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SAFETY OF FEEDING BIOLOGICALLY WATERMELON VINE TO LACTATING GOATS AND ITS EFFECT ON THEIR PERFORMANCE, MILK YIELD AND PESTICIDE RESIDUE

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Abstract

This study was investigate the effect of untreated or biological treated with fungus (Trichoderma reesie) watermelon vine as a replace of berseem hay in ration of lactating goats on their performance and rumen fermentation. Twenty-five lactating goats 2-4 years old were assigned randomly to five groups (five goats in each) using a randomized complete block design. Animals fed ration contained BH plus CFM (1:1) and served as control R1, while groups R2, R3, R4 and R5 fed two levels of sun-dry watermelon vine (WMVH) or biological treated watermelon vine with fungus Trichoderma reesie (WMVF) (25 and 50 %), respectively by replacing BH in the ration. Results showed the goats fed R1 and R4 had significant ($P<0.05$) improved have been observed in milk production milk fat, protein yield, fat corrected milk (FCM) and feed conversion compared with R2, R3 and R5. The animals fed R1 and R4 were significantly ($P<0.05$) higher in NH_3-N, TVFA's concentrations and propionate than compared the other experimental ration. The animals fed R1, R4 and R5 had significantly ($P<0.05$) lower values for CO_2 and CH_4 than R2 and R3. So, it could be recommended that safety introduced of watermelon vine after treating it with fungus in diets without any adverse effect on their performance.

Key words*: *watermelon vine, berseem hay, milk yield, pesticides, biological treatment and lactating goats

INTRODUCTION

The feeding of agricultural products previously sprayed with pesticides to dairy animals is a common practice in most intensive farming systems. This is due to diversification of agricultural practices in an attempt to increase food production for the growing human population which leaves limited land for grazing animals. Such animals are therefore supplemented with crop remains after harvest (Njiru, 1996) [29].

Vegetables and dairy milk are important commodities in Egypt. However, agrochemicals are used intensively and excessively in the production system. Therefore, pesticides residues and contamination commonly occur in agricultural products and environments. Million tons of pesticides were annually applied in modern agriculture in order to increase productively through controlling insects, fungi, bacteria, viruses as well as grasses grown in between the economical crops (Liu and Xiong, 2001) [21]. However, less than 5% of these products are estimated to reach the target organisms. One of the most important problems with the use of pesticides is their possible persistence in the environment and, therefore, its possible incorporation into the food chain whereas it affects ecosystem and all human beings (Liu and Xiong, 2001) [21]. Major problem are caused from the contamination of food by pesticide, and pollution of environmental ecosystems. Presently, indoor use of pesticides for pest control is widespread in Egypt. No accurate information of the types and amounts of Egyptian household pesticide use, or numbers of contamination incidents is available. Generally, use of indoor pesticides is inadequately managed. The results of a survey of Egyptian farmer's attitudes toward pesticides and their usage behavior garnered new insights as to how pesticides should be better controlled and regulated in Egypt (Mansour, 2008) [23]. The of pesticides has been known to have environmental impacts though its residues and contamination agricultural water and sediments are suspected as the source of pesticides contamination in agriculture and animal products (Ntow, 2003) [31].

Organochlorines (OCs) are known as persistent accumulated compounds in the environment since they are–degradable (Matsumura, 1985) [24], which eventually becomes a common residue detected in food crops such as corn, cabbage, rice, tomatoes, watermelon and soybean (Soejitno, 2002) [43]. Animal products such as eggs, meat and milk have also been reported to contain pesticide residues in Egypt (Ibrahim *et al*., 1994) [18]. In Egypt, extensive use of agrochemicals has led to public health and environmental problem (Yassin *et al*., 2002) [49].

The reactions that destroy pesticides change most pesticides residues in the environment to inactive, less toxic and harmless compounds. However, degradation is detrimental when a pesticide is destroyed before the target pest has been controlled. There are types of pesticide degradation, microbial, chemical, and photo degradation. Microbial degradation is the breakdown of pesticides by fungi, bacteria, and other microorganisms that use pesticides as a food source (DebMandal *et al*., 2008) [10].

Biological treatments using some fungi (Khorshed, 2000) [19] were tested to improve the nutritive value and digestibility of poor quality roughages. El-Ashry *et al.* (2003) [12] showed that enzymatic hydrolysis by fungi and biological conversion of cellulosic materials improves the nutritive value of residues especially crude protein and crude fiber. Biological treatment with fungi (*Trichoderma resei*) is reported to be highly effective in reducing the level of pesticides. Hassan *et al.* (2010) [17] showed that biological treatment with fungi or bacteria could be advisable in order to overcome the harmful effect of tomato haulms exposure to pesticide.

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 (Bassioumi, 2001) [4]. There are a few literatures on using watermelon vines in feeding ruminants; thereby we are in need for more studies on using these byproducts in feeding farm animals. This study was carried out to evaluated:

1-The use of Biological treatment with fungi (*Trichoderma resei*) and sun-dry treatment as detoxification of pesticides residues tools from watermelon vines

2-The effect of partial replacing (25% or 50%) of beseem hay by sun-dry or biological treated water melon vine with fungi in ration of lactating goats on their performance, milk production, milk composition, rumen and blood parameters during early lactation period.

MATERIALS AND METHODS

The present study carried out at Noubria Experimental Station, Animal Production Research Institute, Agriculture Research Center, Egypt. This study conducted to investigate the effect of partial replacement of berseem hay by the untreated and biological treated watermelon vines hay (WMVH) with fungi (*Trichoderma resei*) as detoxification of pesticides residues from on performance of lactating goats.

Experimental design, animals and diets

Twenty-five lactating goats of 2-4 years old and 30.58 ±1.23 kg weight in average and in the first week of lactation assigned randomly into five groups, each of five lactating goats were used for the present investigation. Animals fed berseem hay (BH) plus concentrate feed mixture (CFM) at the ratio 1:1 on DM basis (control) (R1) and two levels of replacement with untreated and treated WMV with fungi on the expense of BH (25% and 50%). The watermelon vine was collected from Noubria area, after harvesting, chopped

(1 to 3 cm in length) and left to sundry for a period of 7-10 days reaching a moisture content of 10-12%.

Concentrate feed mixture fed as an energy supplement during the experiment. It was offered twice a day at approximately 7:00 am and 02:.00 pm, while BH and WMV offered at 9:00 am and 4:00 pm. The feed allowances calculated according to NRC (2001) [30]. Goats had unlimited access to water. Experiment started from the last month from pregnant until the second month of postpartum. 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 0.5Mineral premix. The chemical compositions of CFM, bersrrm hay (BH), untreated watermelon vine (WMVH) and treated watermelon vine with fungi (WMVF).

Table 1. Chemical analysis and cell wall constituents of Berseem hay (BH), untreated and treated watermelon vine hay with fungi (% of DM basis)

Item	CFM	BH	WMVH	WMVF
DM	89.36	88.12	87.86	86.51
OM	93.46	92.67	91.45	89.08
CP	15.75	12.76	8.63	14.57
CF	6.68	24.81	28.62	24.66
EE	2.96	1.62	1.36	1.02
NFE	68.07	53.48	52.84	48.83
Ash	6.54	7.33	8.55	10.92
NDF	36.85	56.26	63.39	59.57
ADF	19.55	37.82	47.86	45.06
ADL	3.57	8.16	11.87	9.98
Hemi-cellulose	17.30	18.44	15.53	14.51
Cellulose	15.98	29.66	35.99	35.08

Source:CFM: Concentrate feed mixture; BH: Berseem hay; WMVH: Watermelon vine hay (untreated water melon vine); WMVF: Watermelon vine treated with fungi

Does weighed directly 15hr after kidding then weighed at 15, 30, 45 and 60 days of age where kids weaned at 60 days old. The does milked at 15, 30, 45 and 60 days from kidding and samples of sucked milk were taken and analyzed for total solids (TS), solid not fat (SNF), fat, protein, ash %, lactose calculated by difference.

Rumen liquor:

Rumen liquor samples were taken from three animals of each group at the last day of milking using stomach tube at 0, 3 and 6hr after the morning meal. The rumen contents were collected before the morning feeding of the animals. Collected rumen liquor 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 using magnesium oxide (MgO) as described by AOAC (2000) [3].Total volatile fatty acid (TVFA'S) concentration estimated using steam distillation methods (Warner, 1964) [47] and microbial protein measured by sodium tangistate method according to Shultz and Shultz (1970) [41].

In vitro gas production was undertaken according to the procedure described by Menke and Steingass (1988) [27]. Samples (200 mg) of the air-dry feedstuffs were accurately weighted into 50 ml calibrated glass syringe fitted with plungers. The rumen contents were kept in a water bath at 39ºC with CO_2 saturation until inoculation took place. The buffer and inoculum (2:1 v/v) were mixed and kept in a water bath at 39ºC with CO_2 saturation (Onodera and Henderson, 1980) [33]. All laboratory handling of rumen fluid was carried out under a continuous flow of CO_2. Buffered rumen fluid (15ml) was pipetted into each syringe, containing the feed samples, and the syringes were immediately placed into the water bath at 39ºC. Syringes were incubated *in vitro* in water bath for 96 h and gently shaken every 2hr. The syringes were continuing incubation up to 96 h and gas production was recorded at 3, 6, 9, 12, 24, 72 and 96 h of incubation *in vitro*. Total gas values were corrected for blank incubation which contains only rumen fluid.

The cumulative gas production (Y) at time (t) was fitted to the exponential model of (Ørskov and McDonald, 1979) [34].

$$\text{Gas}\ (t) = a+b \times (1-\exp^{-ct})$$

where: a = the gas production from the soluble fraction (ml),
b = the gas production from the insoluble fraction (ml),
c = the gas production rate (ml/h), and t = incubation time (h).
The energy values were calculated from the amount of produced gas at 24hr of incubation with supplementary analyses of crude protein, ash and crude fat. (Menke *et al*., 1979; Menke and Steingass, 1988) [26, 27].

ME (MJ /Kg DM) = 1.06+ (0.157* GP at 24 h) + (0.084*CP) + (0.22* EE) –0.08* A

OMD (%) = 14.88+0.889*gas at 24h+0.45*CP+0.0651*A

NE (Mcal/lb) = ((2.2+ (0.0272*GAS at 24h) + (0.057*CP) + (0.149*EE))/14.64

where:
ME is the metabolizable energy,
OMD is organic matter digestibility,
GP is 24 h net gas production (ml/200 mg DM),
A is ash (% of DM),
NE is the net energy, and
EE is ether extract or crude fat (%of DM).
Short chain fatty acids (SCFA) were calculated according to the Getachew *et al.* (2005) [15] using the following equation:

SCFA= (- 0.00425+0.0222*GP at 24h)*100

where: GP is 24 h net gas production (ml/200 mg DM).
Microbial protein was calculated as 19.3 g microbial nitrogen per kg OMD according to Czerkawski (1986) [9].
Methane volume, carbon dioxide volume and the percentage of methane in the total gas were determined according to (Fievez *et al*., 2005) [14].

Statistical analyses

Data of growth statistically analyzed according to SAS (2003) [38]. The difference between means was tested by Duncan᾿s Multiple Range Test (Duncan, 1955) [11]. The used model was:

Yij+ µ+Ti+eij

where:
Yij= The observation on the 1th treatment.
µ= Overall mean.
Ti= Effect of the1th treatment.
eij = experimental error.

RESULTS AND DISCUSSIONS

Concentration of pesticides residues of watermelon vine:

The Concentration of pesticides residues of untreated and treated watermelon vine with *Trichoderma reesie* are presented in (Table 2). The treated watermelon vine with *Trichoderma reesie* showed lower values of pesticides residues compared with untreated one.

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

Items	Water melon vine hay	
	Untreated watermelon vine (WMVH)	Watermelon vine treated with fungi (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
***PP* DDE**	0.11	0.01

Source:WMVH: Watermelon vine hay (untreated water melon vine); WMVF: Watermelon vine treated with fungi

Milk yield and its compositions

Data concerning milk yield and its composition of lactating goats fed the experimental rations are presented in Table (3). The milk yield and fat corrected milk (FCM) were significantly increased (P<0.05) for R1 and R4 compared with the other experimental groups R2, R3 and R5. Milk fat and protein yield were also significantly increased (P<0.05). Concerning milk composition and milk produced from animals fed R1 and R4 had significantly (P<0.05) higher contents of fat, protein, lactose, total solids (TS) and solids not fat (SNF) compared with the other experimental groups.

Concentrations of pesticides residues (µg/kg on fat basis) in milk

The concentrations of pesticides residues (µg/kg on fat basis) of the watermelon in milk are presented in (Table 4). The pesticides residues in milk of goats fed rations contain WMV untreated (R3 and R2) showed high values of pesticides residues compared with other rations. But the pesticides residues in milk of goats fed rations R1, R4 and R5 were none detected.

Table 3. Milk yields and milk composition for lactating goats fed the experimental rations

Items	**R1**	**R2**	**R3**	**R4**	**R5**	**SEM**	***P Value***
Live body weight (kg)	30.525	30.625	30.550	30.600	30.620	1.23	0.648
Milk yields (g/d)	914.75^{a}	739.42^{b}	539.74^{d}	934.62^{a}	619.62^{c}	41.62	< 0.001
4% FCM (g)	808.85^{a}	657.12^{b}	478.70^{d}	818.50^{a}	555.65^{c}	45.99	< 0.001
Fat, (g/d)	29.53^{a}	24.09^{b}	17.52^{c}	29.64^{a}	20.52^{bc}	1.68	0.001
Protein, (g/d)	28.99^{a}	23.68^{bc}	15.84^{d}	29.15^{a}	19.55^{dc}	1.31	< 0.001
Milk composition (%)							
Total solids	13.92^{a}	13.45^{b}	13.14^{c}	13.99^{a}	13.41^{b}	0.077	0.021
Solids not fat	10.46^{a}	10.14^{b}	9.95^{c}	10.55^{a}	10.15^{b}	0.061	0.016
Fat	3.46^{a}	3.31^{b}	3.19^{c}	3.44^{a}	3.26^{b}	0.084	0.019
Protein	3.44^{a}	3.23^{b}	2.87^{c}	3.41^{a}	3.10^{b}	0.078	0.01
Lactose	6.23^{a}	6.04^{c}	6.09^{bc}	6.26^{a}	6.12^{b}	0.066	0.027
Ash	0.79^{c}	0.87^{b}	0.99^{a}	0.88^{b}	0.93^{a}	0.023	0.012

Source:FCM: fat corrected milk

$^{a,,b,c\ and\ d}$ *Means within rows with different superscripts are significantly different (P<0.05).* S.E *(stander error*

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 reesie).*
R5: *50% CFM + 50% WMV treated with fungi (Trichoderma reesie).*

Concentrations of pesticides residues (µg/kg on fat basis) in milk:

The concentrations of pesticides residues (µg/kg on fat basis) of the watermelon in milk are presented in (Table 4). The pesticides residues in milk of goats fed rations contain WMV untreated (R3 and R2) showed high values of pesticides residues compared with other rations. But the pesticides residues in milk of goats fed rations R1, R4 and R5 were none detected.

Table 4. Concentrations of pesticides residues (µg/kg on fat basis) of the milk goat's samples

Items	**R1**	**R2**	**R3**	**R4**	**R5**
Permethrin	ND	0.09	0.15	ND	ND
Malathion	ND	0.11	0.14	ND	ND
Acetamiprid	ND	0.001	0.08	ND	ND
HCB	ND	0.002	0.01	ND	ND
Lindine	ND	0.001	0.02	ND	ND
p.p' DDE	ND	0.001	0.005	ND	ND

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 reesie).*
R5: *50% CFM + 50% WMV treated with fungi (Trichoderma reesie).*

Rumen Parameters

Consequently, higher levels of total volatile fatty acids (TVFA), acetate to propionate ratio (A:P) and variable ammonia nitrogen (NH_3-N) are produced (Table 5). Resulted indicated that rumen liquor pH values did not significantly differ among treatments.

The NH_3-N and TVFA's concentrations was significantly (P < 0.05) higher in R1 and R4 than the other experimental ration. R3 had the lowest value (P<0.05) of NH_3-N and TVFA's concentration.

Table 5. Rumen liquor parameters of lactating goats fed the experimental diets

Items	R1	R2	R3	R4	R5	SEM	*P Value*
pH	6.32	6.29	6.17	6.23	6.20	0.11	0.847
NH_3-N (mg/100 ml)	13.64^{a}	13.47^{ab}	12.08^{c}	13.70^{a}	12.99^{b}	0.18	0.031
TVFA's (meq/100 ml)	10.99^{a}	9.09^{b}	8.33^{c}	10.61^{a}	9.12^{b}	0.36	0.026
Acetate (meq/100 ml)	55.31^{c}	57.35^{ab}	57.97^{a}	55.79^{c}	56.11^{bc}	0.47	0.033
Propionate (meq/100 ml)	26.34^{a}	24.37^{b}	22.85^{c}	26.86^{a}	24.00^{b}	0.31	0.016
Butyrate (meq/100 ml)	7.70^{b}	8.88^{a}	9.07^{a}	7.83^{b}	7.93^{b}	0.28	0.041
Acetate: propionate ratio	2.10^{c}	2.53^{a}	2.54^{a}	2.08^{c}	2.34^{b}	0.11	0.013
Gas production volume at 24 h	23.6^{b}	20.4^{c}	18.1^{d}	28.2^{a}	21.3^{c}	1.34	0.001
CO_2	45.78^{b}	48.08^{a}	48.31^{a}	45.86^{b}	45.95^{b}	0.49	0.027
CH_4	24.92^{d}	27.02^{a}	27.81^{a}	25.97^{c}	26.02^{b}	0.21	0.011
Organic matter digestibility (OMD)	39.09^{b}	35.97^{c}	33.30^{d}	43.47^{a}	36.66^{c}	2.27	0.001
Microbial protein	75.45^{b}	69.41^{c}	64.28^{d}	83.90^{a}	70.75^{c}	3.11	0.001
Metabolizable energy (ME)(MJ /Kg DM)	5.03^{b}	4.46^{c}	3.99^{d}	5.64^{a}	4.41^{c}	0.38	0.014
Net energy (NE) (Mcal/lb)	2.34^{a}	2.24^{b}	2.13^{c}	2.41^{a}	2.21^{b}	0.07	0.036
Short chain fatty acids	51.97^{b}	44.86^{c}	39.76^{d}	62.18^{a}	46.86^{c}	2.65	0.001

$^{a,,b,\ and\ c}$ *Means within rows with different superscripts are significantly different (P<0.05).*

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 reesie).*
R5: *50% CFM + 50% WMV treated with fungi (Trichoderma reesie).*
NH3-N: Ammonia nitrogen; TVFA: Total volatile fatty acids

Feed intake, feed conversion and economic evaluation:

Data of feed intake, feed conversion and economic evaluation of the experimental rations are presented in Table (6). Results revealed that daily feed cost of experimental groups had lower values for untreated and treated WMV for different ratios (25 and 50 %) than control one. TDMI and fat corrected milk yield were higher (P<0.05) in both R1and R4 than R2, R3 and R5 groups. R4 group recorded the best value (P<0.05) of feed conversion compared with other experimental groups.

Biological treatment with *Trichoderma resei* is reported to be highly effective in reducing the level of pesticides. Hassan *et al.* (2010) [17] showed that biological treatment with fungi or bacteria could be advisable in order to overcome the harmful effect of tomato haulms exposure to pesticide. Sharaf *et al.* (2006) [39] reported that understanding pesticide metabolism in plants and microorganisms is necessary for pesticide development for safe and efficient use, as well as for developing pesticide bioremediation strategies for contaminated soil and water. Andersson and Henrysson, (1996) [2] showed pesticide biotransformation may occur via multistep processes know as metabolism or co-metabolism. To increase the levels of degradation in soil, some researchers have inoculated polluted soils with various fungal species immobilized on different lignocellulosic supports (e.g woodchips, corncobs, and wheat straw).

Table 6. Feed intake, feed conversion and economic evaluation for lactating goats fed the experimental rations

Items	**R1**	**R2**	**R3**	**R4**	**R5**	**SEM**	***P Value***
CFM	500	500	500	500	500	0.0	-
BH	543.75	330	-	303.75	-	-	-
WMVH	-	124.58	284.58	211.25	389.17	-	-
TDMI (g/h/d)	1043.75^{a}	954.54^{b}	784.58^{d}	1015.00^{a}	889.17^{c}	52.24	< 0.001
Milk yields g/d	914.75^{a}	739.42^{b}	539.74^{d}	934.62^{a}	619.62^{c}	41.62	0.001
4% FCM (g)	808.85^{a}	657.12^{b}	478.70^{d}	818.50^{a}	555.65^{c}	45.99	0.001
Feed conversion (g/g)							
TDMI / Milk yields (g /g)	1.14^{c}	1.29^{b}	1.45^{a}	1.09^{c}	1.44^{a}	0.39	0.012
TDMI/FCM (g/g)	1.29^{c}	1.45^{b}	1.64^{a}	1.24^{c}	1.60^{a}	0.99	0.007
Economic evaluation							
Daily feed cost, L.E	2.39	2.15	1.44	2.14	1.50	-	-
Price of daily milk yield, L.E	9.15	7.39	5.40	9.35	6.20	-	-
Economic return, L.E	6.76	5.24	3.96	7.21	4.70	-	-
Economic return,(h/d) %	100	77.51	58.58	106.66	69.53	-	-

$^{a,,b,\ c\ and\ d}$ *Means within rows with different superscripts are significantly different (P<0.05)*
Source:CFM: Concentrate feed mixture; BH: Berseem hay; WMVH: Watermelon vine hay
TDMI: Total dry matter intake:. FCM: fat corrected milk

Regarding average milk yield and its composition contents, the current results are in accordance with those reported by Saleh *et al*. (2003) [36] who indicated that yield of milk, fat corrected milk (FCM), fat, protein, total solids and solids not fat (SNF) recorded significantly (P <0.05) higher values for animal fed rations contain WMVH. The same results reported by Hassan *et al*. (2010) [17] he showed that the increase in milk yield may be due to higher DMI or slight increase of milk lactose, which had a positive correlation with milk yield. Further, Fazaeli *et al*. (2004) [13] reported that inclusion of fungal treated straw upto 30% of the total mixed ration in late lactating Holstein cows improved the nutrients digestibility and also noted an increase in fat corrected milk yield by 13%.

Biological treatment with fungi (*Trichoderma resei*) is reported to be highly effective in reducing the level of pesticides. Hassan *et al.* (2010) [17] showed that biological treatment with fungi or bacteria could be advisable in order to overcome the harmful effect of tomato haulms exposure to pesticide. DebManadal *et al*. (2008) [10] reported that microbes (fungi, bacteria, and other microorganisms) could degrade or breakdown the pesticides whereas they used them as food source. Quintero *et al*. (2008) [35] showed that white fungi species have demonstrated a high capacity to degrade organic pollutants such as the insecticide lindane (y-HCH).

Fermentation pattern observed with fungal treated substrates upon microbial digestion favourably altered ruminal parameters because of biodelignification by WMVH which enables faster accessibility by rumen microbes. Hassan *et al*. (2010) [17] reported that it could be a result of proteolytic activity in the rumen. Yadov and Yaday (1988) [48] noticed that increased ruminal NH_3-N concentrations may due to the higher intake of nitrogen and CP digestibility. Bassiouni, (2001) [4] 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. Tripathi *et al*. (2008) [44] found that bio-processed mustard straw with *C. versicolor* (21 days) increased rumen pH and TVFA after 6h of feeding in sheep. Further, cultured straw increased small holotricks but reduced large holotricks population in rumen liquor, while no effect on ruminal microbial enzyme activities was observed. These studies imply that most of the microbially converted feeds are safer and the potential biohazards associated with them are very low (Villas-Bôas *et al*., 2002) [46] for ruminants. Molar proportions of individual VFA and the acetate to propionate ratio were significantly affected by feeding the experimental rations which increased the propionate proportion and decreased the acetate and butyrate proportions for R4 without significant difference with control group (R1). Consequently, there was a decrease in the acetate to propionate ratio compared with control. Enteric methane (CH_4) production arises principally from microbial fermentation of hydrolyzed dietary carbohydrates such as cellulose, hemicellulose, pectin and starch. The amount of CH_4 produced during ruminal fermentation is dependent upon the nature of the substrate being fermented. Diet composition alters the digestion efficiency of animals thereby CH_4 production. In general, methanogenic potential of ruminal microflora is greatest for the fermentation of structural carbohydrates compared to that of non-structural carbohydrates (Boadi *et al*., 2004) [7]. The goats fed R1, R4 and R5 had significantly ($P<0.05$) lower values for CO_2 and CH_4 compared with R2 and R3 groups. The gas production volume at 24h, organic matter digestibility, microbial protein, metabolizable energy, net energy and short chain fatty acids were significantly ($P<0.05$) higher in R4 than the other experimental ration. These results agree with Menke *et al*. (1979) [26] suggested that gas volume at 24 h after incubation is in indirect relationship with metabolisable energy in feedstuffs. Sommart *et al*., (2000) [42] suggested that gas volume is a good parameter to predict digestibility, fermentation of end-product and microbial protein synthesis of the substrate by rumen microbes in the *in vitro* system. Report elsewhere (Chumpawadee *et al*., 2007) [8] indicated that *in vitro* dry matter and organic matter digestibility were shown to have high correlation with gas volume. Gas volume has also shown to have a close relationship with feed intake (Blümmel *et al*., 1997) [6]. The higher gas volume recorded in the R4 group was likely to have been caused by its reduced contents of cell wall, especially ADF and ADL. Lignin has been implicated in rations with depressed digestibility (Van Soest, 1994) [45] due to its effect on lowering the rate of microbial colonization of such high fibre feed (Okano *et al*., 2009) [32]. This implies good digestibility potential for the fungal treated rice straw when harnessed as feed resources for ruminant livestock. Although gas production is a nutritionally wasteful product (Mauricio *et al*., 1999) [25], but provides a useful basis from which metabolisable energy (ME), organic matter digestibility (OMD) and short chain fatty acids (SCFA) may be predicted. High OMD was observed in R4 suggesting that the microbes in the rumen and animal have high nutrient uptake. The higher fibre content in control probably resulted in lower OMD since high NDF and ADL content in feedstuffs result in lower fibre degradation (Van Soest, 1994) [45]. Higher production of gas and the eventual preponderance of SCFA in the R4 probably showed an increased proportion of acetate and butyrate but may mean a decrease in proximate production. The estimated ME was found to be comparable to that reported for fungal treated millet stover (Akinfemi *et al*., 2010) [1]. The *in vitro* gas production method has been widely used to evaluate the energy value of several classes of feed (Getachew *et al*., 2002) [16]. Others (Krishnamoothy *et al*., 1995) [20] suggested that *in vitro* gas production technique should be considered for estimating ME in tropical feedstuffs. Evaluating ME using *in vitro* technique reduces cost, time and is comparable to those evaluated by *in vivo* method.

As cell wall components (NDF and ADF) are known to have a negative correlation with gas production (Sallam *et al*., 2007) [37], and thus readily available soluble carbohydrate fractions found in fungal treated substrates are expected to produce more gas (Chumpawadee *et al*., 2007) [8] and short chain fatty acids (SCFA), with an increased ME contents (Mahesh, 2012) [22]. Mahesh (2012) [22] observed a reduction in CH_4 (%) from fungal treated wheat straws which contained lesser fibre fractions (NDF and ADF) than untreated straw. This could probably due to indirect effect via fibre digestion leading to lesser residency of feed particles in the rumen (Sallam *et al*., 2007) [37]. The role of quality forages in reducing enteric CH_4 production in ruminants has been evident from several studies (Mohini *et al*., 2007) [28]. It can be concluded that enteric CH_4 emissions are highest when the animal is presented with poor quality forages. Thus, by fungal treatment, an improvement in the forage quality with respect to cell wall digestion and overall enhancement in carbohydrates digestibility as well as increased DM intake will be expected to reduce the CH_4 emissions relative to nutrients digestibility, in ruminants (Mahesh, 2012) [22].

The substitution of berseem hay by treated WMV with fungi resulted in better economic evaluation expressed as economic return. Saleh *et al*. (2003) [36] showed that better economic efficiency obtained in rations contained WMV may be due to the decreasing in feed cost of these rations compared to control ration. The best relative economic efficiency value was detect with (R4) being 109.72 when compared with the control group (100%) because their higher milk production. The same trend was observed by Bendary *et al*. (1996) [5]. Hassan *et al*. (2010) [17] showed that biological treatment with fungi or bacteria could be advisable in order to overcome the harmful effect of tomato haulms exposure to pesticides.

CONCLUSIONS

Conclusively, it could be concluded that biological treatment with fungi could be advisable in order to overcome the harmful effect of watermelon vine exposure to pesticide. The present study suggested the possibility of replacing berseem hay by treated WMV with fungus in rations of lactating goats up to 25% as a cheap ingredient. Moreover, it could be used safely and economically in formulating ruminants.

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