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Effect of feeding Moringa oleifera forage on productive performance of growing goat kids

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Summary

A five-months experiment was carried out to investigate the effect of partial replacement of rice straw in the ration of goat kids by Moringa oleifera (MO) forage on feed intake, digestibility, rumen fermentation, some blood parameters and productive performance of growing goat kids. Twenty-one growing Baladi goat kids averaged six months age and 11.20 kg live body weight (LBW) were divided into three similar groups and randomly assigned to the following dietary treatments; control group (R1) which fed 60% CFM + 40% RS, while group (R2) fed 60% CFM + 20% RS + 20% MO and R3 fed 50% CFM + 25% RS + 25% MO. The daily feed allowance of goat kids was calculated according to NRC (2007) and adjusted biweekly. The experimental rations offered twice a day at 8 am and 2 pm in equal portions up to the end of the experimental period. Body weight, feed intake and feed conversion were determined over the whole trial. At the end of the feeding trial, three digestibility trials were conducted on twelve goat kids. Results indicated that the digestibility of most nutrients of the two tested rations were significantly higher than those of control one. The highest values were recorded with 20% MO-ration (R2). The feeding values as TDN and DCP followed a similar trend to those of nutrients digestibility among dietary treatments. Growth performance in respect of final weight, total weight gain, daily gain and feed conversion efficiency were significantly superior with kids fed R2 and R3 rations compared with control ration (R1). The best values occurred with R2. Also, kids fed 20 or 25% MO-rations had significantly higher return and economic efficiency than those fed control ration (R1). Rumen function parameters and blood metabolites profile have been also investigated throughout this study.

Accordingly, we could recommend for feeding the growing goat kids, supplementing ration with Moringa oleifera forage especially those containing poor quality roughage like rice straw, since it improve daily gain, digestibility. feed efficiency, and economic efficiency. The recommended replacement rate with Moringa is for 20 or 25% of rice straw.

Keywords: Moringa oleifera**,** goats, digestibility, ruminal fermentation and growth performance**.**

INTRODUCTION

In many developing countries, ruminant production is limited by unavailability and high prices of high-quality feeds. In Egypt, insignificant area of arable lands has been dedicated for producing green forage in summer season, due to that most area usually occupied by crops like maize, rice, cotton, vegetables and others. Generally, farmers feed their animals with crop residues and low-quality hay that are low in nutritive value due to low crude protein content, high in indigested lignocelluloses and lignocellulosic matrix, deficient in vitamins and minerals, which leads to low digestibility, reduced voluntary feed intake, poor growth, poor reproductive performance, poor meat quality and low milk yield (Gebregiorgis *et al.* 2012). Many researchers have been worked on fodder trees, shrubs and browses and confirmed the potential of these plants for ruminant nutrition in the tropics (McDonald *et al.* 1998; Benninson and Paterson, 2003). One of these potential tree forages is Moringa oleifera Lam (syns. Moringa pterygosperm, family Moringaceae), which grows throughout the tropics (Debela and Tolera, 2013). M. oleifera is an indigenous native tree from the Himalaya (Duke, 2001) but, at present, it is widely spread worldwide (Soliva *et al*. 2005). It can grow in humid, hot, dry tropical and subtropical regions. It is a drought tolerant plant that can grow in all types of soils, except those water-logged (Abdul, 2007), and can tolerate dry seasons lasting up to 6 months (Mendieta-Araica *et al.* 2013). The yield per ha varies widely depending on season, variety, fertilization, irrigation regimen, accession and ecological zone (Palada *et al.* 2007). Reported yields range from 43 to 115 tons of biomass/ ha/year (Foidl *et al.* 2001; Safwat *et al*. 2014), about 4.2–24 tons /ha/year of dry matter (Reyes-Sánchez *et al*. 2006[a]; Nouman *et al*. 2014). Moringa is a non-leguminous multipurpose tree and is one of the fastest growing trees in the world, with leaves high in crude protein (Aye and Adegun, 2013). Substantially Moringa leaves contain good quality protein of high digestibility for livestock (Makkar, 2012). Additionally, the leaves are rich in carotenoids, vitamin C and other antioxidants (Yang *et al*. 2006). Experiments included feeding Moringa fresh foliage, small branches and twigs either to goats (Sultana *et al*. 2015), sheep (Fadiyimu *et al*. 2010) or cows (Mendieta-Araica *et al*. 2013) reported animal improvement in feed utilization and productive performance. Moreover, Fadiyimu *et al*. (2010) concluded that offering M. oleifera at different levels in diets of sheep, remarkably decreased intake with increasing M. oleifera in the diet, but nutrients digestibility increased. Also, its use as supplement improved intake of poor quality roughages, increased growth rates and improved reproduction efficiency of ruminants (Alayon *et al*. 1998 and Orden *et al*. 2000).

The objective of this study was to asses the effects of including different levels of whole Moringa plant to the rations of Baladi goats on their feed intake, digestibility, rumen fermentation, blood parameters and productive performance.

MATERIALS AND METHODS

This study was conducted at El-Karada Agricultural Research Station locate at Kafr El-Shikh province and belong to Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture, Egypt.

Animals feeding and experimental design

Twenty-one growing Baladi goat kids averaged six months old and 11.20 kg live body weight (LBW) were allotted randomly into three similar groups, seven each. Nutritional allowance of all groups was calculated according to NRC, (2007). The experiment employed to evaluate the productive performance of the growing goats i.e, feed intake, rumen fermentation, digestibility, total and daily gain. Goats were initiated on a 10-d adjustment period, during which they were gradually introduced to the experimental diets. A comparative feeding trial based on randomized complete block design was used and lasted for 154-d. Total mixed ration (TMR) feeding system was followed in the experiment, where the rations consisted of concentrate feed mixture (CFM), rice straw (RS) and Moringa oleifera (MO). Moringa forage included leaf, petiole, stem and soft rachis. The hard-woody rachis was removed from the Moringa to ensure suitable intake. Rice straw and whole Moringa foliage were chopped with a chaff cutter into 2 to 3 cm pieces before feeding. The feed in each treatment was mixed with 1.0 and 0.5% di-calcium phosphate and salt respectively, prior to feeding. The control group (R1) fed 60% CFM + 40% RS, while tested groups (R2) fed 60% CFM + 20% RS + 20% MO and R3 fed 50% CFM + 25% RS + 25% MO, up to the end of the experimental period. All feedstuffs were chemically analyzed and the calculated composition are presented in Table (1).

Management:

Daily feed allowance of goat kids was adjusted biweekly and offered to all animals twice daily at 8 am and 2 pm in equal portions. Minerals blocks and fresh water were available freely all the day time, while fasting LBW of kids were recorded at the start of the experiment before morning feeding then biweekly until the study was finished. All kids were kept under semi-open sheds. Body weights of kids were recorded at different stages of puberty and sexual maturity.

Digestibility trials and rumen parameters:

At the end of the experiment, three digestibility trials were conducted on twelve goat kids. Animals were randomly allotted in four equal groups and placed in the metabolic cages as described by Maynard *et al.* (1979), where each group fed one of the three experimental rations (R1, R2 or R3) for a preliminary period of 14 days (adaptation period) followed by a 7 day collection period. Representative sample of feces from each animal (10% of the whole amount) was oven-dried over- night at 60°C, finally grounded and kept in plastic bottle until analysis. Chemical composition of feeds and feces were determined according to A.O.A.C. (1995). Total digestible nutrients (TDN) was calculated according to the equation of Cheek *et al*. (1982). At the end of digestibility trials, rumen liquor samples were individually collected after three hrs. of the morning meal by a rubber stomach tube. Collected rumen liquor was directly tested for pH using Orian 680 digital pH meter and thereafter samples were strained through four layers of cheese cloth for ammonia nitrogen (NH3-N) determination using an automatic N analyzer (A.O.A.C, 1995). Total volatile fatty acid (VFA's) concentration was estimated by using steam distillation methods (Warner, 1964).

Sampling and analysis of blood serum:

Blood samples were taken from all kids at the beginning of the experiment then every month until the end. Blood collected three hours after morning feeding from the jugular vein into clean glass tubes and left at room temperature for 45-60 minutes, then centrifuged at 4000 rpm for 15 minutes. Blood serum was separated into clean dry glass vials and stored at -20 C^o until analyses. Blood serum samples were analyzed for the following parameters; total protein (Henry, 1964), Albumin (Doumas *et al*. 1971), Globulin was calculated by subtraction of serum albumin from total serum protein. Glucose and Cholesterol were quantified in blood serum by kits of Spinreact, S. A.U. Ctra. Santa Coloma, 7 E-17176 Sant Esteve de Bas (GI) Spain by spectrophotometer. Serum aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were determined according to Reitman and Frankel (1957).

Statistical analysis:

The collected data of measured parameters were subjected to one-way analysis of variance according to Steel and Torrie (1980) applying the general linear model procedure of SAS (2001). Duncan's Multiple Range Test (1955) was applied to separate significant means.

RESULTS AND DISCSSION

Chemical composition of the experimental diets:

Data of chemical composition of CFM, RS and MO and experimental rations are presented in Table 1. Results showed that RS was markedly higher in crude fiber and ash compared to Moringa oleifera (38.43 vs. 21.76 and 17.15 vs. 10.64), respectively. While, MO contained higher crude protein, ether extract and nitrogen free extract compared to RS (17.78 vs. 2.93%, 2.16 vs. 1.05% and 47.66 vs. 40.44, respectively).

Table (1): Chemical analysis of the feedstuffs and calculated chemical composition of the experimental rations.

Item	DM	CP	EE	CF	NFE	Ash
Ingredients:						
CFM	89.25	13.91	2.63	14.34	60.66	8.46
RS	88.76	2.93	1.05	38.43	40.44	17.15
MO	36.42	17.78	2.16	21.76	47.66	10.64
Rations:						
R1	89.05	9.52	2.00	23.98	52.57	11.93
R2	78.59	12.49	2.22	20.64	54.02	10.63
R3	75.92	12.13	2.12	22.22	52.36	11.17

R1= 60% CFM + 40% RS (control ration). R2= 60% CFM + 20% RS + 20% MO

R3 = 50% CFM + 25% RS + 25% MO

Table (2) Nutrient digestibility and feeding value of experimental rations by goat kids.

	R1	R2	R3
Digestibility (%):			
DM	62.71 ± 7.51^b	66.42 ± 5.93^a	66.03 ± 5.82^a
CP	63.45 ± 8.11^b	67.61 ± 8.13^a	67.21 ± 7.45^a

CF	53.30 ± 5.82[b]	58.47 ± 6.21[a]	57.67 ± 8.12[ab]
EE	67.93 ± 5.35[b]	71.19± 5.81[a]	70.91 ± 7.25[ab]
NFE	68.94 ± 6.85[b]	76.13 ± 8.43[a]	76.06 ± 6.78[a]
Feeding value (%):			
TDN	58.12 ± 5.86[b]	65.20 ± 5.45[a]	64.17 ± 5.41[ab]
DCP	6.85± 0.58[c]	8.44 ± 0.37[b]	8.15 ± 0.48[b]

R1= 60% CFM + 40% RS (control ration). R2= 60% CFM + 20% RS + 20% MO
R3 = 50% CFM + 25% RS + 25% MO

Digestibility and feeding values:

Regarding the chemical composition of the experimental rations, there was a great variation between control ration and the tested ones respecting all nutrients, especially CP and CF and that due to the substitution rate of RS by MO forage. Almost, no great differences between R2 and R3 rations in respect of most nutrients, while they differed significantly respecting all nutrients, in particular CP and CF compared with R1 (control ration). On the other hand, in comparison with berseem forage (the main crop forage in Egypt), Khayyal *et al*. (2015) found that MO forage was markedly higher in its contents of CP and EE and lower in CF content, being 11.97, 1.52 and 26.15% for berseem vs. 18.33, 2.15 and 21.46% for MO, respectively.

Data in Table (2) showed that R2 (20% MO-ration) had the highest digestibility values for most nutrients followed by R3 (25% MO-ration), while the lowest values recorded for R_1 that contained 40% Rice straw. All differences between the two tested rations (R2 and R3) were not significant respecting most nutrients digestibility while all values were significantly higher than control diet. This might due to an added value resulted of joining MO with rice straw in tested rations that recognized as a positive association effect. Also, the inclusion of MO in tested rations increased the activities of fibrolytic bacteria in the rumen due to its richness with many essential nutrients in balanced proportions that lead to an improvement of microbial growth and multiplication, resulting in increasing the efficiency of rumen fermentation and in turn fiber utilization. Similar results was obtained by Manaye *et al*. (2009) who reported that supplementation of Moringa forage to rice straw improved DM, OM, CP and neutral detergent fiber digestibility in sheep, leading to better animal performance. The results of the present study clearly indicate that Moringa forage played a positive role in improving rumen function and digestibility compared to the rice straw-based diet. Moreover, Sultana *et al*. (2015) partially and completely replaced the concentrate feed mixture in the diets of goats with Moringa forage and found that partial replacement increased nutrients intake, ruminal fermentation and NDF digestibility compared to the complete replacement and control. On the other hand, Khalel *et al*. (2014) and Khayyal *et al*. (2015) indicated that partial or complete replacement of berseem (up to 40%) by Moringa oleifera forage in the diets of ruminants led to significant increases in all nutrients digestibility values. These positive effect of MO on digestibility could be regarded to its high contents of multiple vital compounds that need to enhance rumen microbial activities. Similar assumption was reported by Poppi and Mclennan (1995) who suggested that feeding Moringa forage improved nitrogen supply and corrected N deficiency of low quality diets. Also, results here are in good agreement with those recorded by Newton *et al*. (2010) that Moringa forage is rich in highly vital nutrients particularly when they were added to low quality diets and hence all metabolic processes are in favorable state.

Concerning feeding values, which expressed as TDN and DCP (Table 2), it could be noticed that animals in R2 recorded higher values followed by R3, while the lowest values were recorded with R_1. This attributed to that animals in R2 received high levels of CP in the diets compared with other treatments. Moreover, Reyes-Sanchez *et al*. (2006[b]) reported that feeding Moringa forage had limited effect on rumen fill due to its low NDF content which could encourage improvement of nutrient digestibility of feed intake. Lastly, the present study clearly indicate that Moringa played a positive role in improving rumen function and digestibility, leading to higher animal performance compared to rice straw - based diet.

Rumen fermentation:

Mean values of pH, ammonia concentration and total VFA in rumen fluid after three hrs. of Moringa feeding with the different dietary treatments are presented in Table (3). The pH values were significantly ($P<0.05$) higher with R2 diet than control one, but insignificantly higher than that of R3 diet. It ranged from 6.36 to 6.75, which consider a very suitable environment for the potential activities of rumen microbes. Rumen pH values were in the normal range for roughage diets (Ørskov and Ryle, 1990). The concentration of NH3-N in the rumen fluid ranged from 142.27 to 244.48 mg/L, where its values in rumen liquor increased ($P<0.05$) with R2 followed by R3, while the lowest values recorded with R_1. Earlier studies with MO demonstrated that, the relatively high contents of tannins and saponins which are naturally occurred in Moringa forage could affect ruminal proteolytic activity and consequently decrease ruminal ammonia-N in comparison with that of diet free from MO (Sliwinski *et al*. 2002 and Soliva *et al*. 2005). The optimum concentration of rumen NH3-N for efficient digestion processes ranges from 150 to 200 mg/L (Krebs and Leng, 1984; Preston, 1986). Total VFA's concentration was significantly higher for R1 ration, followed by R3, while the lowest values were recorded with R_2. This might due to the high levels of tannin and polyphenol compounds in MO which leads to reduce TVFA concentration in rumen liquor of animals fed MO-rations. On the other hand, in comparison with berseem hay-ration, Mohamed *et al*. (2018) found that replacing 25 to 50% of berseem hay by MO in the ration of growing does led to a significant increase in TVFA's and decrease in NH3-N concentration in rumen liquor.

Table (3): Rumen fermentation parameters of goat kids fed experimental rations.

Item	R1	R2	R3
pH	6.36 ± 0.12^{b}	6.75 ± 0.29^{a}	6.68 ± 0.32^{ab}
NH_3-N (mg/100 m/R.L)	142.27 ± 17.6^{c}	244.48 ± 19.3^{a}	224.59 ± 18.3^{b}
VFA (meq/100 m/R.L)	14.87 ± 1.2^{a}	13.37 ± 1.37^{c}	14.19 ± 1.33^{b}

R1= 60% CFM + 40% RS (control ration). R2= 60% CFM + 20% RS + 20% MO
R3 = 50% CFM + 25% RS + 25% MO

Rumen fermentation activity in animals depends on nutrient digestibility, rate of absorption, rate of digesta passage from rumen, and the activities of microbial population in the rumen (Flatt *et al*. 1956).

Blood parameters:

Data of some blood biochemical profile are presented in Table (4). Glucose concentration was significantly ($P<0.05$) lower in control diet than that of tested diets, with, no significant differences between R2 and R3 rations. The range of glucose concentration was from 64.33 to 69.33 (mg/dl) which within the normal range. These results are in agreement with those reported by Kholif *et al*. (2016), Khalel *et al.* (2014) and Azzaz *et al*. (2016) who observed that feeding Moringa to goat kids had significant effects ($P<0.05$) on glucose concentration. Also, Khalel *et al.* (2014) reported that feeding Moringa fodder may help in by passing some soluble carbohydrates to be absorbed, as glucose. On other study, Babiker *et al*. (2017) found that feeding ewes and goats with M. oleifera diet significantly lowered the glucose content of the serum compared to those fed alfalfa diet. While, Zeng *et al*. (2017) reported that feeding M. oleifera silage did not affect serum concentration of glucose as well as revealing no effects on hepatic metabolism of lactating cows.

Table (4): Some blood biochemical profile in goat kids fed the experimental rations.

Item	R1	R2	R3
Glucose (mg/dl)	64.33±1.28[c]	69.33±1.35[a]	68.53±1.44[a]
Cholesterol (mg/dl)	74.03±0.09[a]	66.65 ±1.88[b]	62.35 ±1.87[c]
Total protein (g/dl)	6.19 ±0.07[c]	6.89 ±0.14[a]	6.51 ±0.16[b]
Albumin (g/dl)	3.29 ±0.03[c]	3.98 ±0.05[a]	3.64 ±0.04[b]
Globulin (g/dl)	2.9±0.03	2.91±0.3	2. 97±0.04
AST (unit/l)	25.72 ±1.53	30.35 ±2.71	28.29 ±2.16
ALT (unit/l)	16.83 ±1.42	18.65 ±1.53	18.57 ±1.29

R1= 60% CFM + 40% RS (control ration). R2= 60% CFM + 20% RS + 20% MO
R3 = 50% CFM + 25% RS + 25% MO

Concerning the cholesterol concentration, it could be noticed that animals received R1 recorded significantly (P<0.05) higher value, followed by R2, while the lowest values recorded with R_3 that contained 25% MO. Similar to the present findings, Kholif *et al*. (2015; 2016) recorded lower serum cholesterol concentrations in goats fed Moringa leaves in their diets. This reduction of cholesterol content in goats fed M. olifera diet might be a function of the phytochemical compounds existed in M. oleifera forage. On the other hand, the serum total protein and albumin concentrations were significantly higher with R2 than the other experimental treatments, being the lowest with R1. Otherwise, the differences were not significant among all treatments respecting serum globulin concentration. The concentrations of total protein and albumin found in the present study are in agreement with those reported by Khalel *et al.* (2014) and Babeker and Abdalbagi (2015). They reported that feeding Moringa diets to goats significantly increased total protein and albumin concentrations. However, contrarily to our findings, Kholif *et al.* (2015) reported that feeding Moringa leaves did not affect serum protein and albumin levels. The high concentrations of serum protein and albumin which observed with Moranga-rations in the present study precisely due to the higher protein content of MO forage.

Regarding the blood serum ALT and AST levels, data in Table (4) cleared that they not affected by different experimental rations. Values are within the normal physiological ranges thus substantially consider an important indicator for normal liver activities and functions. This refer to that no pathological lesions occurred in the liver (Pettersson *et al*. 2008). This result is in good agreement with those obtained by Kholif *et al.* (2016 and 2017). In recent study, Khayyal *et al*. (2015) demonstrated favorable effect due to replacing 10, 20, 30 or 40% and fully replacement of fresh berseem by MO in the diet of sheep, respecting the investigated blood metabolites. All measured blood serum metabolites presented in Table (4) showed that animals groups fed R2 and R3 recorded significant (P<0.05) higher glucose, total protein and albumin than those fed R1. Cholesterol concentration was favorably declined significantly with the two MO-rations. While, differences among all experimental treatments respecting serum globulin concentrations of AST and ALT were insignificant. This might due to the potential synergestic effect of combining Moringa with RS in the tested rations (R2 and R3) as such positive action are well known nutritionally as positive association effect and it improved rate of intake, digestibility and production performance. Such results are nearly similar to those obtained on growing animals by Boyd (2011) and Mahmoud (2013). In the same time, the values of all blood parameters of all tested animals were within the normal range of healthy animals.

Growth performance

Growth performance data are summarized in Table (5). It observed that the values of final weight, total weight gain and daily gain for 20% MO-ration (R2) were significantly higher than those fed control ration (R1), while insignificant higher than those fed 25%- MO ration (R3). This might be due to the highly favorable effects on ruminal function and digestibility as a result of the significant contents of vital micronutrients in MO like vitamins A, B, and C with good profile of amino acids and its enhance of the modulatory effect on the growth performance. Additionally, this might be due to the added value of the synergistic effect between MO and RS of tested rations R2 and R3. The present finding are on line with earlier work of Melesse *et al*. (2015) who reported that feeding air-dried Moringa stenopetala leaf compared to natural grass hay significantly increased body weight gain in Arsi-Bale goat kids.

Table (5): Effect of experimental treatments on growth performance of goat kids.

Item	R1	R2	R3
Changes in LBW, kg			
Initial weight	11.20±0.34	11.21±0.38	11.19±0.48
Final weight	18.24±0.46^{b}	20.10±0.47^{a}	19.73±0.85^{a}
Total weight gain	7.03±0.06^{b}	8.89±0.23^{a}	8.54±0.19^{ab}
Daily weight gain, g	45.65±3.45^{b}	57.73±5.89^{a}	55.45±6.81^{ab}
Daily Feed intake , g			
DMI	511^{a}	469.18^{b}	458.56^{b}
TDN	297	305.91	294.26
CPI	48.65^{c}	58.6^{a}	55.62^{b}
DCP	35.00^{c}	39.60^{a}	37.37^{b}
Feed conversion			
DMI, kg/ kg gain	11.19^{a}	8.13^{b}	8.27^{b}
TDN, kg/ kg gain	6.51^{a}	5.30^{b}	5.31^{b}
CP, kg/ kg gain	1.07^{a}	1.01^{b}	1.00^{b}
DCP, kg/ kg gain	0.77^{a}	0.69^{b}	0.67^{b}

R1= 60% CFM + 40% RS (control ration). R2= 60% CFM + 20% RS + 20% MO
R3 = 50% CFM + 25% RS + 25% MO

Concerning the DMI, data in Table (5) show that animals of the two tested groups had significantly lower ($P<0.05$) values than that of control group. This might due to the potential enrichment of tested rations by the biologically valuable protein and its fractions due to the incorporation of MO in these tested rations. In the meantime, the less DMI in tested rations vs. control one, suggest that the high protein index and biological quality of MO forage could cause this significant improvement in growth performance that happened with the experimental tested rations. Reyes-Sanchez *et al*. (2006[b]) reported that feeding Moringa forage had limited effect on rumen fill due to its low NDF content in which feed intake and nutrients digestibility could be improved. However, Tona *et al*. (2014) and Moyo *et al*. (2012) found no change in DMI of the goats fed different levels of Moringa oleifera. On the other hand, comparison of berseem with 10 to 40% of MO in the diet of sheep, did not significantly affected DMI (Khayyal *et al*. 2015).

Dry matter intake (DMI) is an important factor in the utilization of feed by ruminants and is a critical determinant of energy intake then performance (Devendra, 1997). Regarding, the TDN intake, the difference among the dietary treatments was significant, while, the CP intake data (Table 5) increased significantly with tested rations compared to control one. The highest value was with R2 that have 20%-MO. The CP intake reflects DM intake status and CP content of the diets. Moreover, there was a positive correlation between crude protein intake and dry matter intake (Mtenga and Shoo, 1990). Also, the DCP intake, showed similar trend to that of CP intake, where the intake was significantly higher with both tested rations in comparison with control one. This might due to the increased CP digestibility for tested rations compared to the control one (Table 2). These results are in agreement with those obtained by Aye and Adegun (2013) who stated that the increase in CP digestibility inevitably led to the improve of DCP value. Concerning the feed conversion, that expressed as the amount of intake of DM, TDN, CP and DCP give 1 kg gain (Table 5), results show that the animals fed R2 and R3 rations had better feed conversion compared with control one. Otherwise, based on CP and DCP feed conversion, the worst one was control ration. This bad rate of feed conversion of control ration largely due to decrease of average daily gain in comparison with tested ones. These results are in agreement with those reported by Saliman *et al*. (2016) who evaluated the effect of two levels of Moringa leaves in the diets in comparison with control ration consisted of concentrate feed mixture with clover hay and free from Moringa leaves, the animals fed tested rations had better feed conversion than control one.

Table (6): Economics of experimental rations of growing goat kids.

Item		Experimental		
		R1	R2	R3
Economic evaluation				
Daily gain,	g	45.65 ± 3.45^{b}	57.73 ± 5.89^{a}	55.45 ± 6.81^{ab}
Price of daily gain,	LE	3.20	4.04	3.88/
Feed intake (DM),	g			
CFM		306.6	281.5	229.28
RS		204.4	93.84	114.64
MO		-	93.84	114.64
DMI		511^{a}	469.18^{b}	458.56^{b}
Feed cost,	LE/h/d	1.54	1.62	1.47
Return,	LE*	1.66	2.42	2.41
Relative economic cost Efficiency**		100	145.78	145.18

R1= 60% CFM + 40% RS (control ration). R2= 60% CFM + 20% RS + 20% MO
R3 = 50% CFM + 25% RS + 25% MO

- The price of feedstuffs: CFM/ ton = 4500 LE; RS / ton = 800 LE; M. oleifera /ton = 3000 LE and live body gain / kg = 70 LE . * Return = Price of daily gain (LE) - Feed cost (LE/h/d) ** Economic feed efficiency = Price of the weight gain (L.E.)/daily feed cost (L.E.)x100.

Economic efficiency:

Economical evaluation data (Table 6) revealed, increase of daily gain of kids in R2 and R3 in comparison with control one, despite the lower feed intake in the tested groups. This resulted in increasing the return of R2 and R3 compared with control one. These results indicate that economic feed efficiency of tested rations (R2 and R3) was markedly higher than that of control one (R1).

The low concentrate feed mixture to roughage ratio, in the 25%- MO ration (R3) (Table 6), might due to the significant contents of vital micronutrients in MO like vitamins A, B, and C with good profile of amino acids and its enhancing of modulatory effect of the growth performance. Additionally, this might due to the added value of the synergistic effect between MO and RS in tested rations (positive associative effect).

These results are in harmony with those of Jelali *et al*. (2014) who found that using Moringa for growing lambs decreased feed cost and increased the economic return. Also, Mahmoud (2013) reported that replacing concentrate feed mixture by Moringa, with its vital compound could improve animal performance and increase net return

CONCLUSION

In conclusion, adding Moringa olivera forage could successfully consider as a potential ingredient in ration formulation of growing goat kids especially when combined with a poor quality roughage like rice straw, since it could improve daily gain, feed efficiency and economic efficiency. The recommended replacement rate are 20 or 25% of rice staw by Moringa in the diets of growing kids.

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تأثير التغذية بعلف المورينجا أوليفيرا على الأداء الإنتاجي لجداء الماعز النامية

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تم إجراء تجربة لمدة خمسة أشهر بهدف دراسة تأثير استبدال قش الأرز جزئيًا بأعلاف المورنيجا الخضراء على الهضم ، والتخمر في الكرش ، وبعض عناصر الدم والأداء الإنتاجي لجداء الماعز البلدي النامية. أستخدم في هذه الدراسة واحد وعشرون جدي ماعز نامي بعد مرحلة الفطام بمتوسط وزن وعمر (11.20كجم و عمر ستة شهور) حيث قسمت الماعز على حسب الوزن والعمر إلى ثلاث مجموعات متماثلة وكانت تتغذى حسب الاحتياجات الغذائية لمقررات NRC, (2007) التي قدمت لجميع الحيوانات مرتين يوميًا في الساعة 8 صباحًا و 2 ظهرًا و كان يتم تعديلها كل أسبوعين حتى نهاية التجربة . تم تحديد وزن الجسم ، والمأكول من الأعلاف ومعامل تحويل الغذائي على مدى التجربة. في نهاية التجربة أجريت تجارب للهضم على اثني عشر من جديان الماعز.

المعاملات المختبرة هي :

المعاملة الأولى : تناولت غذاء يحتوى على 60% علف مركز +40% قش أرز.

المعاملة الثانية : تناولت غذاء يحتوى على 60% علف مركز +20% قش أرز + 25% مورينجا.

المعاملة الثالثة : تناولت غذاء يحتوى على 50% علف مركز +25% قش أرز + 25% مورينجا

<u>أهم النتائج:</u>

- **سجلت المعاملات الغذائية المختبرة ارتفاع في معاملات الهضم المختلفة و كانت أعلى بكثير من معاملة الضابط (R1) ، حيث تم تسجيل أعلى القيم مع المعاملة الثانية لمعاملات الهضم وللقيم الغذائية مثل TDN و DCP .**
- **كان معدل زيادة الوزن الكلي و معدل النمو اليومي وكفاءة تحويل الغذاء أعلى بشكل كبير مع الجديان التي تم تغذيتهم (R2و R3) بالمقارنةً بالمعاملة (R1) , وكانت أفضلهم للمعاملة (R2).**
- **أظهرت المجموعات التي غذيت على 20 أو 25 % مورنجا (R2 or R3ً) أعلى عائدًا وكفاءة اقتصادية من تلك التي تتغذى على المجموعة الضابطة.**
- **تم دراسة ومناقشة تأثير المعاملات على وظائف الكرش وخصائص الدم.**

يمكن التوصية بأنه عند وضع خطة لتغذية جديان الماعز النامية بعد مرحلة الفطام يفضل الاستبدال الجزئي للأعلاف الخشنة الرديئة مثل قش الأرز بنسب (20 أو 25٪) بعلف المورينجا الأخضر, مما يؤدى إلى تحسين معدل النمو اليومي والكفاءة الغذائية والاقتصادية والأداء الإنتاجي والكفاءة الغذائية مما يساعد المربين على تحسين الرعاية جديان الماعز النامية بعد مرحلة الفطام.