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The Effects of Partial or Total Replacement of Maize Silage by *Panicum maximum* Silage in Lactating Cows Rations on Ruminal Fermentation, Digestibility and Methane Production

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Abstract

FIVE TOTAL mixed rations (TMR) were formulated to evaluate the influence of partial total replacement of maize silage (MS) with *Panicum maximum* silage (PS) on digestibility, rumen fermentation and milk yield of cows. The experimental rations were TMR contained 100% Maize silage (MS, T1); TMR with 75% MS + 25% PS (T2); TMR with 50% MS + 50% PS (T 3); TMR with 25% MS + 75% PS (T 4) and TMR with 100% PS (R5). Milk yield was performed on fifty Friesian cows (10 cows per treatment) for three months. Rumen fermentation and gas production were determined with Barki rams. The results cleared that CP content of both silages were close together, but ash and NDF were higher for PS but lactic and acetic acids were high for MS. Gas production (GP) was lower for PS on both 24 and 48 h than MS. Meanwhile, both GP for soluble (a), insoluble (b) and the cumulative GP (y) were less with PS than MS, as well as DMD, OMD and SCFA. Rumen fermentation data showed higher NH_3-N, less TVFA's and acetic with the increase of PS in the rations, while the control, R2 and R3 had more acetic compared to other rations. Rations contained 25 and 50 % of PS had more milk and 4% FCM yields, while the lowest milk yield was obtained by incorporating 100% PS in ration (R5). It could be advisable to PS replacing MS in ration up to 50% without any adverse effect on milk production.

Keywords: Panicum maximum silage, apparent digestibility, kinetics, rumen fermentation, milk yield.

Introduction

The increase in people density and increase in purchasing power led to rising demand for animal protein products in recent decades, especially meat and milk, whereas the respective increase in demand is predicted to rise in 2050 by 58% and 73 % [1]. It is important to maximize animal production by increasing yield and efficiency, which is the main challenge in animal production [2]. One of the determining factors in the animal production system in the tropical and subtropical is the lack of fodder supply. Therefore, to improve the animal nutrition and thus productivity, this requires an increase in more cultivation of summer fodder. It's well known that grazing during the advanced stages of the fodder's life its protein content decreases to values as low as 2-3%, and this is less than the animal maintenances (7-8%) [3]. In addition, the high lignified and fibrous content of fodder increases with advance of age through the dry season.

Meantime due to the existence of competition between monogastric and ruminants on the one hand, and humans on the other hand, in the availability of food, raises the prices of the materials included in the formulation of diets, which does not allow the animal to obtain its probable need of energy and protein, and thus leads to poor productivity. These led researchers to find ways to use non-traditional fodders and any types of grasses with high protein content and

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reserve them in the form of silage so that they can be used throughout the year when needed.

Babayemi [4] explained that the use of silage in the tropic allows animals to be supplied with what they need during the year on the basis of taking advantage of the excess grass and keeping it in the form of silage to cover those needs [5].

Panicum maximum (PM) is a promising fodder, it contains 2.67% crude fat, 30.66% crude fiber, 0.61% acid alanine, 0.16% methionine, 0.80% aspartic, 0.39% glycine, 0.45% phenyl alanine and 0.36% isoleucine [6]. It has a high protein content, which allows feeding on it, and their leaves are knowing to have important uses in the treatment of diabetic [7], malaria infections and inflammation, while anti-analgesic activities of leaf extract were reported by [8]. Therefore, it was thought to use it in nutrition with the possibility of replacing maize in order to reduce the cost of feeding. The objective of this study was to evaluate the influence of partially or completely replacement of maize silage (MS) with Panicum maximum silage (PS) on digestibility, rumen fermentation, gas production and milk yield of cows.

Material and Methods

The experiment was conducted at Nubaria experimental station , Animal Production Research Institute (APRI), Agriculture Research Center, Egypt, during summer 2022 .

Silage preparation and its quality

Whole crop maize and panicum maximum were collected and wilted for 24 hours until the moisture reach to 65% then chopped to about 1-2 cm in length and put on nylon plastic sheet on layers (20- 30 cm), after that the farmers press on this layers very well to remove all oxygen to make anaerobic condition then covered with another nylon plastic, after that covered with dust and leave for three months. Chemical composition of maize silage and panicum maximum and silage quality are presented in Table 1.

Animal's management

Fifty multiparous lactating crossbreed Friesian cows (early lactation) and live body weight (543 ± 12.26 kg) were randomly assigned into five groups (10 cows per group) for 3 months. The cows were housed individually in soil-surfaced tie stalls under shades and water was available free choice. Cows were milked twice daily (6.00 and 17.00) and milk yield was recorded. Milk samples were collected on d 25 to d 30, d 55 to d 60 and d 85 to d 90 for fat, true protein, and lactose analyses according to A.O.A.C. [9]. For determination of milk urea nitrogen (MUN) 5-mL milk sampled at 6.00 and 17.00 was mixed with 5 mL of 25% (wt/vol) TCA, then analyzed using an automated colorimetric assay Broderick and Clayton [10] adapted to flow injection (Lachat QuickChem 8000 FIA). Five completed feed rations were formulated to cover cow's nutrients requirements according to NRC [11]. Control ration (R1) contained 100 % maize silage (MS) and T2, T3, T4 and T5 had maize silage replaced by panicum maximum silage (PS) in 25, 50%, 75% and 100%, respectively. Content of feed mixture rations and its chemical composition are presented in Table 2. Silage, rice straw and concentrate feed mixture samples were taken daily, dried at 60 ºC in an air oven for 48 h then stored for chemical analyses. The proximate analysis of feed ingredients and rations are presented in Table 2.

Feed intake and nutrient digestibility

Daily feed and refusals were weighed to record daily feed intake through the experimental period (90 days). At the last week of the experiment period, the digestibility of feed was carried out by using internal indigestibility marker, lignin [12]. Digestion coefficients were calculated according to Ferret et al., [13]; feces samples were taken from cows twice daily at 07:00 and 15:00 h then dried in air oven at 60 ºC for 48 h.

Chemical analyses

Samples of maize silage and PS (300 g) were taken and oven-dried at 65 °C. Crude protein (CP), ether extracts (EE), and ash were analyzed according to AOAC [9]. Acid detergent fiber (ADF), neutral detergent fiber (NDF), and acid detergent lignin were determined according to Van Soest et al., [14]. Non-fiber carbohydrates (NFC) were calculated as: NFC = 1000 – CP – ash – EE – NDF.

Sampling and analysis of rumen fluid

Rumen fluid samples were collected 3 h after the morning feeding to determine total volatile fatty acids (TVFA) and nitrogen ammonia (NH_3-N). Rumen fluid sample were collected from 5 cows of each group using a stomach tube then strained through 4 layers of cheesecloth. A subsample of 5 mL was preserved in 5 mL of 0.2M HCl for NH_3-N analysis [9], and 0.8 mL of strained ruminal fluid was mixed with 0.2 mL of a solution containing 250 g of metaphosphoric acid/L for VFA analysis. Gas-liquid chromatography used to determine concentration of individual VFA.

Gas, CH_4 production, and in vitro digestibility

In vitro gas production was determined according to Menke and Steingass [15]. Three Barki rams was used to collect rumen fluid before morning feeding according to Babayemi and Bamikole [16]. Rams were feed at maintenance total mixed ration containing either MS or PM silages and CFM.

Rumen liquor was collected into thermos flasks then filtered through three layers of cheesecloth then 30 mL of buffered rumen fluid was taken into syringes containing the feed sample. Then they put in water bath with shaker kept at 39°C. Gas production was recorded at 3, 6, 9, 12, 24, and 48 hour of incubation period. Three blank syringes were also incubated.

Organic matter digestibility (OMD) was determined according to Menke and Steingass [15].

Short-chain fatty acids (SCFA) were determined according Getachew et al., [17].

Metabolizable energy (ME) was calculated according to Menke and Steinga≤ss [15]

Total gas volume (GV) was expressed as mL/200 mg DM, CP and ash as g/kg DM-1, ME as MJ/kg DM-1 and SCFA as µmol/g DM-1.

In vitro dry matter, organic matter, acid detergent fiber digestibility

After 48 h, the bottle contents were centrifuged, and residues were dried at 105 °C for 24 hours. The dry residues were weighed, and digestibility calculated as follows

$$IVDMD\ (\%) = \frac{\text{Initial DM input} - \text{DM residue-Blank}}{\text{Initial DM input}} \times 100$$

Economic efficiency:

Equations of efficiency

Total revenue = milk yield * milk price

Net revenue= Total revenue – feed price

Economic efficiency= Net revenue / feed price

Statistical analysis

Data that obtained from nutrient digestibility's and milk yield were analyzed according to a one-way analysis of variance (ANOVA) by using SPSS [18]. The significance differences between the groups were declared at p ≤ 0.05 by using the Duncan [19]. Rumen parameters and gas production data were analyzed according to Latin square analysis.

Results

Data in Table 1 showed the proximate analysis of maize and panicum silages. Panicum maximum silage had more DM, CP, Ash, NDF, pH and Butyric acid than that in maize silage, while it had less CF, EE, NFC, NH3-N, Lactic and Acetic acids. To the discussion acetic acid value in maize silage was more by about 48% compared with PS. Ammonia nitrogen content in the two silages was close together.

The ration ingredients and levels of PS replacements (25, 50, 75 and 100%) are presented in Table 2. Crude protein content of R4 and R5 (75% and 100% PS) was little bit more than other rations; MS had more CF and NFC contents than the rest of rations. Meantime, EE, Ash, NDF and ADF content were quiet the same in all rations. However, all rations were in isocaloric and isonitrogenus.

Gas production, in vitro gas production kinetics and ration degradability are presented in Table 3. It is noticeable that gas production increased with the progression of the incubation period time. The highest (P≥0.05) gas produced was observed with MS rations and it decreased with increasing rates of replacement with PS.

The presence of PS in rations always resulted in less gas production, at 48 hr for instances R2 and R5 had less gas production by about 10.23 to 27.21%, respectively compared with the control one. It was clear that all gas production kinetics decreased as well with more PS replacement percentage in the ration. Control ration (R1) has Higher (P≤0.05) a cumulative gas production (Y). Meantime, the control ration had almost higher methane production. Ration contained 100% MS had higher (P≤0.05) OMD, DMD and NDFD. As percentage of PS increased in rations DM, OM and NDF degradability decreased.

Although ruminal pH values increased with increasing replacement level of PS in rations, still they had in the normal range. As replacement level of PS in ration increased ruminal NH3-N, Propionic (P) and butyric acids increased, while TVFA, acetic (A) acid ratio decreased. All apparent digestibility (%) for the control (R1), R2 and R3 were highest (P≤0.05) with insignificant among each other's. The worst one was R5 (Table 4).

No significant differences were noticed for DMI among the experimental rations (Table 5). Rations 2 and 3 had the highest (P≤ 0.05) milk production (26 and 10% more than R1) followed by R1 while higher percentage of PS replacing MS (R4 and R5) presented the lowest (P≤ 0.05) milk production. However, milk composition (fat, protein and lactose) wasn't affected by level of replacement, while protein yield was higher (P≤0.05) for R1, R2 and R3, with increasing level of PS causing decrease in the protein yield. Same trend was obtained for 4 % FCM.

There was increasing in BUN values by increasing level of PS replacement. The same trend was observed with milk urea nitrogen (MUN). Therefore, BUN and MUN presented the same trend as they decreased with the increase PS replacement level.

Economic efficiency

Net revenue for R1, R2 and R3 was the highest and comparable to each other's. On the other hand, low revenue was recorded by R4 and R5.

Discussion

In this study, the decrease in pH of the maize silage was in the normal range and this agreed with Lamidi and Ojo [20], while that of PS was quiet more but still within the normal pH values of silage making. This was a result of increasing analysis of carbohydrate in fermentation process which characterizes the process of ensiling which make sugar more suitable for producing lactic acid [21]. However, both pH values in MS and PS were indicated for good silages. Also, Whiter and Kung [22] found that as DM increases the metabolic water which is available for the growth of lactic acid bacteria become limiting, whereas it led to decrease lactic acid value. Kung and Shaver [23] found that values of pH ranges between 4.3 and 4.7 for the tropics plants whereas they used in making silage. The normal range of pH more acidic helps silage preservation i.e., inhibit mold or fungi activities. In general, good quality fermentation is caused by anaerobic production of lactic acid, while poor quality fermentation is caused by aerobic butyric acid production, in which Limin Kung et al. [24] showed that the second highest acid concentration in the silage was acetic acid, ranging from 1 to 3% of dry matter. There is usually inverse relationship between concentrations of acetic acid and DM content. Increasing protein content in R4 and R5 may be a result of high protein percent in PS silage. The less CF in all PS silages could be related to the lower CF content in panicum than in maize.

The decrease in gas production by increased level of replacement may be related to that maize silage with grains had high content of sugars, starch, or hemicellulose, in which they are easily fermented substrates for rumen microbes leading to methane and gas production. However, increasing in soluble carbohydrates lead to increase ciliates protozoa population and stimulate hydrogen transfer to methanogens and this lead to increasing methane production. Canul-Solis et al. [25] found that tropical plants contain some secondary metabolites which prevent methanogenesis in the rumen and decrease CH_4 production. Also, El-Zaiat et al. [26] reported that feeding sheep on tropical forage in diet showed decrease in CH_4 production by 11.45%. Meanwhile, the in vitro experiment showed reduced CH_4 production to almost 23% compared to control. The degradation of carbohydrates using H_2 to reduction of CO_2 for producing methane. The decrease of methane production followed the increase level of PS replacement may be attributed to the reduction in H_2 produced during the formation of acetic acid from pyruvate, which can be used as a substrate for formation of CH_4 gas [26].

This decrease could lead to reduce environmental effect on animal production, meantime reducing in animal methanogenesis and increasing protein supply of the animal. However, the presence of plant secondary compounds in plant such tannin has also been linked to reduced methane emission from the rumen [27].

The decreased in ruminal degradation kinetics followed of increased level of PS in rations could led to decrease concentration of carbohydrates highly fermentable and digested, and this agreed with the finding of Joel et al. [28]. However, increasing quality of forage may decrease methane production as the fermentation route changed resulted from increased contents of easy fermentable carbohydrate which had higher passage rate and degradability. The same trend was observed in NDFD, and this is as result of increase fiber content which effect on degradability. It will know that any feedstuffs material that have higher IVDMD and gas production tend to have higher CH_4 production. This increase agreed with Campanili et al. [29] found that increase level of NDF in diet from concentrate and silage didn’t affect the time that steers chewing diet, and this led to secrete a greater amount of salt buffer, or from less ruminal degradation of these materials. Fermentation of dietary protein in rumen led to produce N compounds (NH_3-N). However, decreasing values of ammonia-N indicated that rumen microbes were used ammonia in building their body and produce single cell protein that ruminant can use. This is in agreement with the finding of Binuomote et al. [30] who found that this decrease may be indicator of the increase nitrogen uptake by rumen microbes as source of amino acid in the ruminants. Also, rumen ammonia can increase as result of insufficient energy in diet and limiting synthesis of microbial protein [31] It's well known that ruminants take about 70% of energy requirement from VFA that are classified as main end-product of anaerobic carbohydrates fermentation in the rumen [32]. The decrease of VFA values may be due to decrease digestion coefficient of diets especially fibers and this decrease was also in accordance with acetic acid values [33] .He also reported that acetic acids values indicated that predominate of volatile fatty acids production is acetic acids and this could be related to the nature of the forage fed to the ruminants and its chemical composition.

Meanwhile, the increase level of Propionic and Butyric acids with increasing level of PS replacements were agreed with the results obtained by Binuomote et al. [30] by feeding West African sheep with different levels of panicum maximam.

It was clear that rations contained up to 50% of PS can be considered better replacement for improvement of nutrients digestibility due to improve of rumen fermentation and rumen microbes. The less digestibility followed by high level of PS in rations may be due to the increase CF content which had inversely effect on microbes and all rumen condition [34] Higher milk production was agreed with Dannylo Sousa et al. [35] who found that milk production and intake was affected by formulation of diet more than forage source. Depeters and Ferguson [36] reported that the concentration of BUN reduces by increasing amount of NFC in feed diet which rapidly ferments. Maria et al. [37] reported that when the concentration of BUN increases there is an evidence on decrease efficiency of nitrogen utilization in the rumen.

Blood urea nitrogen concentration (i.e., BUN) was well known as indicator for balance of nitrogen and energy in ration for microorganisms in rumen to synthesis microbial protein [38], The BUN and MUN took same trend as they decreased with the increase of the replacement level of PS and theses are related to protein degradation of the rations, protein to energy ratio and concentration of NH3-N in the rumen [39].

Conclusion

It may be advisable to partially replace maize silage with panicum maximum silage at 25 and 50% levels in dairy cow rations in order to improve rumen fermentation, nutrient digestibility and get acceptable revenue without any adverse effect on cow's health and milk yield.

Declarations

Ethical Approval

The animal study was examined and authorized by the APRI's ethical committee, which is part of the Agricultural Research Centre in Egypt.

Competing interests

The authors declare that when conducting their search, there was no business or financial relationships that may be interpreted as constituting a conflict of interest.

Authors' contributions

HAS, AAH, MHY, MSK, and AAE, AMS organized the experiment, carried out the research, and finished the laboratory analysis. AAH, MHY, and AZMS finished the data analysis, writing, and paper revision. All writers examined the final manuscript and approved it.

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Availability of data and materials

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TABLE 1. Chemical composition of maize and *Panicum maximum* silages and their quality (on DM basis)

Items	Maize silage	*Panicum maximum* silage
Chemical composition (g/100 g DM)		
CP	8.06	8.94
CF	23.75	21.62
EE	2.15	1.56
Ash	6.27	11.89
NFC	27.17	11.87
NDF	56.35	65.74
Silage quality		
DM, g/kg	283.7	313.5
pH	3.9	4.5
NH_3-N, g/kg total-N	68.2	61.7
Lactic acid, g/kg DM	89.1	45.8
Acetic acid, g/kg DM	26.4	13.7
Butyric acid, g/kg DM	0.1	0.32

NFC: Non-Fibrous Carbohydrates; CP: Crude Protein; CF: Crude Fiber; EE: Ether Extract; NDF: Neutral Detergent Fiber; DM: Dry Matter.

TABLE 2. **Composition and nutrient levels of experimental rations**

Ingredients (% DM)	Treatments				
	T1	T2	T3	T4	T5
Maize silage	53.5	40.125	26.75	13.375	0.0
***Panicum maximum* silage**	0.0	13.375	26.75	40.125	53.5
Rice straw	4.5	4.5	4.5	4.5	4.5
Maize grain	6.5	6.5	6.5	6.5	6.5
Wheat bran	5.5	5.5	5.5	5.5	5.5
Sugar Beet pulp	2.6	2.6	2.6	2.6	2.6
Sunflower meal	8.2	8.2	8.2	8.2	8.2
Soybean meal	14.6	14.6	14.6	14.6	14.6
Beet molasses	2.19	2.19	2.19	2.19	2.19
Limestone	1.2	1.2	1.2	1.2	1.2
Di-calcium phosphate (DCP)	0.5	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5	0.5
Sodium bicarbonate	0.11	0.11	0.11	0.11	0.11
Vitamin-Mineral Premix	0.1	0.1	0.1	0.1	0.1
	100	100	100	100	100
Chemical composition (%DM basis)					
DM	61.78	62.06	62.87	63.02	63.56
CP	14.66	14.79	14.91	15.05	15.16
CF	18.15	17.97	17.87	17.60	17.42
EE	2.86	2.78	2.71	2.63	2.56
Ash	6.71	6.78	6.81	6.96	7.15
NDF	35.63	35.87	36.05	36.29	36.55
ADF	21.48	21.59	21.77	21.89	22.06
NFC	40.14	39.78	39.52	39.07	38.58
Net Energy (NEl), Mcal/kg DM	1.67	1.62	1.59	1.53	1.46

NFC: Non-Fibrous Carbohydrates; CP: Crude Protein; CF: Crude Fiber; EE: Ether Extract; NDF: Neutral Detergent Fiber; DM: Dry Matter.

TABLE 3. Effects of different levels of *panicum maximum* silage on gas production, degradability and in vitro gas production kinetics at different incubation periods for rations

Gas production, ml	Treatments					SEM	*p* value
	T1	T2	T3	T4	T5		
3 h	6.4^{a}	6.1^{a}	5.7^{ab}	5.3^{b}	4.9^{b}	0.27	0.026
6 h	15.7^{a}	14.6^{a}	12.3^{b}	10.2^{c}	9.9^{c}	0.98	0.001
12 h	26.9^{a}	24.5^{b}	23.8^{b}	20.4^{c}	18.6^{d}	0.86	0.001
24 h	35.7^{a}	32.5^{b}	30.9^{bc}	29.7^{c}	27.6^{d}	1.78	0.001
48 h	44.1^{a}	39.6^{b}	36.6^{c}	34.8^{cd}	32.1^{d}	1.94	0.001
in vitro gas production kinetics							
a	23.1^{a}	20.9^{b}	18.1^{c}	17.8^{c}	15.6^{d}	0.46	0.001
b	62.4^{a}	58.6^{b}	51.5^{c}	47.3^{c}	42.7^{d}	3.56	0.001
c	0.06	0.05	0.05	0.06	0.03	0.02	0.571
Y	18.55^{a}	15.76^{b}	13.92^{bc}	12.41^{c}	10.66^{d}	1.43	0.001
SCFA (µmol g^{-1})	1.53^{a}	1.39^{b}	1.31^{bc}	1.26^{c}	1.17^{d}	0.06	0.001
ME (MJ.kg^{-1})	7.16^{a}	6.59^{b}	6.27^{b}	5.98^{bc}	5.54^{c}	0.41	0.001
Methane at 24 h, ml	11.20^{a}	10.66^{b}	10.39^{b}	10.31^{bc}	9.89^{c}	0.35	0.001
Degradability (%)							
OMD	52.76^{a}	50.36^{b}	49.05^{bc}	48.35^{c}	46.22^{d}	1.21	0.001
DMD	49.66^{a}	46.94^{b}	45.25^{bc}	44.76^{c}	42.07^{d}	1.33	0.001
NDFD	41.46^{a}	38.66^{b}	37.57^{bc}	36.07^{c}	32.64^{d}	1.07	0.001

^{abcd}Means in the same row with different superscripts differ, P ≤ 0.05.

a = gas production produce from the soluble fraction (ml), b = gas production produce from the insoluble fraction (ml), c = gas production rate (ml/h), Y= the cumulative gas production at time (t): SCFA: Short Chain Fatty Acid; ME: Metabolizable Energy; OMD: Organic Matter Digestibility; DMD: Dry Matter Digestibility; NDFD: Neutral Detergent Fiber Digestibility.

TABLE 4. Effects of different levels of *panicum maximum* silage on ruminal fermentation and apparent digestibility for dairy cows

Ruminal fermentation	Treatments					SEM	*p* value
	T1	T2	T3	T4	T5		
pH	6.25 ^{b}	6.29 ^{b}	6.30 ^{ab}	6.33 ^{a}	6.37 ^{a}	0.03	0.013
Ammonia-N (mg/L)	124 ^{d}	131 ^{c}	137 ^{b}	144 ^{a}	149 ^{a}	4.75	0.001
Total volatile fatty acids (mmol/L)	133 ^{a}	121 ^{b}	115 ^{b}	111 ^{bc}	107 ^{c}	5.84	0.001
Acetic acid (mmol/L)	69.45 ^{a}	66.06 ^{b}	64.23 ^{b}	61.42 ^{c}	59.14 ^{c}	2.06	0.006
Propionic (mmol/L)	26.77 ^{b}	28.06 ^{ab}	29.23 ^{a}	29.97 ^{a}	31.25 ^{a}	1.63	0.003
Butyric (mmol/L)	7.46 ^{c}	8.22 ^{b}	8.67 ^{ab}	8.94 ^{a}	9.14 ^{a}	0.44	0.001
Acetic/propionic ratio	2.59 ^{a}	2.35 ^{b}	2.20 ^{b}	2.05 ^{bc}	1.89 ^{c}	0.13	0.001
Apparent digestibility, %							
DM	64.25 ^{ab}	64.98 ^{a}	65.42 ^{a}	63.06 ^{b}	60.16 ^{c}	1.36	0.005
OM	65.75 ^{ab}	66.05 ^{a}	66.57 ^{a}	63.82 ^{b}	60.77 ^{c}	1.06	0.009
CP	62.15 ^{ab}	62.76 ^{a}	63.07 ^{a}	61.06 ^{b}	59.41 ^{c}	0.84	0.017
NDF	55.25 ^{ab}	56.48 ^{a}	56.96 ^{a}	53.01 ^{b}	50.38 ^{c}	0.93	0.001
ADF	49.03 ^{ab}	49.85 ^{a}	50.24 ^{a}	47.36 ^{b}	45.27 ^{c}	0.67	0.014

^{abc}Means in the same row with different superscripts differ, $P \leq 0.05$. OM: Organic Matter; DM: Dry Matter; CP: Crude Protein; NDF: Neutral Detergent Fiber; ADF: Acid Detergent Fiber.

TABLE 5. **Effects of different levels of *panicum maximum* silage on milk yield of dairy cows**

Items	treatments					SEM	*p* value
	T1	T2	T3	T4	T5		
Cow BW, kg	575	543	551	563	581	54.46	0.842
DMI, kg/d	16.75	16.35	16.21	16.15	16.04	0.67	0.783
N intake, g/d	392.89	386.91	386.71	388.89	389.06	5.94	0.794
Milk, kg/d	19.85 ^{b}	20.25^{a}	20.01 ^{a}	18.15 ^{c}	17.85 ^{c}	0.61	0.001
Feed efficiency	1.19 ^{b}	1.24 ^{a}	1.23 ^{a}	1.12 ^{c}	1.11 ^{c}	0.02	0.0001
Milk fat, %	3.4	3.4	3.3	3.5	3.5	0.12	0.844
Fat yield, kg/d	0.67	0.69	0.66	0.64	0.62	0.05	0.752
Milk true protein, %	3.04	2.98	2.95	2.97	2.91	0.12	0.788
Protein yield, kg/d	0.60 ^{a}	0.60 ^{a}	0.59 ^{a}	0.54 ^{b}	0.52 ^{b}	0.02	0.026
Milk lactose, %	4.48	4.52	4.51	4.53	4.57	0.08	0.805
Lactose yield, kg/d	0.89	0.92	0.90	0.82	0.82	0.07	0.753
Milk N, % of N intake	23.94 ^{a}	24.31 ^{a}	23.91 ^{a}	21.79 ^{b}	20.95 ^{c}	0.16	0.001
BUN, mg/dL	15.0^{c}	15.6 ^{b}	15.9 ^{b}	16.4 ^{a}	16.7 ^{a}	0.25	0.001
MUN, mg/dL	14.1 ^{b}	14.5 ^{b}	15.1 ^{ab}	15.6 ^{a}	15.9 ^{a}	0.27	0.017
4% FCM, kg/d	17.99 ^{a}	18.45 ^{a}	17.90^{a}	16.86 ^{b}	16.44^{b}	0.31	0.026
ECM, kg/d	19.48 ^{b}	19.87 ^{a}	19.34 ^{b}	18.11 ^{c}	17.61 ^{c}	0.13	0.001
ECM Feed efficiency	1.16 ^{b}	1.22 ^{a}	1.19 ^{ab}	1.12 ^{c}	1.09 ^{c}	0.02	0.001

^{abc}Means in the same row with different superscripts differ, $P \leq 0.05$. FCM - fat corrected milk determined according to equation of gains: 4% FCM = 0.4 milk yield + 15 fat yield; BW: Body Weight; DMI: Dry Matter Intake; N: Nitrogen; BUN: Blood Urea Nitrogen; MUN: Milk Urea Nitrogen.

TABLE 6. Economic return from PS replacement effect

Items	T1	T2	T3	T4	T5
Price TMR/ton	3858.22	3784.66	3711.1	3637.53	3563.97
TFI(Kg)	16.75	16.35	16.21	16.15	16.04
Feed price (LE)	64.63	61.88	60.16	58.75	57.17
Milk yield (Kg)	19.85	20.25	20.01	18.15	17.85
MP/Kg (LE)	6	6	6	6	6
Total revenue	119.1	121.5	120.06	108.9	107.1
Net revenue	54.47	59.62	59.90	50.15	49.93
Economic efficiency	0.84	0.96	0.99	0.85	0.87
Relative economic efficiency	100	114	118	101	103

TMR: Total Mixed Ration; MP: Milk Price; TFI: total feed intake.

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تأثير الاحلال الكلى او الجزئي لسيلاج نبات البونيكام محل سيلاج الذرة فى علائق الابقار الحلابه على تخمرات الكرش ، معاملات الهضم و انتاج الميثان

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الخلاصة

تم تكوين خمس علائق لتقييم امكانيه الاستبدال الجزئى او الكلى لسيلاج الذرة بسيلاج البونيكام على معاملات الهضم ، تخمرات الكرش، انتاج الميثان وانتاج اللبن فى الابقارالحلابه . حيث كانت العلائق التجريبيه هى : عليقه المقارنه (T1) علف مركز+ سيلاج ذرة 100% ، العليقه الثانيه (T2) علف مركز+ 75% سيلاج ذرة + 25% سيلاج بونيكام ، العليقه الثالثه (T3) علف مركز+ 50% سيلاج ذرة + 50% سيلاج بونيكام ، العليقه الرابعه (T4) علف مركز+75% سيلاج بونيكام. + 25% سيلاج ذرة ، عليقه الخامسه (T5) علف مركز+ سيلاج بونيكام 100% و تم اجراء تجربه انتاج اللبن باستخدام 50 بقرة (10 بقرات فى المجموعه) لمده ثلاثه اشهر. تم اجرا تجارب انتاج الغاز و تخمرات الكرش على كباش برقى

واوضحت النتائج ان محتوى البروتين لكلا النوعين من السيلاج متقاربه فى حين ان محتوى Ash و NDF كانت اعلى لسيلاج البونيكام فى حين ان سيلاج الذرة كان اعلى فى محتوى حمض اللاكتيك و الاستيك و لوحظ انخفاض انتاج الغاز لسيلاج البونيكام فى توقيت ال 24 و 48 ساعه و ايضا الاحماض الدهنيه قصيره و فى قياسات تخمرات الكرش لوحظ انه بزيادة نسبه الاحلال لسيلاج البونيكام فى العلائق ادى لزيادة الامونيا و انخفاض الاحماض الدهنيه الكليه الطيارة بينما الكنترول و العليقه الثانيه و الثالثه كانت اعلى فى الاسيتك مقارنتا بباقى العلائق . العلائق التى تحتوى على 50% , 25% من سيلاج البونيكام كانت اعلى فى انتاج اللبن معدل الدهن (4%) و اقلهم فى الانتاج كانت التى تحتوى على 100%سيلاج بونيكام ومن خلال ذلك يمكن استخدام نسبه الاحلال 50% للحصول على افضل النتائج دون حوث تاثير سلبي على الحيوان.

الكلمات الداله : سيلاج البونيكام ،معاملات الهضم ، انتاج الميثان ، تخمرات الكرش و انتاج اللبن.