Egyptian J. Nutrition and Feeds (2012), 15 (1): 261-271

IMPROVING OF NUTRITIVE VALUE OF POTATO VINES BY BIOLOGICAL TREATMENTS AND ITS EFFECT ON SMALL RUMINANTS PRODUCTION PERFORMANCE.

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(Received 2/4/ 2012, Accepted 3/7/ 2012)

SUMMARY

This experiment was conduced to study the effect of using biological treatment by fungi (*Trichoderma ressei*), bacteria (*Thermonospora fusca*) and (*Cellulomonas cellulose*) to reduce glycoalkaloids content (antinutrional factors) in potatoes tops and improvement their nutritive value and the feasibility of using biological treated vegetable residues (potato vines) in animal nutrition and their effects on productive performance of growing sheep. Twenty growing Barki male sheep with initial live body weight of 25.50± 1.1 Kg/head) (five months old) were used in this study for 90 days. Animals were blocked by body weight and randomly assigned to one of four treatments. They were individually fed on experimental diets. Animals of each group were fed on concentrate feed mixture at 2% of body weight (on DM basis). While untreated and biologically treated Potato vines hay with fungi and bacteria were fed *ad libitum*. R1 group were fed untreated Potato vines hay plus concentrate feed mixture (CFM) and serve as control, R2, R3 and R4 groups were fed biologically treated potato vines with fungi and bacteria, respectively plus concentrate feed mixture (CFM). Daily diets were offered individually at 8.00a.m. and 4p.m in two equal portions. Animals were weighed biweekly at before the morning meal. During the trial, amounts of feed offered and refusals for each animal were weighed daily and recorded and all animals had free access to fresh water. Blood samples were collected at the end of the collection period. A digestibility trial was conducted to determine the digestibility coefficient and nutritive value of the rations using four adult male Barki sheep weighing approximately 50±2Kg body weight were ranked in a 4x4 Latin square design for digestibility trials. The results showed that degradation of Glycoalkaloids was reduced most by treatment with fungi (*Trichoderma ressei*) and to a lesser extent by (*Thermonospora fusca*) and (*Cellulomonas cellulose*) bacteria. Treatment with fungus increased digestibility the most as compared to the two other treatments. The ration containing potato vines treatment with fungus had greater dry matter and component digestibilities than the treatment with bacteria R2 had better ($P<0.05$) fiber fraction digestibility and nutritive value, blood parameters followed by R3 and R4 compared with R1. Rations containing potato vines treated with fungus supported the greatest body weight gains and had greater concentrations of volatile fatty acids and ammonia as compared to the other treatments. The results indicated the feasibility of using biologically treated potatoes tops in growing sheep nutrition to reduce fed costs without harmful effects on performance.

Keywords: *biological treatment; potatoes vines; digestibility coefficients; nutritive value; rumen and blood parameters; feeding lambs.*

INTRODUCTION

Forages are the cheapest source of livestock feeding in developing countries (Bilal, 2008) and Egypt is not an exception. Besides forages other agricultural residues are second major source of feeding for livestock feed. In Egypt, there are about 30 million tons of agricultural residues available per year. Locally produced feeds are not sufficient to meet the nutritional requirements of livestock feed in Egypt (Abou Akkada, 1988). Treatments that improve the nutritive value of by-products could greatly alleviate the shortage of animal feeds and subsequently increase milk and meat production. Vegetables and fruits, such as potato vines, eggplant shoot, pea tops, watermelon leaves and tomato tops all were wasted and not economically used in animal feeds. Vegetables leaves are known to be the cheapest source of essential amino acids, vitamins and minerals. But, the presence of inherent toxic factors or anti-nutritional components in certain plants is considered as one of the major obstacles in harnessing their full benefits and nutritional value (Lewis and Fenwick, 1987). Nightshade Family *(Solanaceae)* include tomatoes *(Lycoperscion esculentum)*, potatoes (*Solanum tuberosum*) and eggplants (*Solanum melongena*) leaves are known to contain glycoalkaloids. The alkaloids concentration in the foliage of the solanum species was estimated to be between 110 and 890 mg/100g in fresh weight (Vaananen, 2007). Therefore, many methods such as biological treatments are essential for improving the nutritive values of many such by-products (Gowda *et al.*, 2007) and reducing anti-nutritional factors. There are certain fungi, such as *Aspargillus parasiticus*, have been shown to degrade degrading aflatoxins, possibly through fungal peroxidases (Lopez-Garcia and Park, 1998). However, if the nutritive value of the agricultural by-products like potatoes tops can be enhanced through their biological treatments, this it can play an important role to cover nutrient requirements of the animals. It was estimates that about 13.0 million tons of total digestible nutrients (TDN) are required per year in Egypt, while only 9.6 millon tons are annually produced providing 75% of the livestock energy requirements (Agriculuture Economic and Statistics Institute, 2011). As a solution to overcome the shortage of animal feeds, scientists had suggested the use of ammonia or urea to increase the crude protein contents of the poor quality roughages to improve their nutrient digestibilities (Fouad *et al.*, 1998). Recently biological treatments using some fungi were tested to improve the nutritive value and digestibility of poor quality roughages (El-Ashry *et al.*, 1997 and Khorshed, 2000). El-Ashry *et al.* (2003) showed that the enzymatic hydrolysis produced by fungi could conversion of cellulosic materials and improve the nutritive value of crop residues especially crude protein and crude fiber. Keeping these finding in view the present study was designed to study the effect of biological treatment on improve the nutritive value of potatoes vines and its effect on productive performance of growing lambs.

MATERIALS AND METHODS

The present study was carried out at Noubria Experimental Station, By-products Utilization Department, Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture, Egypt. The experimental work lasted for 90 days. The study was conducted to investigate the possibility of biological treatments of potato vines (PV) in order to reduce the effect of ant-nutritional factors on the productive performance of sheep.

Preparation of potato vines:

Potato vines a wet (80-85%, moisture content) was sun-drying to 9-10% (DM), samples of the dried material were taken grounded by hammer mill and kept for subsequent processing.

Biological treatments:

Fungi (Trichoderma ressei):

Trichoderma ressei ATCC 28217 (RS) was obtained from the Microbiological Chemistry Center (MIRCEN), Faculty of Agric., Ain–Shams University, Kolubia, 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^{0}C. For maintenance of microorganisms agar slants of stock culture of microbial strains were kept in a refrigerator at 4^{0}C, and subculture was carried out every month. The purity of the cultures was regularly, purity of the cultures was regularly verified by microscopic tested.

Cultivation Procedures:

For preparation of fungi inoculum, *Trichoderma ressei* 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 shaked for 72 hours in a water bath adjusted at 37^{0}C. Mycelium of the fungi was collected and broken into small hyphal bits using a waring 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 potato vines hay and lifted for 15 days as fermented period. However, 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 fermented potato vines was dried at 60^{0}C over night and ground. After the fermentation period, the biologically treated potato vines were dried for 5 days, before formulating the tested rations.

Preparation of bacterial cultures:

Two strains of cellulolytic bacteria (anaerobic) were isolated from rumen fluid of sheep and were grown as pure cultural. Rumen fluid was with drown from the rumen of fistulated ewes. The separated strains were *Cellulomonas cellulose* and *Thermonospora fusca*. The isolation of species by the pour-plate technique for pure preparation of cultures according to A.T.C.C. (1992).

Ensiling (small scale silo study):

Potato vines was chopped to 2 - 4cm and mixed with water, molasses, urea (2% w/w), formic acid and acetic according to **Abdel-Galil (2000).** The samples were subjected with one of the following treatments by 1.5 liters ($7.7x10^5$) viable anaerobes/Kg of wet silage)/ton. Tested samples were pressed in 2 liters jars for laboratory use and incubated for 6 weeks.

Experimental rations:

Four experimental rations were formulated as follows:

R1: Untreated otato vines as control ration.
R2: Potato vines treated with fungi (*Trichoderma ressei*).
R3: Potato vines treated with bacteria (*Thermonospora fusca*).
R4: Potato vines treated with bacteria (*Cellulomonas cellulose*).

CFM (500g/h/day) was fed as an energy supplement during the experiment. Potato vines was offered to animals *ad libitum* twice daily at 9.00 a.m and 4.00 p.m, while CFM was given once daily at 10.00 a.m.

Digestibility trial:

Four adult male Barki sheep weighing approximately 50±2Kg BW were assigned to a 4x4 Latin square design for digestibility trials. Experimental animals were housed in four metabolic crates. Sheep were kept on rations for a preliminary period of 21 days followed 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 sample were dried at 60°C for 72 hrs. Feed and fecal samples were ground through cheese cloth 1 mm screen on a wiley mill grinder and a sample of (50 gm/sample/treatment/ sheep) was taken for analysis. The 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 A.O.A.O (1995). 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 (1982). 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.* (1978) on a dry matter basis (DM). Rumen liquor samples were taken at 0, 3 and 6 hrs after the morning meal from four fistulated adult female sheep applying 4x4 Latin square design experiment. Collected rumen liquor was directly tested for pH using Orian 680 digital pH meter. Samples were strained through four layers of chesses cloth for each sampling time, while ammonia nitrogen (NH_3-N) was determined by using magnesium oxide (MgO) as described by the A.O.A.O (1995). Total volatile fatty acid (VFA's) concentration was estimated by using steam distillation methods (Warner, 1964).

Feeding trial:

Twenty growing five month old Barki male sheep with initial body weight of 25.5 kg±1.0 kg were used in this study for 90 days. Animals were randomly divided into four similar groups according to body weights (five animals each). Animals of each group were fed on concentrate feed mixture at 2% of body weight (on DM basis). While untreated and biologically treated potato vines with fungi and bacteria were fed *ad libitum*. Daily diets were offered individually at 8.00a.m. and 4p.m in two equal portions. Animals were weighed biweekly at before the morning meal. During the trial, amounts of feed offered and refusals for each animal were daily weighed and recoded and all animals had free access to fresh water. Blood samples were collected at the end of the collection period from the jugular vein and allowed to flow into acid washed heparimized tubes and immediately centrifuged at 4000 r.p.m. for 20 minutes to separate the serum which was stored at -20°C for subsequent analysis. Total protein was measured as described by the Buiret method according to Henry and Todd (1974), total lipids according to Zollner and Kirsch (1962), albumin was determined according to Doumas *et al.* (1971), globulin was calculated as the difference between total protein and albumin. A/G ratio was calculated. Alanine aminotransferase (ALT) (u/l), aspartate aminotransferase (AST) (u/l) were measured according to Reitman and Frankel (1957).

Statistical analysis:

The data were statistically analyzed according to Snedecor and Cochran (1980) using SAS (1999). The difference between means was tested by Dancan's multiple range test (1955). The model used was as follows: $Y_{ij} + \mu + T_i + e_{ij}$

Where:
Y_{ij} = the observation on the 1^{th} treatment.
μ = Overall mean. .
T_i = Effect of the 1^{th} treatment. e_{ij} = Random experiment.

RESULTS AND DISCUSSION

Chemical analysis:

It is clearly to notice as present in Table (1) that the biological treatment with fungi (*Trichoderma ressei*), bacteria (*Thermonospora fusca*) and (*Cellulomonas cellulose*) positively increased protein content by 21.28, 15.45 and 14.43%, respectively. While CF content was reduced by 21.1, 15.64 and 15.87%, respectively, as well as its fiber fractions. EE increased by about 11.58, 28.66 and 27.43%. Ash content was increased by 16.97, 20.32 and 20.60%, respectively. Increasing of ash content may be attributed to the growth or degradation of organic matter of potato vines by microorganism in one hand and concentration of ash on the other hand (Ahamed, 1998). Because microorganism depend on these material as carbon source in growing up then converted them into microbial protein. These finding are in -agreement with Shourkry *et al.* (1985) who found that fungal treatment by *Trichoderma sp* improved the nutritive value of bagasse because the mycelia of the fungus have high cellulase activity which convert cellulosic materials into single cell protein or microbial protein and decreased DM after incubation with the fungus.

Table (1): Chemical analysis of CFM, untreated and treated potato vines with fungus or bacteria (%DM basis).

Item	Potato vines	potato vines with *T. ressei*	potato vines with *T. fusca*	potato vines with *C. cellulose*	CFM
Moisture	11.44	12.41	11.97	11.64	10.25
OM	75.44	71.27	70.45	70.38	93.23
CP	14.62	17.73	16.88	16.73	13.78
CF	13.30	10.50	11.22	11.19	5.93
EE	1.64	1.83	2.11	2.09	2.37
NFE	45.88	41.21	40.24	40.37	71.15
Ash	24.56	28.73	29.55	29.62	6.77
NDF	33.40	31.25	32.92	32.85	24.64
ADF	24.01	22.10	23.81	23.85	11.74
ADL	11.25	11.32	11.80	11.69	4.73
Hemicellulose*	9.39	9.15	9.11	9.06	12.90
Cellulose**	12.76	10.78	12.01	12.10	7.01

* *Hemicellulose: NDF – ADF.* ** *Cellulose: ADF – ADL.*

These results were found to be in-agreement with Warren (1996), who stated that the microorganisms are efficient enough to degraders starch, chitin, and polysaccharides in plant cell walls as carbon and energy reserves in plant as they have the capability hydrolysis polysaccharides to metabolizable products. The present indicated that biological treatment with fungi (*Trichoderma ressei*), bacteria (*Thermonospora fusca*) and (*Cellulomonas cellulose*), decreased the OM, CF, NDF and ADF and increased CP and ash contents in potato vines. Similar results were recorded by Mahrous (2005) and Zaza *et al.* (2008) as they treated cotton stalks with *T. viride* or date kernels with *T. harizianum.* They found that OM, CF, NDF and ADF were decreased but CP and ash were increased. Also, Ghoneem (2010) stated that treatment bean straw with *T. ressei*, for 14 days decreased CF, NDF and ADF by 33.7, 14.4 and 9.99% and increased CP by 294.3%. On the other hand, NDF content was decreased by 15.77, 17.53, 17.99, 19.85, 17.17, 15.81 and 17.51%, respectively. Reduction in NFE could be related to the use of these carbohydrates by the microorganism as energy sources for their growth and multiplication. These finding are in agreement with those of Villas-Boas *et al.* (2002) who reported that, biological treatment is used for increasing the nutritional value of many by-products, because they have significant concentrations of simple carbohydrates, such as mono-and disaccharides. For these reason the microbial conversion of these wastes can improve their nutritional value and transforming them into animal feed with reasonable feeding value.

Carbon and nitrogen ratio (C/N Ratio):

Results of carbon and nitrogen ratio of non-treated and biologically treated potato vines are showed in Table (2). It was clear that C:N ratio declined with advancing fermentation time the more pronounced one was found for fungi treatment (9.62:1), followed by the both bacteria treatments. The less declined was obtained with the untreated one (13.25:1) after 21 days. This result is confirmed by Richard (1997) who found that grass clipping contained (C/N) ratio between 9-25. This value decreased after conducting biological treatment. Results given in Table (3) showed that (C/N) ratio of potato vines as affected by fungi (*Trichoderma ressei*), bacteria (*Thermonospora fusca*) and (*Cellulomonas cellulose*) during the composting process.

Table (2): Effect of biological treatments on C: N ratio.

Rations	Zero time	7 days	15 days	21 days
R1	17.91:1	15.35:1	14.42:1	13.25:1
R2	13.94:1	12.82:1	11.73:1	9.26:1
R3	14.48:1	13.22:1	12.31:1	10.42:1
R4	14.60:1	13.83:1	13.11:1	11.26:1

The reduction of (C/N) ratio can be attributed to the loss in total dry mass due to losses of C as Co_2 (Hamoda *et al.*, (1998). Ammonium-N (NH_4-N) and nitrate-N (NO_3-N) will also undergo some changes. NH_3 levels were increasing in the initial stages but declining towards the end Liao *et al.* (1995). These results were supported by Richard (1997) who reported that C/N ratio decreased during the composing process, with the ratio of finished compost typically close to 10/1. Moreover, Saidi *et al.* (2008) reported that, the C/N ratio ranged between 22 and 27/1 at the beginning of the cycle of compositing and decreased during the composing process. At the end of process, the C/N ratio varied between 10-15/1.

Glycoalkaloids content:

Resulted of Table (3) showed the total glycoalkaloids (TGA) content of untreated and biologically treated Potato vines. It noticed that untreated potato vines contained 218.34mg/100g glycoalkaloidsin in the dry vines. These results coincided with Nicholson *et al.* (1987) who found that the TGA levels in dry potato vines were 184 and 224 mg/100g. However, glycoalkaloids content of potato vines was reduced by about 55.57% as affected by fungi treatment (*Trichoderma ressei*), 65.55% by bacteria (*Thermonospora fusca*) and 64.68% by bacteria (*Cellulomonas cellulose*).

Table (3): Glycoalkaloids content of untreated and biologically treated potato vines.

Item	Experimental rations			
	R1	R2	R3	R4
Glycoalkaloids, mg/100g dry potato vines	218.34	75.22	77.12	79.01

These results are in agreement with Martin (1977) who stated that many bacteria are capable of utilizing steroids as a sole carbon and energy source, by degrading steroids completely to carbon dioxide and water. Also, Pilnik and Voragen (1993) found that *Trichoderma Sp.*, in particular strain of *T. harzianum or T. reesi; Aspergillus Sp.,* in particular strain of *Aspergillus aculeatus; Aspergillus awamori; Aspergillus oryzae; Aspergillus iaponicus or Aspergillus niger* and strains of *Fusarium Sp.* were produced rhamnosidase enzyme. In this respect, Bushway *et al.* (1990) found that rhamnosidase could able to liberate the rhamnose units from both alpha-solanine and alpha chaonine (both being glycoalkaloids resent in potato). Also, Keukenes *et al.* (1995) stated that removal of either rhamnose molecules from α-chaconine destroys the ability of α-chaconine to disrupt membranes and so is likely to represent a detoxification event. Moreover, Vesela *et al.* (2003) found that 1.4 -2.24x10^8 CFU/ml of *Lactobacillus plantarum* (976H) could degraded glycoalkaloids at temperature of 30°C for 120h.

Digestibility coefficients and nutritive value:

Dry matter intake, apparent digestion coefficients, feeding values and nitrogen utilization are presented in Table (4). Potato vines biologically treated by fungi (*Trichoderma ressei*) (R2); by bacteria (*Thermonospora fusca*) (R3) and by (*Cellulomonas cellulose*) (R4) had higher ($P<0.05$) DM intake than those fed untreated potato vines (R1). The lower intake from untreated potato vines (R1) ration may be due to the effect of high content of glycoalkaloids. These results coincided with the work of Nicholson *et al.* (1987) whom found that the glycoalkaloids levels in dry potato vines were 184 to 224 mg/100g. Salama *et al.* (2011) showed that animals fed ration contain untreated potato vines recorded lower DM intake than those fed potato vines treated with fungi or bacteria.

Results given in Table (4) showed the digestibility coefficients, nutritive values and nitrogen utilization of nutrients as affected by different experimental rations. Rams fed potato vines treated with fungi (R2), bacteria (*Thermonospora fusca*) (R3) or (*Cellulomonas cellulose*) (R4) showed significantly higher ($P<0.05$) digestion coefficients of DM, OM, NFE, hemicellulose and cellulose compared those fed the control group (R1). While fungus groups had higher ($P<0.05$) digestion coefficients of CP, CF, EE, NDF, ADF and ADL than all other groups. These were reflected on nutritive values (TDN and DCP), whereas, R2 had higher (P<0.05) TDN and DCP values. These results could be due to the more feed intake by groups of rams fed the treated potato vines and the less contain of glycoalkaloids. Khalel *et al.* (2008) reported that using jojoba meal treated with *Trichoderma ressei* in sheep ration significantly increased digestibility of DM, OM, CP, CF, EE, NFE, DCP and TDN. Rams fed on R2, R3 and R4 had higher (P<0.05) values of nitrogen utilization compared with the control group (R1). R2 group was significantly increased than R3 and R4 for N intake, N-absorbed and N-retention without significantly difference between (R3) and (R4).

Table (4): Dry matter intake, digestibility coefficients, nutritive values and nitrogen utilization of experimental rations (mean±SE).

Item	Experimental rations			
	R1	R2	R3	R4
DM intake, g/h/d:				
CFMI, g	699.69±20.55	699.82±5.52	701.23±9.13	704.91±4.04
Potato vines, g	387.12±10.68^{c}	499.79±6.13^{a}	475.09±10.58^{b}	468.31±6.75^{b}
Total DMI, g	1086.81±21.84^{b}	1199.61±9.64^{a}	1176.32±12.73^{a}	1173.22±11.94^{a}
Digestibility coefficients (%):				
DM	54.78±1.28^{b}	64.05±0.79^{a}	62.75±0.44^{a}	63.06±0.80^{a}
OM	59.57±1.26^{b}	68.18±0.48^{a}	67.20±0.39^{a}	67.55±0.61^{a}
CP	55.09±1.09^{c}	68.28±0.12^{a}	64.04±0.92^{b}	62.52±1.05^{b}
CF	54.92±1.38^{c}	65.83±0.51^{a}	62.60±0.45^{b}	62.71±0.93^{b}
EE	59.00±0.60^{b}	68.43±0.54^{a}	61.82±0.85^{b}	61.17±0.65^{b}
NFE	61.59±1.40^{b}	68.78±0.57^{a}	68.84±0.43^{a}	69.42±0.55^{a}
NDF	47.84±1.85^{c}	62.77±0.84^{a}	59.67±0.55^{b}	59.41±0.82^{b}
ADF	44.49±0.96^{c}	59.63±1.88^{a}	58.11±0.93^{b}	57.77±0.76^{b}
ADL	41.77±2.75^{c}	55.41±1.63^{a}	52.83±1.77^{b}	52.04±0.99^{b}
Hemicellulose	49.86±2.64^{b}	64.95±1.77^{a}	61.68±1.76^{a}	60.88±2.54^{a}
Cellulose	43.87±1.76^{b}	60.05±1.54^{a}	58.57±1.76^{a}	57.94±1.65^{a}
Nutritive values (%):				
TDN	55.52±1.19^{c}	62.47±0.43^{a}	60.18±0.35^{b}	59.44±0.60^{b}
DCP	5.65±0.15^{c}	8.54±0.02^{a}	6.81±0.11^{b}	6.13±0.09^{b}
Nitrogen utilization (g/h/d):				
N-Intake	17.85±0.42^{c}	24.01±0.17^{a}	19.84±0.25^{b}	19.56±0.12^{b}
N-Absorbed (NA)	9.84±0.41^{c}	16.40±0.14^{a}	12.71±0.33^{b}	11.60±0.26^{b}
N-Retention (NR)	2.79±0.11^{c}	6.62±0.14^{a}	5.42±0.12^{b}	5.15±0.05^{b}
NR % of NI	15.60±0.29^{b}	27.57±0.37^{a}	27.33+0.74^{a}	25.72±2.08^{a}
NA % of NI	28.34±0.53^{b}	40.37±0.49^{a}	42.70±1.33^{a}	41.05±2.67^{a}

^{abc} *Means within rows with different superscript are significantly differ (P<0.05).*

Rumen parameters:

Ruminal pH values were found to be insignificant differences (P>0.05) among the experimental rations (Table 5). The values were declined at 3hrs post feeding, then it raised up at 6hrs post feeding. There were followed the concentration of TVFA's in the rumen, however R2 rations had the highest (P<0.05) TVFA's concentration compared to other rations. The same trend was noticed for ruminal NH_3-N concentration. The control ration found to have lower values of NH_3-N and TVFA's concentration. These data could be related the more proteolytic activity (Ørskov, 1992 and Yadov and Yadav (1988) and the more release of enzymes by the fungus compared to the other two bacteria used in this study, in the meantime, the more fermentation process of potato vines.

Our results are in agreement with that obtained by Salem (1980) who found that TVFA's concentration in the rumen was low before feeding and increase with time depending on type and physical consistency of the ration. Allam *et al.* (2006) reported that the TVFA's concentration in rumen is governed by several factors such as DM digestibility, rate of absorption, rumen pH, transportation of the digesta from the rumen to other parts of the digestive tract and the microbial population in the rumen in the rumen and their activities. El-Sayed *et al.* (2002) found that fed Balady goats on rations contained 25% cotton stalks biologically treated with *T. viride* and *Saccharomyes cervisiae* or both, increased TVFA's and ammonia concentration compared to the untreated cotton stalks.

Table (5): Rumen liquor parameters of experimental rations (mean±SE).

Item	Time Hrs.	Experimental rations R1	R2	R3	R4
pH	0	6.78±0.53	6.63±0.41	6.69±0.39	6.67±0.44
	3	6.26±0.22	6.21±0.07	6.24±0.11	6.24±0.09
	6	6.63±0.17	6.60±0.19	6.62±0.17	6.60±0.10
NH_3-N concentration	0	9.88±0.13^c	11.94±0.33^a	10.61±0.04^b	10.44±0.11^b
(mg/100ml)	3	11.28±0.25^c	14.36±0.26^a	12.47±0.22^b	12.39±0.21^b
	6	10.42±0.18^c	12.52±0.17^a	11.03±0.13^b	11.10±0.09^b
TVFA's concentration	0	5.83±0.09^c	7.82±0.18^a	7.15±0.08^b	7.03±0.05^b
(meq./100ml)	3	7.45±0.11^c	9.68±0.33^a	9.04±0.14^b	8.94±0.19^b
	6	6.62±0.19^c	7.99±0.21^a	7.47±0.22^b	7.36±0.07^b

^{abc} *Means within rows with different superscript are significantly differ (P<0.05).*

Blood parameters:

The effect experimental rations on some blood plasma parameter of lambs are shown in Table (6). Data revealed that plasma total protein, albumin and globulin were significantly (P<0.05) affected by treatments. The overall means of plasma total protein in all treatments ranged from 6.03 to 6.44g/dl.

Table (6): Effects of biological treatments on some blood parameters of experimental rations (mean±SE).

Item	Experimental rations R1	R2	R3	R4
Total protein (g/dl)	5.39^b±0.24	6.06^a±0.02	6.44^a±0.10	6.03^a±0.06
Albumin (g/dl)	2.91^b±0.33	3.50^a±0.01	3.60^a±0.18	3.52^a±0.02
Globulin (g/dl)	2.40^c±0.16	2.56^b±0.06	2.84^a±0.19	2.51^b±0.21
A/G ratio	1.24^b±0.18	1.36^a±0.12	1.26^b±0.06	1.40^a±0.03
Cholesterol (mg/dl)	80.20^a±1.71	69.20^c±0.76	71.01^b±0.55	69.18^c±0.32
Total lipids (mg/dl)	389.20^a±4.71	335.4^c±10.40	338.0^b±6.36	338.21^b±8.60
Creatinine (mg/dl)	1.72^a±0.13	1.60^c±0.14	1.62^b±0.05	1.63^b±0.08
AST (U/L)	38.07^a±0.05	34.96^b±0.10	34.89^b±0.12	35.02^b±0.12
ALT (U/L)	69.52^a±0.02	59.10^c±0.05	62.96^b±0.11	60.11^c±0.30

^{abc} *Means within rows with different superscript are significantly differ (P<0.05).*

Animals fed ration contained untreated potato vines (R1) showed significantly increased in AST and ALT activities. AST and ALT values reflected impaired of liver function when their values increased. Also, Blackshow (1978) stated both enzyme escapes to the blood from the injured liver cells. While total protein, albumin, globulin cholesterol and total lipids contents were decreased in the treated groups compared with the control one. These declines may be due to that potato vines contain some effective materials (such as glycoalkaliods) caused a reduction cholesterol synthesis. In this respect, Lee *et al.* (1999) reported that saponins inhibit intestinal cholesterol absorption in rabbits resulting in decreased plasma and hepatic cholesterol level. However, animals fed biologically treated potato vines were recorded normal values for these blood parameters.

Growth performance:

Average of daily gain for lambs fed rations contained potato vines treated with fungi (R2) was found to be significantly higher (P<0.05)than other experimental groups Table (6). Same trend was found for dry matter intake (DMI), the reverse effect was found for the control group. However these finding were reflected on the more feed economic and relative economic efficiency for the fungus group (R2). The bacterial groups (R3 and R4) were came into the second ordes for such parameters. The depression in feed consumption with R1 could be attributed to the lower intake from untreated potato vines (R1) ration may be due to the effect of high content of glycoalkaloids.

These results coincided with Nicholson *et al.* (1987) who found that the TGA levels in dry potato vines was positively affected on the DM intake. Salama *et al.* (2011) showed that animals fed ration contained untreated potato vines were recorded lower DM intake than those fed treated potato vines with fungi, bacteria.

Table (7): Growth performance and economic efficiency (%) of lambs as affected by feeding experimental rations.

Item	Experimental rations			
	R1	R2	R3	R4
Initial number of lambs:	5	5	5	5
Body weight (g):				
Initial	25.50±1.06	25.30±1.15	25.80±0.72	25.50±1.08
Final	36.19±1.05^{c}	50.50±1.12^{a}	44.39±1.51^{b}	44.06±1.13^{b}
Total gain (Kg/h)	10.69± 0.15^{c}	25.2 ± 0.21^{a}	19.13 ± 0.07^{b}	18.56 ±0.09^{b}
Average daily gain (g/h)	118.78±0.95^{c}	280.00±0.57^{a}	212.56±0.78^{b}	206.22±0.82^{b}
Feed intake (g/head):				
Daily feed intake	1150	1250	1200	1200
Feed efficiency (feed/gain)	9.68±0.77^{a}	4.46±0.25^{c}	5.65±0.63^{b}	5.82±0.58^{b}
Feed conversion:				
Total feed intake (g)	103.5	112.5	108	108
Average Daily feed cost (LE)	1.57	1.68	1.66	1.67
Price of Daily gain (LE)	2.73	6.44	4.89	4.74
Economical return (LE/h/day)	1.16	4.76	3.23	3.07
Economic Efficiency (%)	1.74	3.98	2.95	2.84
Relative Economic Efficiency	100	410	278.45	264.66

^{abc} *Means within rows with different superscript are significantly differ (P<0.05).*

CONCLUSION

The biological treatments by the fungus *Trichoderma ressei*, bacteria *Thermonospora fusca* and Cellulomonas *cellulose* could reduce glycoalkaloids content (antinutrional factors) in potatoes vines and improvement their nutritive value. There were feasibility in using biologically treated vegetable residues such as potato vines in animal nutrition for good productive performance of growing sheep without any adverse effects and with economical profits. In the end it can help in clean environment.

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تحسين القيمة الغذائية لعروش البطاطس بالمعاملات البيولوجية وتاثيرها على الاداء الانتاجى للمجترات الصغيرة.

أمل محمد عبد المجيد فايد ، محمد حلمى محمد ياقوت ، احمد عبد الرحمن محروس ، أيمن عبد المحسن حسن و عفاف حسن زيدان

معهد بحوث الإنتاج الحيوانى - مركز البحوث الزراعية- الدقى - جيزه - مصر.

يهدف هذا البحث الى دراسة مدى تاثير المعاملة البيولوجية بالفطر او البكتيريا على تحسين القيمة الغذائية و ايضا التخلص من المواد المثبطة (الجليكوسيدات) لعرش البطاطس و مردود ذلك على الأداء الإنتاجى للأغنام النامية و لذلك استخدم 20 حمل برقى بمتوسط وزن 25.5± 1.06 كيلو جرام قسمت بشكل عشوائى إلى أربعة مجموعات تجريبية (خمسة حيوانات فى كل مجموعة) حيث تغذيت حيوانات المجموعة الأولى على عرش البطاطس غير المعامل (*ad lib.*) + العلف المركز 2% من الوزن الحى ، المجموعة الثانية على عرش البطاطس معامل بفطر *(Trichoderma reesei)* + العلف المركز ، المجموعة الثالثة على عرش البطاطس معامل ببكتيريا (*Thermonospore fusca*) + العلف المركز ، المجموعة الثالثة على عرش البطاطس معامل ببكتيريا (*Cellulomonas cellulose*) + العلف المركز. تم إجراء تجربة هضم باستخدام 20 كباش برقى تامة النمو وأضحت النتائج أن المجموعة الثانية (العروش البطاطس المعاملة بفطر*Trichoderma reesei*) حققت أفضل النتائج بالنسبة لمعاملات الهضم و القيمة الغذائية و كفاءة التحويل الغذائى و ايضا الوزن النهائى و متوسط الزيادة اليومية فى الوزن و قياسات الدم تليها المجموعتين الثانية و الثالثة مقارنة بالمجموعة الأولى (عرش البطاطس الغير معامل) .

يستخلص من هذا البحث بانه يمكن الأستفادة من مخلفات زراعة البطاطس (العروش) و التى تعد من أحد مصادر تلوث البيئة و ذلك برفع قيمتها الغذائية و التخلص من المواد المثبطة (الجليكوسيدات) عن طريق المعاملات البيولوجية. فقد أمكن استخدامها بنجاح فى تغذية الحملان النامية بما يساهم فى التغلب على مشكلة تغذية الحيوانات و الأستفادة من المخلفات الزراعية مع الحافظ على نظافة البيئة.