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Utilization of Biologically Treated Watermelon Vine in Rations for Dairy Cows

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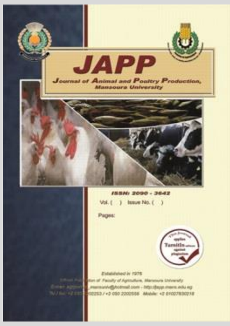

ABSTRACT

The objective of this study was to investigate the effect of replacement of berseem hay by watermelon vine (WMV) biologically treated with *Penicillium oxalicum* fungi (rations contained 0 “control ration”, 25, 50, 75 and 100 % of WMV) on digestibility parameters using fifteen adult crossbred male sheep 3 for each ration, rumen liquor parameters using three crossbred female sheep fitted with permanent rumen fistula and performance of milk production using ten lactating crossbred Friesian multiparous used in duplicated 5X5 Latin squares. The results revealed that an improvement was observed for the rations containing 25 and 50 % WMV and their results were comparable with the results of control ration for digestibility coefficients, nutritive value, TVFA's, acetic acid, C2:C3 ratio and microbial nitrogen synthesized, also were significantly higher than that the rations containing 75 and 100 % WMV. Dry Matter intake, milk yield and composition indicated that cows fed control and R2 (25% treated WMV and 75% berseem hay) recorded significantly ($P<0.05$) the highest yield of actual milk, 4% FCM and milk contents followed by cows fed R3 (50% treated WMV and 50% berseem hay). While, there were no significant differences among the experimental rations in feed intake. Cows fed R2 and R1 (control) showed the highest economic efficiencies followed by R3, while those fed the R4 (75% treated WMV and 25% berseem hay) and R5 (100%treated WMV and 0% berseem hay) rations had the lowest values.

Keywords: Ruminants, dairy cows, watermelon vine, berseem hay and biological treatment.

INTRODUCTION

Egypt, like other developing countries, is facing a deficiency of animal protein sources. So there are urgent needs to search for more available untraditional and cheaper feed sources (El-Ashry *et al.*, 2003). About 25 million tons of agricultural residues as described by Shoukry (2013) produced annually. But, 7 million tons only used for ruminant feeding. Remains of them burned or wasted hence contributing to environmental pollution and health hazards. Increasing animal production in Egypt depends upon the utilizing all available agriculture residues for animal feeding. Watermelon vine (WMV) as an unconventional source in ruminant diets is investigated. Large areas in Egypt are cultivated by watermelon; about 200 thousand Fadden which produces huge amounts of WMV without beneficial usage that remained after harvested watermelon fruit. This by-product has a low content of crude protein (CP, 8-11%) and a high content mount of crude fiber (CF, 30-33%). Although, it's crude fiber content is high, its digestion coefficient is acceptable due to biological treatment applied. A recent study indicated that ruminant fed WMV treated with *Penicillium oxalicum* fungi was showing a significant improvement in digestion coefficients and degradability of fiber fraction in the rumen, compared to those fed WMV without treatment (El-Morsy *et al.*, 2018). The major factors limiting the utilization of crop residues are high fiber content (cellulose, hemicellulose and lignin) and low protein content. Many methods are applied to improve the nutritive value and increase its utilization in ruminant nutrition. The biological treatments are the most commonly treated apply to agricultural residues, to improve their nutritive value by the accessibility of cellulosic fractions (Yu *et al.*, 2009). Many scientists suggested that decreased of crude fiber and fiber fractions content with increased of crude protein content and then increase the nutritive value of crop residue when treated with different fungi species as biological treatments. Berseem (*Trifolium alexandrinum*) is annual leguminous forages, which is native in the Mediterranean region and in the Middle-East (Hackney *et al.*, 2007). This species has the advantage over other annual species, of providing multiple harvests during the growing season. Berseem is cultivated in large areas, reached 1.3 million hectares in 2007 in Egypt (El-Nahrawy, 2011). The berseem hay is the most common source of high quality forage used in Egypt, which rich in protein, when berseem hay is used; the need for high priced protein feeds is largely reduced. During the berseem season, it is more commonly used for ruminants and has high nutritive value. But, the available amount of it is usually insufficient for animal feeding that lead to increasing prices for ruminant feed. Part of this shortage can be covered by agricultural residues.

Hence, the present study aimed to examine the effects of replacement of berseem hay by water melon vine biologically treated with *Penicillium oxalicum* fungi on the nutritive value, rumen function, milk yield and composition in lactation cows, to maximize the utilization from watermelon vine as a feed and fill the deficit occurring in quantity of berseem available to ruminants.

MATERIALS AND METHODS

This study was carried out during the end of winter (2017) at the Noubaria Station, Animal Production Research

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Institute and Regional Center for Feed and Food. Watermelon vine (WMV) was collected from Noubaria region at the end of July 2017, dried and chopped at 1 – 3 cm length, and then it was stored until it has been treated.

1- Experimental Diets

Five total mixed rations were prepared; that consisted of 40% concentrate feed mixture (CFM), 20% corn silage and 40% berseem hay replacement with watermelon vine (WMV) biologically treated with *Penicillium oxalicum*, as follows

R1	0% untreated WMV	100% berseem hay
R2	25% treated WMV	75% berseem hay
R3	50% treated WMV	50% berseem hay
R4	75% treated WMV	25% berseem hay
R5	100% treated WMV	0% berseem hay

Penicillin oxalicum fungi were obtained from the Department of Microbiology, Faculty of Science, University of Alexandria. The strain was maintained on a potato dextrose agar (PDA) medium, for 3 days (potato infusion 200g, dextrose 20g, agar 20g and distilled water 1000 ml) recommended by Difco (1984). This medium was used for initial growth and then transferred into the basal mineral medium. A basal mineral medium was prepared according to Duff (1988), one liter of this mineral medium contained {KH_2PO_4 2g, $MgSO_4.7H_2O$ 4g, Na_2 $B_6O_7.10H_2O$ 1.4g, Fe_2 $(SO_4)_3$. $6H_2O$ 20mg, peptone 1 g, (NH_4). MO_7 O_2 4 H_2O 0.3 mg, $CUSO_4.5H_2O$ 0.6mg, $MnSO_4.H_2O$ 0.22 mg, $ZnSO_4$. $7H_2O$ 35.6 mg and lactose 10 g}. The final pH was 7.0±0.2 for incubation in 250 ml vented tissue culture flasks. The incubation was performed at 28 °C for 4 days. This medium contains a variety of different salts, which provide the necessary nutrients required for the growth of *Penicillium oxalicum.* Mycelium was collected and broken into small hyphal beta using a washing blender. The fermentation medium was inoculated with 4% (v/v) of the basal mineral medium and then cultivated at 30 °C in a 50 liters stirred-tank fermenter for 72 hr. The 50 liters of fermentation medium transferred into 200 liters of a water solution containing 2% molasses. The above 250 liters were mixed well with about 200 kg of chopped watermelon vine which was pasteurized before mixed (watermelon vine was soaked in water tanks 200 liter volume and pasteurized for one hour) and left for 20 days. However, the moisture of treated WMV was adjusted at approximately 70%. After the fermentation period, the fungal treated WMV were taken out and aerated for 5 days. All treatments were dried before animal feeding.

2- Digestibility Trials

Fifteen adult crossbred male sheep (average live body weight 41 ± 1.75 kg) were used in a completely randomized design digestibility experiment. They were distributed into five equal groups of 3 animals in each. Each group of animals was fed one of experimental rations (R1, R2, R3, R4, and R5) that cover of their maintenance requirements recommended by NRC (1985). Each digestibility trial lasted 3 weeks as a preliminary period followed by 1 week as a collection period. The animals were housed in metabolic cages and beneath each, a stainless steel screen having 4 mm mesh to retain feces but allow free passage of urine, which was collected through a funnel containing 5 – 7 ml sulfuric acid preservative to prevent the loss of nitrogen from the urine. The animals were fed one of the experimental rations twice daily at 8.00 AM and 17.00 PM Requirements for each group are estimated during preliminary period, the Water was available all time. Feed samples were collected and prepared for proximate analysis. Feed consumption was recorded daily by weighing feeds offered to head and refused per each animal to calculate feed intake. Feces was collected quantitatively once a day before the morning meal at 8.00 AM and stored at – 10 °C. The seven days combined collection was mixed the sampled and kept for routine analysis. Fecal samples were dried at 60 °C for 72 hours (partial drying) and ground through a 1 mm screen on a Wiley mill grinder. They were composted (20 gm) per sample per treatment per animal for analysis. Daily urine volume was measured and samples of 10% of the volume were taken in glass bottles and stored in a refrigerator for nitrogen determination. Digestibility was determined and expressed on dry matter basis. Proximate analyses were carried out according to AOAC (1995), crude protein (CP) by Kjeldahl, while nitrogen free extract (NFE) was calculated by difference. Fiber fraction (NDF, ADF and ADL) was determined as described by Goering and Van Soest (1970).

3- Rumen Fermentation Trials

Three crossbred female sheep fitted with permanent rumen fistula (average BW 40 ± 1.50 kg) were used in rumen fermentation. The animals were fed the same rations used in the digestibility trials. Rumen contents were collected from the fistula at 0, 3 and 6 hr post-feeding and then calculate overall mean. Samples were flushed with CO_2 during the collection time, and incubated at 39 °C in thermostatically controlled water-bath. At zero time two sub-samples were poured into another jars containing formalin (1 ml/ 100 g rumen contents) and swirled vigorously to stop metabolic activity. One of these samples was used to estimate concentration of ammonia and volatile fatty acids (VFA's); rumen samples taken at zero after one hour of fermentation was strained through cheesecloth. The supernatant was used for determining pH immediately using a glass electrode, ammonia nitrogen (mg/ 100 ml rumen liquor (RL) using magnesium oxide (MgO) distillation method of Al-Rabbat *et al.* (1971). The total VFA's (m. eq / 100 ml RL) were estimated using steam distillation as described by Warner (1964). While, molar percentages of major VFA's (acetic and propionic) were carried out using HPLC.

The microbial protein (MP) synthesized in the rumen of the sheep fed the experimental rations were calculated as g MP per day using, total bacteria count carried out according to Chen and Gomes (1992). The method based on measurement of purine derivatives (PD mmol/day) by determined allantoin and uric acid in urine by using spectrophotometer at 520 nm. Urine is collected into a container with approximately 100 ml of 10% H_2SO_4 to prevent bacterial destruction of PD in urine. Record the original volume of the urine every day for 5 days. Filter urine through glass wool, and take a subsample of about 20 ml for analysis. Those equations are used to calculate microbial nitrogen (MN). $MN = (70 \times AP) / (0.83 \times 0.116 \times 1000)$, where 70 represents the amount of N in the purines (mg N/mmol), 0.83 is the digestibility of the microbial purines, and 0.116 is the purine N: total N ratio in ruminal microorganisms. The absorbed microbial purines (AP, mmol/day) are calculated from the total excretion of purine derivatives (PD, mmol/day), using the equation: $AP = \{PD - (0.385 \times BW^{0.75})\} / 0.85$, where 0.85 is the recovery of absorbed purines as urinary purine derivatives, and 0.385 *

$BW^{0.75}$ is the endogenous contribution in the urinary excretion of PD (Verbic *et al.*, 1990).

4- Lactation Trials

Ten lactating crossbred Friesian multiparous were chosen based on their milk production, they had the same days in milk, lactation number and with an average live body weight (550 ± 15.5 kg), used in duplicating 5X5 Latin squares design according to the mathematical models mentioned by Steel and Torrie (1980). Each cow was offered one of the experimental rations, the first 20 days were considered as a preliminary period followed by 10 day collection period. Maintenance requirement calculated according to NRC (2001) and requirement for the production were calculated from preliminary period and also the milk yield previous according to Barney Harris (1992). Cows were fed at 8.00 AM and 17.00 PM the cows were milked twice during collection periods and milk samples (1% of milk yield/ period) were taken during the 10 days at 7.00 AM and 16.00 PM Actual milk yields were recorded daily and milk samples were taken and kept at 4 °C for analysis. Fat corrected milk (4 %) was calculated according to Gaines and Davidson (1923) using the following equation: FCM = M (0.4+0.15 F %) Where M= milk yield, F = fat percentage. Milk fat percentage was determined according to Gerber's method as described by Ling (1963). Total solids percent (TS), total protein was determined according to the standard methods of AOAC (1995), While, lactose was determined according to a rapid method for the determination of lactose in milk described by John *et al*. (1957). Solid not fat (SNF) was calculated by the difference.

Data were statistically analyzed using the method of least squares analysis of variance using General Linear Models (GLM) procedure (SAS, 2000). The model describing each trait was assumed to be: Duncan's Multiple Range Test (Duncan, 1955) was used to compare among means of each trait.

RESULTS AND DISCUSSION

The nutrient composition (Table 1) reflected that berseem hay had lower neutral detergent fiber, acid detergent fiber cellulose concentrations and higher crude protein concentration than WMV treated with *Penicillium oxalicum.* These results are in agreement with Karsli *et al.* (1999) who found that the chemical composition of berseem hay had lower contain of fiber fraction and high protein contain when compared with other agricultural residues. Results of Table (2) showed that chemical composition of five rations were nearly the same; The DM intake, digestibility trials data and nutritive values are presented in Table (3). The results of DM intake showed a slight linearly decrease with increased WMV in experimental rations. The same trend was recorded with the results obtained from digestibility trials with significant differences between control ration and rations that containing 50, 75 and 100% WMV.The digestibility of crude protein was significantly higher (P<0.05) with ration containing 100% berseem hay followed by that containing 25%of WMV compared with that containing 50, 75, 100% WMV, the results showed quite good congruence with studies obtained by El-Nahas and Tag El-Dein (2010), who found that replacing 25% of berseem hay by apple pomace residues had a high impact on the increased digestion coefficients and subsequently TDN value. Furthermore, this result could be due to berseem like other legumes that generally produce higher quality forage, have high good quality protein digestibility and fiber digestibility (Ball *et al.*, 2001). A slight linearity decreases with the increasing inclusion of WMV in experimental rations for the results obtained from CF digestibility. These results revealed the effect of *Penicillium oxalicum* fungi treatment by WMV and the results were approached with berseem hay, which had lower of fiber content (NDF and ADF) and high digested rate as described by Tag El-Din *et al.* (2009) and Das *et al.* (2015). The highest (P<0.05) digestibility of ADF recorded by R5 and R4 it has been attributed to a reduction in the ability of the fungi *Penicillium oxalicum* have been a great producer of cellulose enzymes related to lignocellulosic biomass deconstruction reported by Schneider *et al*. (2016). Also, the results indicated that TDN% and DCP % were higher (P<0.05) with ration containing 100% and 25% of WMV. While, animals fed rations in (R4 and R5) recorded the lowest value (P<0.05). The differences of nutritive values results might be attributed to the differences in the chemical composition of rations. These results were in agreement with El-Ashry *et al*. (1997) and El-Shinnawy *et al*. (1999), who reported that the berseem hay had highest nutritive value than treatment low quality roughage. While, Akinfemi and Ladipo (2013) and Aziz (2014) found that biological treatment of low quality roughages was increasing the digestibility coefficients for most nutrients and feeding values as TDN and DCP.

Table 1. Chemical composition of treated watermelon vine, berseem hay, corn silage and concentrate feed mixture on DM basis.

Item	concentrate feed mixture	Berseem hay	Corn silage	WMV treated with *Penicillium oxalicum*
OM	91.2	87.56	93.10	87.28
CP	17.06	12.47	7.20	10.21
CF	9.70	25.17	28.03	24.10
EE	3.71	2.40	2.51	2.30
NFE	60.70	47.52	55.62	50.67
Ash	8.83	12.44	6.9	12.72
NDF	16.05	45.72	42.10	51.87
ADF	10.66	24.93	25.51	32.56
ADL	4.03	6.96	4.88	6.29
Hemicellulose	5.39	20.79	16.59	19.31
Cellulose	6.63	17.97	20.63	26.27

Table 2. Chemical composition of the experimental rations fed to animals.

Item	R1(control)	R2	R3	R4	R5
OM	90.20	90.21	90.03	90.17	90.17
CP	13.3	13.10	12.70	12.60	12.40
CF	19.55	19.46	19.38	19.30	19.20
EE	2.94	2.92	2.91	2.92	2.90
NFE	54.41	54.73	55.04	55.35	55.67
Ash	9.80	9.79	9.97	9.83	9.83
NDF	33.12	33.75	34.44	35.10	35.60
ADF	19.40	20.20	21.00	21.7	22.4

Table 3. Digestibility coefficients and nutritive value of experimental rations fed to sheep (Mean ± SE).

Item	R1(control)	R2	R3	R4	R5
DMI. (g)	1000	1000	996.8	990	979
			Digestibility coefficients (%)		
DM	67.55 ^{a} ±1.85	66.83 ^{a} ±1.72	65.26 ^{ab} ±1.16	64.84^{b} ±1.61	64.27 ^{b} ±1.34
OM	69.27 ^{a} ±1.24	68.89 ^{a} ±1.58	67.75 ^{b} ±1.47	66.21^{bc} ±1.35	65.78 ^{c} ±1.33
CP	66.10 ^{a} ±2.47	65.74 ^{a} ±2.63	63.77 ^{b} ±2.51	63.05 ^{b} ±1.02	62.61^{c} ±1.68
CF	65.73 ^{a} ±1.66	64.92 ^{a} ±1.95	64.65 ^{ab} ±1.84	64.24 ^{b} ±1.34	64.13 ^{b} ±2.40
EE	78.55 ^{a} ±2.13	77.21 ^{b} ±2.02	77.16 ^{b} ±2.62	76.96 ^{c} ±2.32	76.54 ^{c} ±2.17
NFE	75.85 ^{a} ±2.61	75.15 ^{ab} ±2.48	74.75 ^{ab} ±1.29	74.21^{b} ±2.54	73.46 ^{c} ±1.25
NDF	63.76 ^{a} ±2.43	63.03 ^{a} ±2.15	62.68 ^{ab} ±2.33	62.14^{b} ±2.42	62.06 ^{b} ±2.73
ADF	57.22 ^{b} ±2.58	57.89 ^{b} ±2.64	58.25 ^{ab} ±2.63	59.01^{a} ±2.88	59.78 ^{a} ±2.75
			Nutritive values (%)		
TDN	68.10 ^{a} ±1.67	67.47 ^{a} ±1.24	66.64 ^{ab} ±1.57	65.81 ^{b} ±1.18	64.64 ^{b} ±1.43
DCP	8.79 ^{a} ±0.25	8.61 ^{a} ±0.38	8.10 ^{ab} ±0.31	7.86 ^{b} ±0.33	7.60 ^{b} ±0.37

^{abc} Means within the same row with different superscripts are significantly differ (P<0.05).

Rumen fluid fermentation parameters are shown in Table (4). The results of ruminal pH showed no-significant differences among rations**,** ruminal pH ranged from 6.49 to 6.62**.** These levels are suitable for the normal function of cellulotic bacteria and pH should be 6.4 to 7.0 according to Wanapat and Cherdthong (2009). Ruminal NH_3-N concentrations were significantly (P<0.05) lower for sheep fed R1 and R2 rations, while, the sheep that fed R4 and R5 rations recorded significantly (P < 0.05) higher values. The current study explained that a positive correlation between reductions of ruminal NH_3-N concentrations with induction of microbial protein synthesis for sheep fed R1 and R2 rations. Many of the research showed that the decrease of ruminal NH_3-N concentration may be of consequence of the increased incorporation of ammonia into microbial protein synthesis and stimulated microbial activity (Tikofsky and Harrison 2006 and Wahrmund *et al.,* 2007). Moreover, Abo-Eid, *et al*. (2007) found that ruminal ammonia concentrate was higher (P<0.05) for animals fed roughage treated with fungi (*Trichoderma reesei*) resulting in breakdown of protein and other nitrogenous compound to NH_3-N. The results of ruminal TVFA's were in accordance with previous suggestions that TVFA's in rumen liquor increased significantly (P<0.05) with increasing values of TDN (El-Nahas and Tag El-Dein, 2010 and Shakweer, 2011)., also a high level of TVFA observed may attributed to formation of organic acids in the rumen accompanied with level feeding of concentrate: roughage, as reported by Galip (2006) and Hassan *et al.* (2011). The relationship between the acetate: propionate ratio can be attributed to the ratio of concentrate: roughage in the ration. Acetate formation depend on fiber degradability by cellulolytic bacteria, whereas propionate formation by fermentation of non-structural carbohydrate. In the current study the results suggested that increase of acetate production, high ratio C2:C3 is compatible with results obtained from fiber digestion. These results are in accordance with previous studies by Mrazek *et al.* (2006) and Xie *et al.* (2018) who reported that the increase fermentation of fiber fractions (NDF and ADF) lead to the increased production of acetic acid. Also, this was observed in our study as a result to treat WMV by *Penicillium oxalicum*. Moreover, there were no statistically significant differences among rations that estimated from the ratio between acetate: propionate. The microbial nitrogen synthesis as obtained by the calculation of purine derivatives in the urine were significantly decreased (P<0.05) with increased the inclusion of WMV compared to control ration which recorded higher value, followed by R2. The result are in-agreement with Kamel *et al.* (2000) who found that increased of microbial protein syntheses by feeding of a high quality roughage. On the other hand, Phillip *et al.* (2014) reported that biological treatment may be having a positive effect on rumen microbial population and microbial activity.

Table 4. Overall mean of rumen parameters of sheep fed the experimental rations (means ± SE).

Item	Experimental rations				
	R1(control)	R2	R3	R4	R5
pH	6.49 ± 0.21	6.52 ± 0.24	6.57 ± 0.32	6.61± 0.27	6.52± 0.36
NH_3-N (mg/100ml R.L)	12.26 ^{b} ± 0.33	12.07 ^{b} ± 21	12.93 ^{ab} ± 0.25	13.61 ^{a} ± 0.29	13. 88 ^{a} ± 0.15
TVFA's (meq/100 ml R.L)	16.02 ^{a} ± 0.24	14.97 ^{a} ± 0.12	13.55 ^{b} ± 0.14	12.72 ^{c} ± 0.22	12.41 ^{c} ± 0.19
Acetic acid,C2 %	67.14 ^{a} ± 3.61	66.83 ^{ab} ± 3.92	65.41 ^{b} ± 4.06	64.03 ^{c} ±3.71	63.76 ^{c} ±3.58
Propionic acid,C3 %	19.67 ^{b} ± 1.25	19.83 ^{b} ± 1.94	19.88 ^{a} ± 1.47	20.04 ^{a} ± 1.36	20.05 ^{a} ± 1.54
C2: C3 ratio	3.41 ± 0.15	3.37 ± 0.14	3.29 ± 0.35	3.20 ± 0.08	3.18 ± 0.14
AP mmol/day	4.08	3.81	3.60	3.30	3.19
DP mmol/day	9.85	9.47	9.46	9.10	9.12
Microbial nitrogen (g/d)	2.97 ^{a} ± 0.07	2.77 ^{a} ±0.05	2.62 ^{ab} ± 0.05	2.40 ^{b} ± 0.06	2.32 ^{b} ± 0.04

^{abc} Means in the same row with different superscripts significantly differ (P< 0.05).

The dry matter intake (DMI) by cows of the different rations is presented in Table (5). The DMI was higher for cows fed ration containing 100% and 75% berseem hay than other rations, without significant differences (P< 0.05). These results may be due to berseem hay is very palatable forage than agricultural residues (Holt *et al.*, 2013 and Zhu, *et al.*, 2013). Furthermore, Mahesh and Madhu (2013) found that biological treatment for agricultural residues improves feed quality either by increasing digestibility or by enhancing palatability. Average daily milk yield and fat-corrected- milk to 4% fat of lactating cows (Table 5) fed the experimental rations showed significantly highest (P< 0.05) actual milk and 4% FCM yield for R1 and R2 while lowest values recorded with cows fed R4 and R5. The present results are in consonance with that obtained by Eastridge (2007) who stated that milk yield decreased as the amount of low quality roughage increased in dairy cows rations. Moreover, a decreased of actual milk yield may be related to the higher fiber fraction percent of the diet that supported by Ruiz *et al.* (1995) while, Zebeli *et al.* (2008) indicated that feeding rations a level of about 30% NDF in the diet may be considered generally optimal without impairing production in high-yielding dairy cows while, increase NDF to 35.9% ± 1.97% in ration had light negative effect of milk production. On the other hand, improvement of milk yield may be related to the more caloric effect and increased DMI. Moreover, Titgemeyer (2003) observed that an increase of milk production was associated with a quantitative increase in the microbial protein in ruminants. Furthermore, Aziz and Kholif (2015) concluded that some factors effect of increase milk production. These factors are increase feed intake, improvement in nutrient digestibility especially CP, CF and improvement in rumen VFA's concentration, especially the molar proportion of acetic acid, that are congruent with the results obtained from our study. An increase of milk fat% of cows' fed control ration or that containing 25% of WMV may be related to the increased molar (acetate to propionate ratio) of the rumen fermentation. Positive relationship exists between ADF and NDF digestion and milk fat percentage (Erdman, 1988). Also, many studies indicated that dairy cattle fed on rations inclusion treated roughage instead of berseem hay (BH) had no effect on milk yield, milk fat and milk protein % (Abd El-Khalek and Abd EL-Aziz, 2009) and (Freitas *et al.*, 2018).

Table 5. Milk production, chemical composition (%) of milk produced and economic efficiency of cows fed the experimental rations (Mean ± SE).

Items	Experimental rations				
	R1(control)	R 2	R 3	R4	R 5
DM intake (kg)	16.7	16.7	16.6	16.3	16.3
Milk yield (kg/d/h)	18.55 [a] ±1.76	18.21[a] ±2.53	17.67 [ab] ±2.21	17.09 [b] ±1.03	16.80 [b] ±2.64
4%FCM(kg/d/h)	17.94 [a] ±1.19	17.28 [a] ±1.77	16.56 [b] ±1.82	15.53 [c] ±2.75	15.06 [c] ±1.34
Fat%	3.78 [a] ± 0.25	3.66 [a] ± 0.34	3.58 [ab] ± 0.29	3.39 [b] ±0.37	3.31 [b] ±0.33
Protein%	3.36 ± 0.18	3.34 ± 0.15	3.33± 0.17	3.33 ± 0.16	3.32±0.24
Lactose	4.63± 0.21	4.63 ± 0.24	4.65± 0.19	4.67±0.26	4.68±0.18
Total solids	12.47 [a] ±0.92	12.33 [b] ± 0.73	12.26 [b] ± 0.75	12.09 [c] ±1.14	12.00 [c] ±0.87
SNF	8.69 ± 0.53	8.67 ± 0.43	8.68 ± 0.57	8.70±0.52	8.69±0.54
Daily feed cost/kg(LE)	54.1	52.1	50.1	48.1	46.1
Milk price	143.5	138.2	132.5	124.2	120.5
Net revenue	89.4	86.1	82.4	76.1	74.4
Economic efficiency%	165.0	165.0	164.4	158.2	161.3

[abc] Means in the same row with different superscripts significantly differ (P< 0.05).
Free market prices (LE/ton) for berseem hay = 2300LE.
Free market prices (LE/ton) for WMV treated with *Penicillium oxalicum* =1100LE.
Free market prices (LE/ton) for CFM = 5400LE.
Free market prices (LE/ton) for the whole silage corn= 750 LE.
Free market prices (LE/kg) for milk yield 4% fat = 8 LE.
According to year 2017 market price.

The economic efficiency% was higher for the cows fed control diet containing 25% WMV flowed that containing 100% and 50% berseem hay while lower recorded with that containing 75% and 100% of WMV. These results were in agreement with results obtained by Saleh *et al.* (2003) who reported that use vegetable vine hay as replaced by berseem hay in rations of lactating buffaloe could reduce feed cost and improve economic efficiency. Also, Galal *et al.* (2015) found that replaced berseem hay with vineberry vine hay in rations of growing lambs, lead to reduce feed cost and improve economic efficiency. Generally, include local agricultural by-products into ruminant diets could reduce the feed cost and improve the economic efficiency of animal production (Borhami and Yacout, 2001).

CONCLUSION

In conclusion, results obtained in this study indicated that replacement of the berseem hay with water milon vine treated with *Penicillium oxalicum* in animals feeding at a level of 25% and 50% led to decrease feed cost and increase income of 4% fat corrected milk and subsequently lead to higher economic efficiency.

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الإستفادة من عرش البطيخ المعامل بيولوجياً فى علائق أبقار اللبن

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الهدف من هذه الدراسة هو استبدال دريس البرسيم بواسطة عرش البطيخ المعالج بيولوجياً بفطريات البنيسيليوم اوكساليكم (تم تكوين خمس علائق تحتوي علي عرش البطيخ بنسب مختلفه ٠ ، ٢٥ ،٥٠ ، ٧٥ ، ١٠٠ % بالاستبدال مع دريس البرسيم) ودراسة تأثيرها علي معاملات الهضم باستخدام ١٥ حمل خليط بالغ لكل عليقة علي حده، كذلك تم تقدير قياسات سائل الكرش بإستخدام ثلاث من النعاج مهجنة مزودة بفستيولات دائمة في الكرش و كذلك تقدير كفاءة إنتاج الحليب باستخدام عشرة من ابقار الفرزيان الخليط الحلابه باستخدام تصميم المربع اللاتينيى (5 X 5). أظهرت النتائج تحسن في معاملات الهضم والقيمه الغذائيه معبراً عنها بمجموع المواد الغذائيه المهضومه والمهضوم من البروتين وذلك للعلائق التي تحتوي على ٢٥ ، ٥٠ % من عرش البطيخ مقارنة مع نتائج العلائق الاخري. ايضاً أوضحت النتائج المتحصل عليها من تخمرات الكرش ان العلائق المحتويه على ٢٥ ، ٥٠ % من عرش البطيخ أظهرت تحسن في نسبة مجموع الأحماض الدهنيه الطيارة ، حمض الأسيتيك ، نسبة C2: C3 وتخليق البروتين الميكروبي ، وكانت أعلى معنوياً من تلك العلائق التي تحتوي على ٧٥ و ١٠٠% من عرش البطيخ. بالنسبه للنتائج المتحصل عليها من تجربة إنتاج الحليب ومكوناته أشارت النتائج الي ارتفاع محصول اللبن ومكوناته في الأبقار التي تغذت علي عليقة المقارنه والعليقه التي تحتوي علي ٢٥ % عرش بطيخ. بينما لم تكن هناك فروق ذات دلاله إحصائية بين العلائق التجريبية في تناول العلف. كذلك أظهرت الأبقار التي تم تغذيتها علي عليقه الكنترول التي تحتوي علي ٢٥ % عرش بطيخ أعلى مستوي من حيث الكفاءة الاقتصادية حيث تساوت مع الابقار التي تغذت علي عليقه المقارنه ثم التي تغذت علي عليقه تحتوي علي ٥٠% من عرش البطيخ ، في حين أن تلك الأبقار التي تغذت على ٧٥٪ تلتها الأبقار التى تغذت على ١٠٠% من عرش البطيخ سجلت أدنى قيم من حيث الكفاءة الاقتصاديه.