respecting the growth performance items. Allam *et al*. (2006) showed that growing lambs fed on fungally treated roughages recorded the highest daily gain compared with control groups, but El-Banna *et al*. (2010) reported that daily gain of sheep fed on bean straw treated with brown rot fungi (*T. reesei* / F-418) was less than those fed on the untreated bean straw. Amal Fayed *et al*. (2012) reported that FBW, TBWG and ADG for growing lambs fed ration contained potato vine treated with fungi (*Trichoderma reesei*) was found to be significantly (P<0.05) higher than the those fed ration contained untreated one. Ration R3 had significantly (P<0.05) the lowest values for all growth performance values. These result might be attributed to the higher feed intake value of lambs fed R4 followed by R1 compared with the other experimental groups, while lowest values of DMI was recoded with R3 that fed ration contained 50% of WMVH. Amal Fayed *et al*. (2012) obtained similar results when they were compared between untreated and biologically treated potato vine. Hassan *et al*. (2010) showed that the lower intake of untreated tomato haulms ration may be due to the effect of pesticide residues which may alter the bacterial population in the rumen. "On the other side, El-Banna *et al*. (2010) reported that total DMI of bean straw treated with brown rot fungi (*T. reesei* F-418) was significantly decreased from 1554 to 1306 g /h/d, compared with the untreated bean straw with sheep.

Table 6. Feed intake and daily gain for growing lambs fed the experimental rations.

Item	R_1	R_2	R_3	R_4	R_5	SEM	*P Value*
Initial body weight, Kg	24.67	24.32	24.37	24.40	24.67		
Final body weight, Kg	58.04^{a}	50.78^{b}	47.02^{c}	57.76^{a}	50.41^{b}	0.53	0.001
Total weight gain, Kg	33.37^{a}	26.46^{b}	22.65^{d}	33.36^{a}	25.74^{c}	0.87	0.004
Average daily gain, g/d	198.63^{a}	157.50^{b}	133.24^{d}	198.57^{a}	153.21^{c}	1.32	<0.001
Dry matter intake, g/d*:*							
CFM	838.62	841.22	843.35	833.11	837.41		
BH	538.18	284.68	-	277.28	-		
WMV	-	169.10	350.55	289.60	499.83		
Total DMI, g/day	1376.80	1295.00	1193.90	1399.99	1337.24		

a,b,c and d Means within rows with different superscripts are significantly different (P<0.05).

Feed conversion and economic efficiency

The results of feed conversion and economic efficiency of that fed to the growing lambs the experimental rations are shown in Table (7). The best feed conversion (FC), (g DMI/g gain) was recorded with animals fed R1 followed by R4 which was significantly (P<0.05) better than R2 and R5. The values of feed conversion recorded 6.93 and 7.05 for R1 & R4 versus 8.22 & 8.73 for R2 and R5 respectively, while R3 had the worsest one (8.96) among all experimental rations. El-Marakby (2003) found that lambs fed wheat straw treated with fungi ration, recorded better feed conversion value than those fed the control (untreated one). El-Banna *et al*. (2010) reported that the feed conversion of the sheep fed on the treated bean straw with brown rot fungi (*T. reesei* F-418) was increased compared to those fed on the untreated bean straw. Average feed cost decreased by 11.98 and 25.62 % for R2 & R3 (rations which contained 25 or 50 % untreated watermelon vines) respectively, and 11.78 & 24.59 % for R4 and R5 (rations which contained 25 or 50% watermelon vines treated with fungi) respectively, compared with control one. The economic efficiency improved by 23.64% for R4 compared with control group and the other experimental groups. The current results are in harmony with the findings obtained by Saleh *et al.* (2003) concluded that rations contain 25 or 45% of watermelon vine hay (WMVH) showed cheaper values than control ration (CFM +50% BH). The higher values of daily gain and daily feed intake of lambs fed R4 were reflected on more feed economic and relative economic efficiency compared with other experimental groups. The 50 % treated WMV ration (R5) was come into the second orders for feed economic and relative economic efficiency parameters. In relation to these results, Amal Fayed *et al*. (2012) showed that the highest values of feed economic and relative economic efficiency were recorded for growing lambs fed rations contained potato vine treated with fungi *(Trichoderma reesei)*, in comparison with the untreated one.

Allam *et al*. (2006) found that animal groups fed biologically treated corn stover were more efficient than those fed the untreated one. Saleh *et al*. (2003) reported that lactating buffaloes fed rations contain 25 or 45% of watermelon vine hay (WMVH) had better economic efficiency than control one (CFM +50% BH).

Table 7. Feed conversion and economic efficiency by growing lambs fed the experimental rations.

Item	R_1	R_2	R_3	R_4	R_5	SEM	*P Value*
Feed conversion (g DMI/g gain)	6.93^{d}	8.22^{b}	8.96^{a}	7.05^{c}	8.73^{b}	0.36	0.001
Average feed cost, LE/h/d	4. 84	4.26	3.60	4.27	3.65		
Average revenue of daily gain, LE	11.12	8.82	7.46	11.12	8.58		
Net feed revenue, LE	6.28	4.56	3.86	6.85	4.93		
Economic efficiency	129.75	107.04	107.22	160.42	135.07		
Relative economic efficiency %	100	82.50	82.63	123.64	104.10		

a,b,c and d Means within rows with different superscripts are significantly different (P<0.05). Price of 1 ton CFM = 4100 L.E., Price of 1 ton BH = 2600 L.E., Price of 1 ton untreated WMV = 400 L.E., Price of 1 ton treated WMV with fungi = 435 L.E and market price of 1 kg live body weight = 56 L.E at time of experimentation

CONCLUSION

The biological treatment of watermelon vines by the fungus (*Trichoderma reesei*) could reduce the antinutrional factors content and improvement their nutritive value. Therefore, the possibility of replacing berseem hay by biologically treated vegetables residues such as watermelon vines hay up to 50% in the rations of growing lambs could be done without any adverse effects on growth performance and economic efficiency, as well as, it can help in clean environment.

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تحسين القيمة الغذائية لعروش البطيخ واثر ذلك على الاداء الانتاجى للحملان النامية .

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يهدف هذا البحث الى دراسة مدى تاثير المعاملة البيولوجية بالفطر على تحسين القيمة الغذائية و ايضا التخلص من المواد المثبطة لعروش البطيخ وكذلك دراسة تأثير الإحلال الجزئى او الكلى لدريس البرسيم بعروش البطيخ (الغير معاملة والمعاملة بفطر التريكوديرما) و اثر ذلك على الأداء الإنتاجى للحملان النامية وقد تم استخدم 50 حمل برقى بمتوسط وزن20و ± 49و24 كيلو جرام قسمت بشكل عشوائى الى خمسة مجاميع متساوية (10 حيوانات فى كل مجموعة). و كانت المعاملات الغذائية كالأتى: المجموعة الاولى: 50% علف مركز +50 % دريس البرسيم (كنترول). المجموعة الثانية: 50% علف مركز+25 % دريس البرسيم+ 25% عرش البطيخ غيرمعامل المجموعة الثالثة : 50% علف مركز +50% عرش البطيخ غيرمعامل. المجموعة الرابعة: 50% علف مركز+ 25% دريس البرسيم+ 25% عرش البطيخ معامل بالفطر. المجموعة الخامسة: 50% علف مركز +50% عرش البطيخ معامل بالفطر . و استمرت التجربة لمدة 6 اشهر وتم إجراء تجارب الهضم باستخدام 3 كباش تامة النمو لكل مجموعة لتقدير كلا من معاملات الهضم و القيمة الغذائية و المهضوم من البرونين الخام وتم استخدام 3 نعاج مزودة بفستيولات الكرش لقياس معدل تحلل المادة الجافة و العضوية و البروتين و الالياف فى الكرش . و اوضحت النتائج ان المعاملة بالفطر لعرش البطيخ أدت الى انخافض نسبة مضادات التغذية فى العرش بنسبة حوالى 53% للفينولات الكلية و 71% للتانينات الكلية و63% للصابونين و 44% لاشباه القلويات و16 % لمركبات الفلافونيدات. حققت المجموعة الرابعة (25% دريس البرسيم+ 25% عرش البطيخ المعامل بالفطر + 50 % علف مركز) افضل النتائج بالنسبة الماكول الكلى من المادة الجافة و الزيادة اليومية فى وزن الحيوانات و معاملات الهضم و ميزان الازوت ومعدل تحلل المادة الجافة و العضوية و البروتين و الالياف فى الكرش وكفاءة التحويل الغذائى و الكفاءة الاقتصادية مقارنة بالكنترول و بباقى المجموعات التجريبية الاخرى و خاصة المجموعة التجريبية الثالثة (50% عرش البطيخ الغيرمعامل + 50 % علف مركز) و التى سجلت اقل قيمة بالنسبة لكلا من الماكول الكلى من المادة الجافة و الزيادة اليومية فى وزن الحيوانات و معاملات الهضم و ميزان الازوت ومعدل تحلل المادة الجافة و العضوية و البروتين و الالياف فى الكرش وكفاءة التحويل الغذائى و الكفاءة الاقتصادية مقارنة بالكنترول. يستخلص من هذا البحث بانه يمكن الأستفادة من مخلفات زراعة البطيخ (العروش) و التى تعد من أحد مصادر تلوث البيئة و ذلك برفع قيمتها الغذائية و التخلص من المواد المثبطة عن طريق المعاملات البيولوجية بفطر التريكوديرما. فقد أمكن استخدامها بنجاح فى تغذية الحملان النامية بادخالها فى العليقة بنسبة تصل الى 25% (كاحلال جزئى من دريس البرسيم بنسبة تصل الى(50%) بما يساهم فى التغلب على مشكلة تغذية الحيوانات بتقليل التكلفة الاقتصادية والأستفادة من المخلفات الزراعية مع الحافظ على نظافة البيئة