EVALUATION OF FEEDING *PANICUM MAXIMUM* FORAGE FOR RUMINANT

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SUMMARY

The study conducted to evaluate the possibility of partially or completely replacement of clover hay (CH) with *Panicum maximum* (Pm) on digestibility, nitrogen balance, rumen fermentation, gas production and its effect on calves performance. The digestibility trial was conducted using three males Barki sheep fed one of the four experimental rations as follow: ration (1) was concentrate fed mixture (CFM) + 100% CH (control) ; second one (T2) was fed CFM + 75% CH + 25% Pm; third one (T3) was fed CFM 50% CH + 50% Pm and fourth one (T4) fed CFM + 100% Pm. Growth trial was carried out for 90 days using 20 calves (5 one each group) .Rumen fermentation and gas production trials were evaluated by 3 rams with rumen fistula .The results were showed more ($P< 0.05$) improvement in nutrients digestibility with T2 compared to the control and the other experimental groups . Less improvement was obtained for T4, while T3 was close to the control group. These were reflected on TDN, DCP and N balance as it was high for T2, while T4 was recorded the lowest ($P< 0.05$) one. No significant differences were noticed for pH values among experimental rations. T1 had the ($P< 0.05$) highest NH_3 concentration, but it had the lowest VFA,s value as it was higher for T2 .Insignificant differences was found among experimental groups for microbial protein (MP) synthesis among the ration contained Pm . While, T1 was recorded ($P< 0.05$) less MP, but it had the highest gas production and short chain fatty acids (SCFA) was followed by T2, meantime T4 showed less gas production and SCFA. T2 was showed the highest DWG and the best FCR; the less one was T4, while values of T1 and T3 were close together. Also, T2 had better economic efficiency followed by T3 and T1 and the lowest one was T4.

***Keywords**: Panicum maximum**,** nutrients digestibility**,** rumen fermentation, nitrogen utilization, kinetics and gas production.*

INTRODUCTION

The main factor of limiting the small ruminant's production in developing countries is decreasing digestibility of forages at dry season which didn't cover farm animal's requirements. In Egypt, the gap between requirements and availability of animal feedstuffs is about 9 million tons of dry matter, (El-Talty, *et al*., 2009). However, feed resources can be divided into low protein , high fiber feeds and organic matter digestibility between 30 – 45 % , it concluded crop residues , grasses and fibrous agro-industrial by- products. In tropical countries, small ruminants consumed it as it produced in large quantities and very cheap as well (Akinyemi *et al*., 2010). The seasonality of forage production under tropical conditions causes variation in crops production and quality through the year and this lead to the seasonality in production of animals (Santos *et al*., 2004). Thus, it is necessary to overcome the seasonality in quality of the forage and production in this period by using high-yield grasses to meet the nutritional requirements of animals (Oliveira *et al*., 2005). Supplemented diets with *Pm* and high quality forages that available all over the year because it had high leaf and seed production and very palatable to animals (Yusuf *et al*., 2016).

Panicum maximum is adapted to tropics and subtropical areas; planted in all types of soil they are good drained, fertile. The depth, dense and root system allows surviving during the drought periods (Aganga and Tshwenyane, 2004). Fiber has very important role in ruminant nutrition as it to maintain the animal health and rumen fermentation and physiology as well (Aghsaghali and Maheri-Sis, 2011).

Increase physically effective neutral detergent fiber (NDF) and fiber content led to enhances rumen fermentation, saliva flow, maintains the rumen pH and increase milk fat percent. Also, level of NDF and the particle size in the diet increase the dry matter intake and improve ruminant performance (Banakar *et. al.*, 2018). Generally, NDF of legumes is more rapid digestion compare with grasses forage, but grasses forage have high content of neutral detergent fiber which highly digestible.

The aim of this study were (1) to study the effect of the partial replacement of clover hay by different levels of *Panicum maximum* (25, 50 or 100%) in Barki rams ration. (2) Study the effect of this replacement on digestion coefficients, rumen parameters, gas production, kinetics parameters and growth performance of calves.

MATERIALS AND METHODS

This experiment was conducted at Noubaria Station; By-products Utilization Department belongs to the Animal Production Research Institute (APRI), Agricultural Research Centre, Egypt. Four experimental rations were formulated as following:

Concentrate feed mixture (CFM) + 100% Clover hay (CH) T1, Control.

CFM + 75 % CH+25 % *Panicum Maximum* (Pm), T2.

CFM + 50 % CH+50 % Pm, T3.

CFM + 100 % Pm, T4.

The concentrate feed mixture (CFM) consist of : 42% yellow corn, 25% wheat bran, 13% soybean meal, 6% sugar beet pulp, 8% cottonseed meal, 3% molasses, 1.5 % limestone, 1 % salt and 0.5 % premix. Chemical composition of CFM, CH and Pm are showed in Table (1).

Digestibility, nitrogen balance and rumen fermentation trials:

Trials of nitrogen balance and digestibility were carried out using twelve Barki rams (54 ± 2 kg; 3 rams in each treatment). Rams were fed twice daily according to NRC (2001) at 8:00 a.m and 2:00 p.m, and water were freely offered. Animals were housed in metabolic crates. They fed the experimental rations for two weeks as the adaptation period followed by 7 days as collection period. Subsamples (20%) of urine and feces were taken once daily and frozen until analysis.

Samples of fecal were air dried at 60 ºC for 72 h. The feed and fecal samples were ground through 1-mm screen (Wiley mill grander). Sample of ration (50 g/ treatment) was analyzed according to AOAC (1997) for dry matter (DM), organic matter (OM), crude fiber (CF), crude protein (CP), and ether extracts (EE). Cell wall constituents were determined for acid detergent fiber (ADF), neutral detergent fiber (NDF) and lignin (ADL) according to Van Soest *et al,* (1991). Hemicellulose and cellulose were calculated by the differences. Urine samples were analyzed for N according to AOAC (1997).

Samples of rumen liquor were taken three times (0, 3 and 6 h) in the morning after feeding from four fistulated ewes for each ration applying 4x4 Latin square design experiment . Rumen pH was immediately measured using digital pH meter then the fluid was strained by using four layers of cheese cloth at each sampling time for other analyses. Ammonia-N concentration was measured by using MgO as reported by Al-Rabbat *et al.* (1971). The concentration of total volatile fatty acid was measured by using steam distillation as reported by Warner (1964). The Microbial protein synthesized in sheep's rumen that fed the experimental rations were estimated by using this equation that developed by Borhami *et al*. (1992):

Microbial protein g/day= mole VFA produced/day × 2 × 13.48 × 10:5 × 6.25/100;

Where one mole of VFA gives about 2 mole ATP (Walker, 1965); one mole of ATP produces about 13.48 YATP (g of DM microbial cell) (Borhami *et al.*, 1979) and N percentage of dry microbial cell = 10.5 (Hungate, 1965).

In vitro gas production technique:

In -vitro gas production was estimated according to the procedure reported by Menke and Steingass (1988).

Syringe preparation:

Samples (200 mg) of feedstuffs were accurately weighted into 50 ml calibrated glass syringe had plungers. The buffer solution was used *in-vitro* gas production reported by (Onodera and Henderson, 1980).

Rumen liquor preparation:

Rumen liquor was collected from cannulated ewes fed clover hay. The rumen liquor was collected in the morning before feeding animals. The liquor was placed in pre warmed (39ºC) insulated flasks and preserved under anaerobic conditions. The rumen liquor was squeezed by using four layers of cheese-cloth and kept in a warm water bath at 39ºC with CO_2 saturation until inoculation took place. Buffer and inoculum (2:1v/v) were mixed and kept in a warm water bath at 39ºC with CO_2 saturation (Onodera and Henderson, 1980). Buffered rumen fluid (15ml) was pipetted into all syringes that containing the feed samples, and immediately placed into the water bath. Syringes were incubated *in-vitro* in warm water bath for 48 h and gently shaken every 2 hr. Gas production was recorded at 3, 6**,** 12 and 24 h of incubation.

Cumulative gas production:

The cumulative gas production (Y) at time (t) was fitted to the model of Ørskov and McDonald, (1979). Gas (t) = a+b× (1-exp-ct)

Where; a = the gas produce from the soluble fraction (ml), b = the gas produce from the insoluble fraction (ml), c = the rate of gas production (ml/h), and t = incubation time (h).

Methane determination:

Methane volume, the percentage of methane in the total gas and carbon dioxide volume were calculated according to Fievez *et.al.* (2005).

Statistical analysis:

Data was obtained from nutrients digestibility, nitrogen balance and growth performance of calves were subjected to a one-way analysis of variance (ANOVA) using SPSS (2015). The significance between the treatments was declared at P < 0.05 by applying the Duncan test (1955). According to the following statistical model:

$$Y_{iK} = \mu + Xi + e_{ik}$$

Where: Y_{iK} = the response variable; µ = the overall mean; X_i = the fixed effect of treatment; e_{ik} = the residual error.

Data for rumen parameters and gas production were subjected to Latin square analysis according to the following model:

$$Y_{iK} = \mu + Xi + T_j + e_{i\,jk}$$

Where: Y_{iK} = the response variable; µ = the overall mean; X_i = the fixed effect of treatment; T_j = the fixed effect of time and eijk = the residual error.

RESULTS AND DISCUSSION

Proximate analysis of *Panicum maximum* (Pm) , clover hay (CH) and concentrate feed mixture CFM fed to the experimental animals are presented in Table (1) .Variability in the nutrient content of Pm in this study has been related to the differences plant parts , species, , season, location, harvesting regime, age and soil type (Norton ,1994). Both plants Pm and CH had nearly same organic matter (OM) content being 88.4% and 88.5%, respectively. The crude protein (CP) content of Pm being 10.2% was less than that of CH and nearly the same with that reported by Sallam *et al.* (2019). Crude fiber (CF) content of Pm was 32.6% this is agree with the observation of Okoli *et al*. (2003) who illustrated that tropical grasses content of CF is usually higher, meantime its NDF content of Pm was higher by about 34.84% compared with CH. Ash content of CH and Pm was nearly the same .While micro minerals content of Pm was higher than that of CH, while it's content of macro mineral was higher than that of Pm.

Nutrients digestibility of the experimental rations are presented in Table (2). Replacement of CH by 25% of Pm (T2) was resulted in more (P< 0.05) digestibility of all nutrients compared with the control and the other rations. Meantime, replacement of 75% of CH (T3) had less nutrients digestibility compared to T2 and T1 in nutrients. On the other hand, ration contained 100% Pm was recorded the lowest ($P< 0.05$) nutrients digestibility. So, as the replacement at 25% the most of digestibility obtained the improvement in the nutrients digestibility for T2 could be due to the increase of feed intake which related to the easier digestion of the grass over legumes (Mertens, 1997 and Banakar *et al*., 2018). Dwayne and Paren (1997) reported that grass fiber can be digested by ruminant at rate of 60-70%, while the legume fiber can digested by 40-50%. With the increase of Pm replacement, the ration was contained more ADL which was less degraded in the rumen and could be not digested (Mertens, 1997). It is well known that with the advanced of the forage maturity the CF and its content (NDF, ADF and ADL) increased at the expense of CP which resulted in fewer digestibility. There is an inverse relationship between the forage content of ADL and the nutrients digestibility (Van Soest, 1965).

Table (1): proximate analysis of clover hay (CH), *Panicum maximum* (Pm) and concentrate feed mixture (CFM) (% DM basis)

Item	CH	Pm	CFM
DM	89.5	63.7	89.5
OM	88.4	88.5	96.7
CP	12.3	10.2	14.4
CF	21.8	32.6	6.1
NDF	44.2	59.6	32.1
ADF	27.1	31.0	21.3
ADL	5.1	6.8	5.0
EE	2.7	1.7	3.0
NFE	51.6	44.0	73.2
Ash	11.6	11.5	3.3
Macro minerals:(ppm)			
Ca	1.8	0.005	0.016
Na	0.15	0.023	0.052
K	4.4	0.377	1.163
Mg	0.07	0.023	0.066
P	0.2	0.031	0.056
Micro minerals:(ppm)			
Fe	1.0	6.2	3.2
Zn	1.8	2.7	3.75
Cu	0.4	0.61	0.25
Mn	3.2	4.16	3.14

CH: clover hay; Pm; panicum maximum and CFM: concentrate feed mixture. DM: Dry matter; OM: Organic matter; CP: Crude protein; CF: Crude fiber; NDF: Neutral detergent fiber; ADF: Acid detergent fiber; ADL: Acid detergent lignin; EE: Ether extract; NFE: Nitrogen free extract; Ca: Calcium: Na: Sodium; K: Potassium; Mg: Magnesium; P: Phosphorus; Fe: Iron; Zn: Zinc; Cu: Copper ;Mn: Manganese

Table (2): Digestion coefficient and nutritive value% of the tested rations fed to Barki sheep.

Item	Experimental rations				SEM
	T1	T2	T3	T4	
Digestibility coefficient (%)					
DM	60.72 ^{c}	65.68 ^{a}	62.36 ^{b}	60.19 ^{c}	0.74
OM	61.62 ^{c}	66.89 ^{a}	63.31 ^{b}	61.61 ^{c}	0.42
CP	56.81 ^{b}	58.14 ^{a}	56.44 ^{b}	52.63 ^{c}	0.57
CF	54.66 ^{b}	55.85 ^{a}	52.27 ^{c}	50.15 ^{d}	0.37
NDF	58.42 ^{b}	60.06 ^{a}	58.38 ^{b}	55.26 ^{c}	0.49
ADF	53.87 ^{b}	55.34 ^{a}	53.68^{b}	51.52 ^{c}	0.55
EE	78.74 ^{a}	76.82 ^{a}	76.55^{a}	72.43 ^{b}	2.06
NFE	67.51 ^{b}	72.06 ^{a}	67.41 ^{b}	67.34 ^{b}	0.44
Nutritive value (%):					
TDN	59.68 ^{b}	63.74 ^{a}	58.96 ^{c}	58.66 ^{c}	0.42
DCP	7.57 ^{a}	7.28 ^{a}	6.77 ^{b}	6.44 ^{b}	0.31

[a,b and c :] *Means different superscripts in the same row are significantly different ($P<0.05$).*
T1: CFM + 100% CH; T2: CFM + 75 % CH+25 % Pm; T3: CFM + 50 % CH+50 % Pm; T4: CFM + 100 % Pm: DM: Dry matter; OM: Organic matter; CP: Crude protein; CF: Crude fiber; NDF: Neutral detergent fiber; ADF: Acid detergent fiber; EE: Ether extract; NFE: Nitrogen free extract; TDN: Total digestible nutrient; DCP: Digestible crude protein

Value of TDN had significantly increase for T2 by 6.8% compared with control (T1) this related to the increase of all nutrients digestibility, meanwhile, T3 and T4 were decreased by 1.21 and 1.71% compared with T1, while there were insignificant ($P< 0.05$) differences between this (T3 and T4). The DCP values showed no significant difference between T1 and T2, but there was significant ($P< 0.05$) decrease between T3 and T4 compared with the control and T2. However, the increase in DCP for T2 could be result from increasing CP digestibility.

Nitrogen utilization:

N intake (NI), N fecal nitrogen, urinary nitrogen and N balance (NB) are presented in Table (3). All rations had showed positive NB, but the highest ($P< 0.05$) value of NB was obtained for T2, followed by the control (T1) then T3 and T4. However, the last two rations had the lower ($P< 0.05$) NB values , which can be due to the more N loss in the feces, this agreed with the finding of Muhammad *et al.* (2020). While animals in the control group had intermediated NB, it had less N excreted than that of the others experimental groups. These were reflected in approximately similarly N utilization percentage expressed as NB/ NI or NB/ NA.

Table (3): Effects of dietary *Panicum maximum* on nitrogen utilization of Barki sheep.

Item	Experimental rations				
	T1	T2	T3	T4	SEM
N intake	19.73 ^{b}	22.20 ^{a}	21.94 ^{a}	20.07 ^{b}	0.36
Fecal N	8.52 ^{b}	9.29 ^{ab}	10.4 ^{a}	9.02 ^{ab}	0.29
Urinary N	7.57 ^{b}	8.86 ^{a}	8.86 ^{a}	8.74 ^{a}	0.21
N balance(NB)	3.64 ^{b}	4.05 ^{a}	2.68 ^{c}	2.31 ^{c}	0.27
NB/I	18.46 ^{a}	18.23 ^{a}	12.56 ^{b}	11.51 ^{c}	0.27
NB/ND	32.49 ^{a}	31.36 ^{a}	23.28 ^{b}	20.90 ^{c}	1.33

$^{a,b\ and\ c}$ *: Means different superscripts in the same row are significantly different (P<0.05).*

T1: CFM + 100% CH; T2: CFM + 75 % CH+25 % Pm; T3: CFM + 50 % CH+50 % Pm; T4: CFM + 100 % Pm

Ruminal fermentation:

Rumen fermentation parameters are presented in Table (4). Values of ruminal pH were not significantly differing among the experimental rations. However, inclusion of Pm in the ration was resulted in decreasing pH value, this agreed with that reported by Abubeker *et al*. (2009), he mension that rumen pH was recorded to be within the normal pH ranges for cellulolytic (pH 6.2 to 6.8) and high proteolytic (pH 6.0 to 7.0) microorganisms when two tropical grass species, *Digitaria eriantha* and *Panicum maximum* were fed.

Table (4): Effects of dietary *Panicum maximum*s on ruminal fermentation and microbial protein synthesis.

Item	Experimental rations				
	T1	T2	T3	T4	SEM
pH	6.35	6.33	6.31	6.27	0.14
NH_3–N, mg/100 ml	16.56 ^{a}	15.14 ^{b}	15.06 ^{b}	14.89 ^{b}	0.11
VFA, meq/100 ml	10.34 ^{c}	11.55 ^{a}	11.06 ^{b}	11.73 ^{a}	0.24
Molar proportion:					
Acetic acid	57.35 ^{b}	58.11 ^{a}	58.36 ^{a}	58.64 ^{a}	0.57
Propionic acid	26.75 ^{a}	25.34 ^{b}	25.17 ^{b}	25.01 ^{b}	0.39
Butyric acid	8.56 ^{b}	8.75 ^{b}	9.21 ^{a}	9.44 ^{a}	0.25
Acetic: Propionic	2.16 ^{b}	2.29 ^{a}	2.32 ^{a}	2.35 ^{a}	0.07
Rumen volume, L	3.28 ^{b}	3.31 ^{a}	3.31 ^{a}	3.33 ^{a}	0.02
Rate of out flow /h	6.37 ^{a}	6.18 ^{b}	6.16 ^{b}	6.12 ^{b}	0.09
Microbial nitrogen yield, g/d	13.85 ^{b}	14.96 ^{a}	14.66 ^{a}	15.03 ^{a}	0.39

$^{a,\ b\ and\ c}$ *: Means different superscripts in the same row are significantly different (P<0.05).*

T1: CFM + 100% CH; T2: CFM + 75 % CH+25 % Pm; T3: CFM + 50 % CH+50 % Pm; T4: CFM + 100 % Pm

Ammonia-N concentration was significant (P< 0.05) decreased with all replacement levels of Pm compared to the control. The lowest one was observed with 100% Pm replacement. The normal ranged of rumen NH_3-N concentration range between 2 and 20 mg /100 ml (Meissner *et al*., 1993). However, 5 mg NH_3-N /100 ml is sufficient and 20–24 mg NH_3-N /100 ml are required for high fermentation rate (Orskov 1982). Results of VFA showed (P< 0.05) an increase by about 11.7% for T2 compared with control, this agreed with the results obtained by Sallam *et al*. (2019). Acetic acid was significantly (P< 0.05) increased in all Pm containing rations compared to the control one without significant differ (P> 0.05) among themselves, while propionic acid was (P< 0.05) decreased compared with control; this decrease could be resulted from increasing rumen fermentation and increase celleulytic bacteria. There was an increase (P< 0.05) in acetic to propionic ratio over the control , respectively Playne and Kennedy (1976) reported that acetic to propionic acid ratio was related to the quality of forage also; meantime high ratio of acetic to propionic acid may be resulted from the decrease of utilization efficient of NH_3-N. Values of rumen volume were (P< 0.05) increased by increase replacement of Pm level; this increase could result from increase CF content by increasing level of Pm replacement. The increase of rumen volume was followed with a decrease of rate of out flow by 2.98, 3.29 and 3.92% for T2, T3 and T4 rations, respectively compared to the control.

The main influencing factor on microbial protein level of in the rumen is the out flow rate in the rumen. Passage of the diet in the rumen with high-speed increases the number of microflora without high energy consumption. Speed of out flow rate is reasonable in reducing the maintenance expenses of microflora since they contribute decrease time of the ration inside the rumen (Jasi *et al*., 2015) .According to AFRC (1992) increasing rate from 0.02 to 0.08 h resulted in degree of microbial protein synthesis in the rumen by 20%. However, inclusion 100% Pm (T4) was showed (P< 0.05) more MP synthesis compared to the control, meanwhile, there was insignificant differ (P> 0.05) with in the Pm containing rations.

Gas production at different incubation time's kinetics parameters was showed in Table (5). There were no significant differences (P< 0.05) between T2 and the control through the overall incubation time for gas produced, while there was significant decreased (P< 0.05) in T3 and T4 compared with control. This means that gas production was decrease by increasing level of Pm replacement and time of incubation. So, T4 showed the lowest gas production (ml/h) however, Nevyani *et al*.(2018) was illustrated that NDF content in grass could be enough to effect on digestibility value which directly effect on gas production; which was increased by increasing incubation time. The same trend was observed with kinetics parameters as the control ration had the highest values, while all treatments had significant (P< 0.05) decreased in a , b and t values . This may be due to increasing NDF content of experimental rations.

Table (5): The volume of gas production and kinitecs parameters (ml/200 mg DM) at different incubation times.

Treatment	volume of gas production				Kinetics parameter					
	3 h	6 h	12 h	24 h	a	b	a+b	c	T	Y
T1	9.2 ^{a}	14.9 ^{a}	22.9^{a}	38.5^{a}	3.2^{a}	22^{a}	25.2^{a}	0.09^{a}	13.4^{a}	17.65^{a}
Panicum maximum										
T2	8.9^{ab}	14.3^{ab}	22.2^{b}	37.6 ^{a}	2.9 ^{b}	21 ^{b}	23.9 ^{b}	0.08 ^{b}	12.8 ^{b}	15.32 ^{b}
T3	8.3 ^{b}	13.1^{bc}	20.1 ^{c}	32.2 ^{b}	2.7 ^{b}	20.3^{b}	23 ^{b}	0.08 ^{b}	12.1 ^{b}	14.13 ^{b}
T4	7.6 ^{c}	12.1 ^{c}	19.2 ^{d}	28.9 ^{c}	2.4 ^{c}	19 ^{c}	21.4 ^{c}	0.06 ^{c}	11.4 ^{c}	11.19 ^{c}
SEM	0.29	0.55	0.07	0.97	0.21	0.84	0.98	0.001	0.77	1.33

$^{a,b\ and,\ c}$: Means different superscripts in the same row are significantly different (P<0.05).

T1: CFM + 100% CH; T2: CFM + 75 % CH+25 % Pm; T3: CFM + 50 % CH+50 % Pm; T4: CFM + 100 % Pm , a : the gas produce from the soluble fraction (ml); b : the gas produce from the insoluble fraction (ml); c : the rate of gas production (ml/h) and t : incubation time (h).

This agreed with that reported by Bezabih *et al*.(2014) that the gas production kinetics was positively correlated with crude protein and negatively with NDF, ADF and ADL contents in forages. Also, Mertens (2009) reported the least digestible component of forages is NDF being from 40 to 70%, while it being very high (> 90%) for non-NDF components.

Table (6): Metabolizable energy, organic matter digestibility, short chain fatty acids and methane production after 24 h incubation of rations with different inclusion levels of *Panicum maximum*.

Item	Experimental rations				SEM
	T1	T2	T3	T4	
ME. MJ/kg DM	9.39 ^{a}	8.70 ^{b}	8.24 ^{b}	7.70 ^{c}	0.48
OMD, %	62.01 ^{a}	55.89 ^{b}	54.57 ^{b}	50.39 ^{c}	1.43
SCFA (µmol)	1.30 ^{a}	1.03 ^{b}	0.99 ^{b}	0.82 ^{c}	0.05
Methane production (%)	28.41 ^{a}	27.15^{ab}	25.25 ^{b}	22.07 ^{c}	1.94

$^{a,b\ and\ c}$: Means different superscripts in the same row are significantly different (P<0.05).

ME: Metabolizable energy; OMD: Organic matter digestibility; SCFA : Short chain fatty acids

Metabolisable energy =00.15 DOMD (MAFF, 1975)

The control ration showed a significant higher (P< 0.05) value of ME, OMD, SCFA and methane production percentage compared with all other experimental rations in Table (6). On the other hand, ration containing 100% Pm (T4) was recorded the lowest (P< 0.05) values, while T2 and T3 ration had intermediated values without significant difference (p> 0.05) among themselves. However, all values were decreased with increasing Pm levels in the ration. In general, to reduce CH_4 per unit of consumed feed must increase feed intake which related to a shorter time to digest in rumen and less extensive fermentation (Pinares- Patiño *et al*., 2003; Yan *et al*., 2010 and Hammond *et al*., 2012).

Results of growth performance were showed in Table (7), there were a significantly higher (P< 0.05) FDW and ADWG for T2 over the control and the other experimental rations. This close with the finding of Babayemi *et al.* (2006) who fed *Panicum maximum*-based diets supplemented with lablab, *gliricidia foliages* and l*eucaena*. The rates of growth were higher compared to control. Earlier studies were showed the differences in growth rates due to the differences in the basal components of the diets, voluntary DMI, efficiency of feed utilization and the physiological state of the animals. The higher growth rates of the animals could be related to more efficient utilization of the animals as indicated by their higher feed conversion ratios (Vincent *et al.*, 2012). Although, there was an insignificant difference (P> 0.05) of feed intake among the experimental rations, feeding T2 resulted in higher (P< 0.05) ADWG against the rest of rations. Meanwhile, it showed best FCR followed by the control (T1) and T3, this agreed with finding of Tripathi *et al.* (2006) who found that there were relationship between growth and feed conversion efficiencies of growing lambs fed varying levels of tree leaves and concentrates which related to the influence of improve nutrient density and quality of nutrients which available for utilization.

Table (7): Effects of replacement of clover hay by *Panicum maximum* on growth performance of calves.

Item	Experimental rations				SEM
	T1	T2	T3	T4	
IBW,Kg	216.8	221.1	219.8	223.4	22.63
FBW,Kg	328.3^{b}	348.9^{a}	323.3^{b}	299.1^{c}	11.07
ADWG,Kg	1.24^{b}	1.42^{a}	1.15^{b}	0.84^{c}	0.09
TWG,Kg	11.5^{b}	127.8^{a}	103.5^{c}	75.7^{d}	5.68
Feed intake, Kg/h/d:					
CFM	4.19	4.35	4.19	4.10	0.16
CH	3.43	2.67	1.71	-----	
Pm	-----	0.89	1.71	3.35	
TFI	7.62	7.91	7.61	7.45	0. 47
FCR	6.15^{bc}	5.57^{c}	6.62^{b}	8.87^{a}	0.54

$^{a,b\ and\ c}$: Means different superscripts in the same row are significantly different (P<0.05).

IBW: Initial body weight; ADWG: Average daily weight gain; FBW: Final body weight; TWG: Total weight gain; TFI. Total fed intake ; FCR. Feed conversion ratio

Table (8): Feed intake and economical evaluation of calves' performance.

Item	Experimental rations			
	T1	T2	T3	T4
Average daily feed intake, Kg/ h/day (as fed):				
CFM	4.19	4.35	4.19	4.10
CH	3.43	2.67	1.71	-----
Pm	-----	0.89	1.71	3.35
TFI	7.62	7.91	7.62	7.46
DWG	1.24^{b}	1.42^{a}	1.15^{b}	0.84^{c}
Average total feed cost, LE/calve/ day:				
CFM	18.86	19.58	18.86	18.45
CH	12.00	9.35	5.96	-----
Pm	----	1.78	2.34	6.70
Total feed cost, LE/calve/day	30.86	30.71	27.16	25.15
Total revenue	74.40	85.20	69.00	53.40
Net revenue	43.54	54.49	41.84	28.25
Economical efficiency	1.41	1.77	1.54	1.12
Relative efficiency	100	125	109.22	79.43

$^{a,b\ and\ c}$ *: Means different superscripts in the same row are significantly different (P<0.05).*

Economic Efficiency:

Economic efficiency of the tested rations is showed in Table (8). Refers to calculation cost of feed and DWG of the calves, ration contained 25% Pm to replace CH (T2) was showed the promised result. It had better net revenue and relative efficiency compared to the control, this followed by T3 which contained 50% of Pm to replace CH in the ration.

CONCLUSION

It could be concluded that replacement of clover hay by *Panicum maximum* by 25 % in ruminants rations led to improvement on nutrients digestibility, rumen fermentation and nitrogen balance and calves had highest growth rate without adverse effect on animals' health.

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التقييم الغذائى لعلف البونيكام للمجترات

ايمن عبد المحسن[1] وهيام عبد السلام سيد [1] ومحمد سمير [1] و محمد حلمى ياقوت[1] و علاء البدوى [2] وعمرو شويرب [1]

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اجريت هذه الدراسه لمعرفه امكانيه الاستبدال الجزئى او الكلى لدريس البرسيم بعلف البونيكام على الهضم , ميزان الازوت , تخمرات الكرش وانتاج الغاز و تأثير ذلك على نمو العجول . حيث اجريت تجارب الهضم باستخدام 12 ذكر اغنام برقى لأربع علائق تجريبيه هى : عليقه المقارنه (T1) علف مركز+ دريس برسيم 100% , العليقه الثانيه (T2) علف مركز+ 75%دريس البرسيم + 25% بونيكام , العليقه الثالثه (T3) علف مركز+ 50% دريس برسيم + 50% بونيكام , العليقه الرابعه (T4) علف مركز+100% بونيكام. و تم اجراء تجربه النمو باستخدام 20 عجل (5 عجول فى المجموعه) و لمدة 90 يوما. فى حين تجارب تخمرات الكرش و انتاج الغاز تم باستخدام 3 نعاج مزودة بفستيولا بالكرش (بالتتابع) .

و اظهرت نتائج تجارب الهضم ارتفاع معدلات الهضم فى العليق الثانيه مقارنه بالعليقه المقارنه و باقى المجاميع و كانت اقلهم العليقه الرابعه فى حين ان العليقه الثالثه كانت قريبه فى نتائج الهضم من مجموعه المقارنه . و قد انعكس ذلك على القيمه الغذائيه للعليقه حيث سجلت العليقه الثانيه اعلى مجموع مركبات غذائيه مهضومه وبروتين مهضوم و ميزان الازوت و كانت اقلهم فى النتائج العليقه الرابعه . و فى قياسات تخمرات الكرش لم يكن هناك فروق معنويه فى قيم الاس الهيدروجينى (pH) فيما بين العلائق فى حين سجلت عليقه المقارنه اعلى نسبه فى الامونيا و اقل نسبه فى مجموع الاحماض الطيارة و كانت اعلاهم و لم يكن هناك اختلاف معنوى فى كميه البروتين الميكروبى فيما بين العلائق المختبرة المحتويه على البونيكام فى حين كانت اقلهم عليقه المقارنه و كانت اكثرهم فى انتاج الغاز و الاحماض الدهنيه قصيره السلسله تلاها T2 اقلهم انتاجا للغاز و الاحماض الدهنيه قصيره السلسله العليقه الرابعه .

و فى تجارب النمو سجلت العليقه الثانيه اعلى معدل زيادة وزنيه يوميه و احسن معدل تحويل غذائى و كانت اقلهم العليقه الرابعه فى حين تقاربت نتائج عليقه المقارنه , العليقه الثالثه مما ادى الى ارتفاع الكفاءة الاقتصاديه النسبيه مع العليقه الثانيه تلاها عليقه المقارنه , العليقه الثالثه و كانت العليقة الاقل اقتصاديا العليقه الرابعه .