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# EFFECT OF FEEDING ON *MORINGA OLEIFERA* STEMS ON PRODUCTIVE PERFORMANCE OF GROWING LAMBS

**A.E.M. Mahmoud**

***Depart. Anim. Prod., Fac. Agric., Cairo University, 12613 Giza, Egypt.***

## SUMMARY

Objective of this study was to evaluate the effect of feeding *Moringa oleifera* stems (MS) on growth performance of growing lambs. Twenty seven of Rahamni lambs with average initial weight 30±1.84 kg were divided into three groups (9 each). Lambs in the control group were fed R1 contained clover hay( CH) (1% from live body weight (LBW) plus concentrate feed mixture CFM (3% from LBW), while the experimental lambs were fed CH plus 25 % *Moringa oleifera* stems from CFM (R2) and 25% *Moringa oleifera* stems from CH plus CFM (R3). Results indicated that the highest (P<0.05) of most nutrients digestibility and nutritive values were recorded for control ration (R1), while R2 showed the lowest values and R3 had intermediated values. Ruminal pH and ammonia concentration values at 3 hours post feeding differed significantly (P<0.05) among tested groups. No significant differences were observed among tested rations for concentration of VFA's before an at all times after feeding. Also, pH values and ammonia concentration before and 6 hours after feeding recorded insignificant differences. Acetic acid concentration was significantly changed among different rations, which tended to be higher for R2 in all times compared to R1 and R3. On the contrary, propionic and butyric acids concentrations were highly significant (P<0.05) differences with feeding R3 followed by R1 then R2. These concentration were reflected on A/P ratio which significantly higher with R2 (2.70) compared to R3 and R1. Total protein, globulin, urea and creatinine concentrations in plasma recorded insignificant differences, while albumin, AST and ALT showed highly significant differences among groups. In the same time, the values of all blood parameters of all tested animals were within the normal range of healthy animals. The average daily and total body weight gains for lambs fed R1, R2 and R3 were 205.13, 223.8 and 211.77 g and 18.46, 20.14 and 19.05 kg, respectively with insignificant differences among groups. Rations contained *Moringa oleifera* stems (R2 and R3) achieved higher feed efficiency than control rations with highly significant different. It could be concluded that *Moringa oleifera* stems are suitable for feeding sheep and can be used to replace a part of CH or CFM without any adverse effect on the performance of Rahmani lambs.

***Keywords:*** *Moringa oleifera stems, Rahmani lambs and growth performance.*

## INTRODUCTION

The recognition of the potential of tree foliage to produce considerable amounts of high protein biomass and energy especially in harsh and arid conditions has led to the development of animal farming systems that integrate the use of tree foliages with local bulky feed resources (Devendra, 1990 and Pezo, 1991). Most trees and shrubs are easily propagated and do not require high management inputs (fertilizer, pesticides, etc.) or advanced technology. Browse foliages are compensatory components in the diets of cattle, sheep and goats and wild in arid and semi-arid regions.

*Moringa oleifera* Lam (synonym: *Moringa oleifera pterygosperma*, Gaertner), is commonly referred to as 'drumstick tree' describing the shape of its pod or 'horseradish tree' describing the taste of the roots (Makkar and Becker, 1996). It has a multipurpose tree that is cultivated both for human food and animal feed in Southern Ethiopia. The leaves could be harvested twice a month and have diverse uses among the local people. Leaves are used as a cabbage, to treat malaria, hypertension, stomach disorders, to expel retained placenta, to treat asthma and diabetes and has antitrypanosomal activity (Mekonnen *et al*. 1999). It can also be used as a protein meal (crude protein approx. 60%) in livestock diet. The leaves of this tree are also edible and are highly nutritious. It used as livestock feed; *Moringa oleifera* leaves (crude protein approx. 25%). Leafs are free from anti-nutritive factors (e.g. phenols, tannins, saponins, etc.) and high in iron (up to 582

mg/kg DM), in beta-carotene (up to 400 mg/kg DM) and in vitamin C (up to 9.2 g/kg DM). Lately, this plant has received a lot of attention. *Moringa oleifera* foliage has been found to increase animal productivity (Foidl *et al*. 2001).

Many researchers are attention of using *Moringa oleifera* leaves as animal feed but it's still highly expensive in our country and we have another part of plants we can used it in ruminants diets and study the potentiality of its as animal feed. So, the objective of this study was to evaluate the effect of feeding of *Moringa oleifera* stems to growing lambs on intake, digestibility, growth performance, rumen and blood parameters.

## MATERIALS AND METHODS

This study was carried out at two places firstly the growth trial was carried out at El-Hadi Farm in Oseem City, Giza Governorate , secondly the digestion trials were done at the Experimental Station of Animal Production Department, Faculty of Agriculture, Cairo University. Twenty seven Rahmani lambs averaged 30kg body weight and 9 months old were divided into 3 groups of 9 animals each according to live weight for 90 days trial. Animals in the control group R1) were fed clover hay (CH) (1% from live body weight) plus concentrate feed mixture (CFM) (3% from live body weight), while, the experimental animals were fed R2) CH plus 25% *Moringa oleifera* stems (MS) from CFM, R3) 25% MS from CH plus CFM. Moringa stems inclusion levels were zero%, 18.75% and 6.25% and the corresponding roughage concentrate ratio was 25:75, 44: 56 and 25:75 in R1, R2 and R3, respectively.

The growing lambs were fed (in groups) CFM and forage twice daily and water was allowed freely all the day round. Orts were collected just before offering the next day's feed. Lambs were weighted biweekly before morning feeding after 17 h fasting period. The CFM was adjusted biweekly according to body weight changes. Feed intake was recorded, daily body weight gain, and feed efficiency (g. feed/g. gain) were calculated. Three Rahmani rams were used in (3X3) Latin Square design to evaluate the experimental rations through four metabolism trials. During this trial the experimental rations (divided into 75 % CFM and 25% roughage) were offered at 2% of live body weight (LBW).

Feeds and feces were subjected for proximate analyses (A.O.A.C., 1990). Nitrogen free extract was calculated by difference. Fiber fractions were analyzed according to Van Soest and Wine (1967). At the end of collection period, rumen liquor samples were taken just before morning feeding, three and six hours post feeding. Rumen liquor samples were collected through rubber stomach tube attached to electric suction pump. Samples of rumen liquor were strained through two layers of cheesecloth and its pH was immediately recorded after collection with Beckman pH meters. Strained rumen liquor samples were acidified with 0.1 N hydrochloric acid and concentrated orthophosphoric acid and stored by freezing for determination of total volatile fatty acids (TVFA's). Concentration of ammonia-N in rumen liquor was determined according to Conway (1957), the concentration of TVFA's was determined in rumen liquor by the steam distillation method (Warner, 1964) using Mrkham micro distillation apparatus. Strained rumen liquor samples were prepared for FVFA's (acetate, propionate and butyrate acids molar percentage) determination following procedures of Erwin *et al*. (1961) and was measured using HPLC (Column:Rezex organic acid , Dimensions: 300 X 7.8 , Mobile phase: 1% orthophosphoric, Flow rate :0.8 ml / min. Detector : UV and wave length 210nm). At the end of each period blood samples were withdrawn from all the experimental animals. The blood samples were taken from the jugular vein in dry clean glasses tubes using heparin as anticoagulant and then centrifuged for 15 minutes at 4000 rpm to obtain plasma. Biochemical of blood plasma constituents were determined using commercial kits, total protein and creatinine as described by Tietz (1986 and 1990), albumin was determined according to Doumas *et al*. (1971), blood plasma urea was determined according to Patton and Grouch (1977). Alanine amino transferase (ALT) and activity of aspartate amino transferase (AST) were determined by the methods of Young (1990).

Data were analyzed using the general linear model procedure of SAS (2000). One way ANOVA procedure used to analyze data following the next model:

$$Y_{ij} = \mu + R_{ij} + E_{ij}.$$

Where: $\mu$ is the overall mean of $Y_{ij}$; $R_{ij}$ is the treatment effect; $E_{ij}$ is the experimental error.

The differences among means were separated according to Duncan's New Multiple Range Test (Duncan, 1955).

## RESULTS AND DISCUSSIONS

### *Chemical composition:*

The proximate composition of *Moringa oleifera* stems (MS), concentrate feed mixture (CFM) and clover hay (CH) is shown in Table (1). Obtained results indicated that MS contained high protein, ash, CF and low OM, EE and NFE contents compared to CH and CFM. Meantime CFM had the highest values of OM, EE, NFE and the lowest values of ash and CF compared to MS and CH. The mean CP concentration of MS was 16.14%, which is within the range of 15.6 to 26.4% reported by other workers (Malik *et al*. 1967; Gupta *et al*. 1989; Becker, 1995; Makkar and Becker, 1996 and 1997 and Reyes Sa´nchez *et al*. 2006).

Concerning fiber fraction exception hemicellulose, MS had the highest values of all fiber fractions followed by CH while CFM had the lowest values. The mean NDF and ash concentration of *Moringa* were 74.45 % and 9.18%. These values were within the range of 88%and 21.9 % reported by others authors (Malik *et al*. 1967; Gupta *et al*. 1989; Becker, 1995; Makkar and Becker, 1996 and 1997 and Reyes Sa´nchez *et al*. 2006) for NDF and ash, respectively. It is important to realize that the chemical composition of Moringa can vary considerably mainly depending on the amount of smaller branches and twigs included along with the leaves in the leaf meal. This was shown by Fujihara *et al*. (2005), who analyzed different fractions of *Moringa oleifera* (leaves, seed cake, soft twigs, and bucks). The leaves and seed cake had a CP content of approximately 25 to 30 % while leaves with soft twigs had a CP content of 19.5 %. The CP content of soft twigs alone was yet somewhat lower but this fraction can be used for animals with lower nutrient requirements. Forages with less than 8 % CP on DM basis are defined by Leng (1990) as low quality forages. So, the CP content presented in Table 1 shows that the MS used in this experiment was high quality forage.

Data showed that, the three experimental rations have nearly similar DM, OM, CP, EE and Ash, but ration two (contained 25% CH + 18.75 MS + 56.25CFM) had the higher CF (17.00 %) and lower NFE (54.58%) compared to other tested rations. This may be due to that R2 contained the highest proportion of roughage compared to R1 and R3 (43.75 vs. 25 and 25 % respectively). Such results were mainly a reflection of the chemical composition and the proportion of the experimental feedstuffs.

### *Digestion coefficients and nutritive values:*

Results in Table (2) for digestion coefficients were insignificant differences among three tested rations for EE and cellulose, while the highest digestibility for other nutrients (DM, OM, CP, CF, NFE, NDF, ADF and hemicellulose) were scored with R1 followed by R3 with significant differences between treatments. However, ration two led to significantly decrease all nutrients digestibility. This can be explained on the basis of that R1 and R3 contained the highest proportion of CFM compared to R2 (75:75:56.25%, respectively) with R2 with the highest proportion of MS (18.75%) and consequently had the highest contents of CF and its fractions especially ADL compared with other tested rations as shown (Table 1) which caused adverse impact on digestion and nutritive values of R2. In general, the higher digestibility values of most nutrients obtained of all tested rations may be attributed to the effect of feeding such high quality roughages (CH and MS) which provided stimulatory factors to rumen cellulolytic and other bacteria. These factors resulted in some changes in digestive function which led to increasing the availability and utilization of nutrients in the rumen and could have a significant impact on digestion and nutritive values of experimental rations.

Results of nutritive values (Table 2) revealed that TDN and DCP values for experimental rations appeared to be more affected by nutrients digestibility and concentrate roughages ratio. It was noticeable that R1 with highest nutrient digestibility and high concentrate ratio (75.00 %) showed the highest TDN (65.39%) and DCP (11.07%), while R2 with lowest nutrients digestibility recorded the lowest values 59.34% and 9.96 % for TDN and DCP, respectively. Meantime, intermediate values of nutrients digestibility of R3 led to intermediate TDN and DCP values (61.52 and 10.75%) respectively.

## *Rumen parameters:*

Data of ruminal pH, NH3-N and TVFA's concentration are presented in Table (3). Results indicated that ruminal pH values were significantly (P<0.05) higher with feeding R1 and R2 at 3hours than R3, while no significant differences between treatment before feeding and at 6hours after feeding.

Concerning sampling time, values of pH before and returned to increase at 6hours after feeding for all experimental rations. Similar results were noticed by Mahmoud (2011). Owens *et al*. (1998) concluded that rumen pH is affected TVFA's concentration in rumen fluid as results of intensive fermentation process of both non structural and structural carbohydrates and the production of volatile fatty acids.

The means of pH values of sheep fed the different rations were within the normal range as mentioned by Hungate (1996) being 5.5 to 6.85. Variations in pH values obtained in the present study could be explained that rumen pH values were varied according to the nature of diet, after feeding time and quantities of organic acids in the ingesta mentioned before by Phillipson (1970).

Values of TVFA's concentration in Table (3) indicated that the minimum TVFA's was recorded at zero time and gradually increased to the maximum at 3hours post feeding and tended to decrease again at 6hours post feeding. The highest value of TVFA's concentration was at 3hours post feeding, which was reflected on pH values at the same time. There were insignificant differences in TVFA's concentration between all treatments in all sampling times. Such results might be indicated that inclusion of MS in tested rations had created similar rumen environment in relation to TVFA's production which showed closer values for all dietary rations either before or after feeding.

Values of ammonia-N concentration in Table (3) indicated that ammonia NH3-N was recorded at zero time and gradually increased to the maximum at 3hours post feeding and tended to decrease again at 6hours post feeding. In this respect, ammonia concentration was found to be significantly (P<0.05) highest with R3 compared to other tested rations. Regarding sampling time, NH3-N concentration was significantly lowest with R3. The same ration (R3) recorded highly significant values (P<0.05) at 3 and 6hours after feeding compared to other tested rations (R1 and R2).

The decrease in ruminal $NH_3$-N concentration at 3 hours after feeding could be related to the utilization of N by the ruminal microorganisms or a dilution from a large rumen total volume. Ammonia-N concentration was within the normal range described by Church (1976), being 10 to 45 mg/100 ml depending on composition of the ration, time of sampling and method of analysis used. Also, Mehrez (1992) indicated that the optimal $NH_3$-N concentration for maximum rate of fermentation in the rumen was affected by the dietary type and level of fermented energy in the rumen. Lower ruminal $NH_3$-N concentration may indicate best utilization of $NH_3$-N by rumen microbes (Saxena *et al*. 1971).

Volatile fatty acids is the mainly source of energy in ruminants especially acetic and propionic acid and the major volatile fatty acids was acetic acid, if the ruminants feeding on roughages, this explain the following results are presented in Table 4. Result revealed that, acetic acid concentration appeared to more affect by the level of roughage concentration ratio, fiber content and fiber fractions in the experimental diet. It was noticeable that R2 characterized with the highest roughage ratio, CF content (17.00 *vs* 14.99 and 14.17%, respectively) and fiber fractions, achieved the highest acetic acid concentration. While, the lowest acetic acid concentration was recorded with feeding R3 which contained the lowest CF and fiber fractions, meanwhile, R3 contained intermediate CF and fiber fractions values recorded intermediate acetic acid concentration.

Results indicated that, propionic acid with increasing concentrate ratio and using both kinds of roughages (CH and MS). It was noticeable that R3 with higher concentrate ratio 75% and containing CH and MS provide the highest propionic acid concentration. While, the lowest values were recorded with feeding R2 contained the lowest concentrate ratio (56.25%) but feeding R1 recorded intermediate values, with highly significant differences (P<0.05) among all treatments.

Proportion of acetic acid is highest on the feeding of high proportion of cellulose rich fibrous diet and decrease gradually with corresponding increase in the proportion of propionic acid with variable effects on butyric acid on increasing the ratio of concentrate, starch or sugars (molasses) in the diet (Annison and Armsrtrong, 1970; Johri *et al*. 1982; Murphy *et al*. 1982 and Kamra and Pathak, 1996).

## *Blood parameters:*

Results concerning the effect of feeding sheep on the experimental rations by sheep on some blood parameters are shown in Table (5). In the present study, total proteins in all experimental rations are nearly similar within the normal range being 6-8 g/dl (Kancko, 1989). Results indicated that there were insignificant differences in blood globulin, urea and creatinine among experimental rations. Data of ALT was significantly lower with R2 compared to R1 and R3. In the same time, R3 recorded the lowest value of AST compared to R1 and R2 with highly significant differences. Blood plasma transaminase enzymes activity (ALT and AST) are the most important indicators of liver cells activity where increasing the concentration of these enzymes indicate the tissue activity are destroyed (Molander *et al*. 1957). According to Maxwell *et al*. (1990), blood parameters are important in assessing the quality and suitability of feed ingredients in farm animals. Esonu *et al.* (2001) had stated that haematological constituents reflect the physiological responsiveness of the animal to its internal and external environments which include feed and feeding. Animashahun *et al.* (2006) affirmed that the comparison of blood chemistry profile with nutrient intake might indicate the need for adjustment of certain nutrients upward or downward for different population groups. Evaluation of the blood profile of animals may give some insight as to the potentials of a dietary treatment to meet the metabolic needs of the animal since according to Church *et al*. (1984), dietary components have measurable effects on blood constituents such that significant changes in their values can be used to draw inference on the nutritive value of feeds offered to the animals.

## *Body weight change, feed intake and feed conversion:*

The results of live body weight values are shown in Table (6). There were no significant differences ($P<0.05$) among the lambs at the start of the experiment (IBW), and at the end of the experiment (FBW). Also, total body gain and daily gain are within the normal range of daily gain of Rahmani lambs fed traditional Egyptian rations (Gabr et al. 2006). Meantime, results of daily and total live body weight indicated that equipment of the expected production of the experiment lambs were covered by giving all tested rations. Results revealed also that, the average daily gains for successive treatments appeared to more affect by the level of MS inclusion in the tested diets.

It was noticeable that R2 contained the highest level of MS (18.75% on DM basis of diet) achieved the highest daily gain (223.85 g) and total BWG (20.14 kg), followed by feeding R3 (contained 6.25% on DM basis of diet) being 211.77 g/day and 19.05 kg as total BWG. While the lowest daily and total BWG were recorded with feeding diet without Moringa (R1). The positive relationship between MS inclusion and both daily and total BWG is probably a reflection of increasing quality of the diets with increasing level of Moringa which well be probably enhance the utilization and the availability of essential nutrients especially protein, energy and mineral of the dietary organic matter. Akinyemi et al. (2010) indicated that the optimum level of replacement of Panicum maximum grass with MS with feeding West African Dwarf (WAD) rams at about 25% which achieved the best N balance and N retention. Data of voluntary feed intake (Table 5) indicated that fed R1 contained 25% CH and 75% CFM showed significantly ($P<0.05$) the highest DM, TDN and DCP intakes followed by feeding R3 with the same ratio of roughage concentrate ratio. While, lambs fed R2 contained 43.75% roughage: 56.25% CFM recorded the lowest values of DM, TDN and DCP intakes with significantly differences between R1 and R2. The highly daily DM, TDN and DCP intakes were mainly due to consume more amounts of CFM in R1 and R3 compared to feeding R2.

Feed efficiency is the amount of DMI or TDN and DCP required producing one kg of live body weight gain. Results indicated that lambs fed control rations (R1) were the least efficiency as compared to the lambs fed R2 and R3 with highly significant differences. The better feed efficiency obtained by feeding R2 and R3 may be attributed to the beneficial effects of MS, which provided stimulator factors and essential nutrients specially protein, energy, minerals and vitamins that better utilized by sheep. These factors and essential nutrients resulted in some change in the digestive function that led to increasing the availability and utilization of nutrients in the rumen and could have a significant impact on the feed utilization and growth rate.

## CONCLUSION

*Moringa oleifera* stems are suitable for feeding sheep. It could be concluded that Moringa stems can be used to replace a part of CH or CFM without adverse effect on the performance of Rahmani lambs.

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## REFERENCES

A.O.A.C. (1990). Official methods of an analytical. 15th Ed. Association of Official Analytical Chemists. Washington, DC., USA .

Akinyemi A.F.; A.A. Julius and N.F. Adebowale (2010). Digestibility, nitrogen balance and hematological profile of west African dwarf sheep fed dietary level of *Moringa oleifera* as supplement to *Panicum maximum*. J. of American Sci., (10):634-643.

Animashahun, R.A.; S.O. Omoikhoje and A.M. Bamgbose (2006). Haematological and biochemical indices of weaner rabbits fed concentrates and *Syndrella nodiflora* forage supplement. Proc of 11th Ann Conf Anim. Sci. Assoc of Nigeria. Institute of Agricultural Research and Training, Ibadan, Nigeria, pp: 29-32.

Annison, E.F. and D.G. Armstrong (1970). In physiology of digestion and metabolism in ruminants. P422 (Ed., Phillipson, A.T.)Oriel Press 1td. New castle-upon-Tyne, England.

Becker, K. (1995). Studies on utilization of *Moringa oleifera* leaves as animal feed. Institute for Animal Production in the Tropics and Subtropics, vol. 480. University of Hohenheim, Stuttgart, p. 15.

Church, J.P.; J.T. Judd; C.W. Yomg; T.L. Kebay and W.W. Kim (1984). Relationship among dietary constituents and specific serum clinical components of subjects eating self selecting diets. Amer. J. Clin. Nutr., 40: 1338–1344.

Church. D.C. (1976). Digestive Physiology and Nutrition Ruminants, Vol. 1. Digestive Physiology 145. 2nd Ed. 8 Books, Corvallis, Oregan. (C. F. Marei (2007))

Conway, E.F. (1957). Modification Analysis and Volumetric Error. Rev. Ed. Lockwood, London.

Devendra, C. (1990). The use of shrubs and tree fodders by ruminants. In Devendra, C. (ed.). Shrubs and Tree Fodders for Farm Animals. International Development Research Centre, Ottawa, pp. 24-29.

Doumas, B.; W. Wabson and H. Biggs (1971). Albumin standards and measurements of serum with bromochresol green. Clin. Chem. Acto., 31:87.

Duncan, D.B. (1955). Multiple Range and Multiple F Test. Biometrics, 11:10.

El-Shinnawy, A.M.M. (2003). Studies on Silage in Ruminants Feeding. M.Sc. Thesis, Fac. of Agric. Cairo Univ. Egypt, 136 p.

Erwin, W.S.; G.J. Marco and E.M. Emery (1961). Volatile fatty acids analysis of blood and rumen fluid by gas chromatography. J. Dairy Sci., 44(9):1768.

Esonu, B.O.; O.O. Emenalom; A.B.I. Udedibie; U. Herbert; C.F. Ekpor; I.C. Okoli and F.C. Iheukwumere (2001). Performance and blood chemistry of weaner pigs fed raw Mucana bean (velvet) meal. Tropical Animal Production Investigation, 4: 49 –54.

Foidl, N.; H.P.S. Makkar and K. Becker (2001). The potential of *Moringa oleifera* for agricultural and industrial uses. In: Lowell Fuglie J editors.The Miracle Tree: The Multiple Attributes of Moringa oleifera . Wageningen, The Netherlands: CTA Publication; p 45-76.

Fujihara, A.; S. Fajemilehin and A. Omojola (2005). The egg quality characteristics of layers fed varying dietary inclusions of Siam weed (*Chromolaena odorata*) leaf meal (SWLM). Int. J. Poult. Sci., 4:752–757.

Gabr, A.A.; S.A. El-Ayouty; M.g. Gabr; M.A. El-Harairy and E.S. El-Gohary (2006). Effect of feeding level and replacement of *nigella sativa* meal in diets of Rahmani ewe lambs on: 1. Growth performance at pre- and post-pubertal ages. Egyptian J. of Sheep, Goat and Desert Animals Sciences (2006) 1(1):153-170.

Gupta, K.; G.K. Barat; D.S. Wagle and H.K.L. Chawla (1989). Nutrient contents and anti- nutritional factors in conventional and non-conventional leafy vegetables. Food Chem., 31:105-116.

Hungate, R.E. (1996). The rumen and microbes. Academic Press. New York (C. F. El-Shinnawy, 2003).

Johri, C.B.; S.K. Ranjhan and N.N. Pathak (1982). Effect of different levels of urea and molasses supplementation of whaet bhusa on the voluntary intake, digestibility of nutrients and growth response of male buffalo calves. Indian J. Anim. Sci., 52:193.

Kamra, D.N. and N.N. Pathak (1996). Nutritional microbiology of farm animals. 1st published vikas publishing house PVTLTP. New Delhi.

Kancko, J.J. (1989). Clinical Biochemistry of Domestic Animals, 4th Ed. Academic Press, Inc., New York.

Leng, R. (1990). Factors affecting the utilization of poor quality forages by ruminants, particularly under tropical conditions. Nutr. Res. Rev. 44, 277–303.

Mahmoud, A.E.M. (2011). Fresh water reed silage as non conventional forage in feeding lactating buffaloes and growing lambs. Ph.D. Thesis, Fac. of Agric., Cairo Univ. Egypt.

Makkar, H.P.S. and K. Becker (1996). Nutritional value and anti-nutritional components of whole and extracted *Moringa oleifera* leaves. Anim. Feed Sci. Technol., 63:211–228.

Makkar, H.P.S. and K. Becker (1997). Nutrients and anti-quality factors in different morphological parts of the *Moringa oleifera* tree. J. Agric. Sci. Camb., 128:311– 332.

Malik, M.Y.; A.S. Abhtar and W.H. Shah (1967). Chemical composition of indigenous fodder leaves (*M. pterygosperma*). Pak. J. Sci., 19:171–174.

Marei. M.E.M. (2007). Evaluation of Reed Plants (*Arundo Donax L*) for Feeding Lactating Buffaloes. Ph.D. Thesis, Fac. of Agric. Kafrelsheikh Univ. Egypt, 89 p.

Maxwell, M.H.; W. Robertson; S. Spener and C.C. Maclorquodale (1990). Comparison of hematological parameters in restricted and *ad libitum* fed domestic fowls. British Poult. Sci., 31:407-413.

Mehrez, A.Z. (1992). Influence of roughage: concentrate ratio on N-requirements of rumen microbes for maximal rate of fermentation. Proceedings of international conference on manipulation of rumen microorganisms to improve efficiency of fermentation and ruminant production, Alexandria, Egypt, 20-23 September, 234 p.

Mekonnen, Y.; V. Yardley; P. Rock and S. Croft (1999). *In vitro* antitrypanosomal activity of Moringa oleifera stenopetala leaves and roots. Phototherapy Research, 13:538–539.

Molander, D.W.; E. Sheppard and M.A. Pyen (1957). Serum transaminase in liver disease. J. Anim. Sci., 163:1461.

Murphy, M.R.; R.L. Baldwin and L.J. Koong (1982). Estimation of stoichio-metric parameters for rumen fermentation of roughage and concentrate diets. J. Anim. Sci., 55:411.

Owens, F. N.; Secrits, D. S.; Hill, W. J. and Jill, D. R. (1998). Acidosis in cattle: a review. J. Anim. Sci., 76: 275.

Patton, F.G. and S.R. Grouch (1977). Colorimetric determination of urea, Anal. Chem., 49:468.

Pezo, D. (1991). La calidad nutritiva de los forrajes. Produccion y utilizacion de forrajes en el tropico. Compendio. Serie Materiales de Ensenanza, 15 p.

Phillipson, A.H. (1970). Physiology of digestion and metabolism in the ruminants. Oriel Press, Newcastle Upon Tyne, England. (C. F. Marei (2007)).

Reyes Sa´nchez, N.; B. Eva Spo¨ rndly and Inger Ledin (2006). Effect of feeding different levels of foliage of *Moringa oleifera* to Creole dairy cows on intake, digestibility, milk production and composition. Livestock Science 101:24-31.

SAS (2000). SAS users guide statistical analysis system institute, Inc., Cary, Nc, USA.

Saxena, S.K.; D.E. Otterby; J.D. Donker and A.L. Good (1971). Effect of alkali-treated oat straw supplemented with soybean meal or non-protein on growth of lambs and certain blood and rumen liquor parameters. J. Anim. Sci., 33:485-490.

Tietz, N.W. (1986). Text Book of Clinical Chemistry. W. B. Saunders, Philadelphia, 1271.

Tietz, N.W. (1990). Clinical Guide to Laboratory Tests 2nd Ed. Philadelphia.

Van Soest, P.J. and R.M. Win (1967). Use of detergent in the analysis of fibrous feed. IV. Determination of plant cell wall constituents. J. Assoc. Off. Anal. Chem. 50:50-55.

Warner, A.C.I. (1964). Production of volatile fatty acids in the rumen, methods of measurements. Nutr.Abst. and Rev., 34:339.

Young, D.S. (1990). Effects of drugs on clinical laboratory tests, 3rd Ed. 3:6.

**Table (1): Chemical composition and fiber fractions of the experimental feedstuffs and rations (% on DM basis).**

| Item | Feedstuffs | | | Experimental rations | | |
|---|---|---|---|---|---|---|
| | CH | MS | CFM | R1 | R2 | R3 |
| Chemical composition | | | | | | |
| DM | 91.07 | 94.23 | 91.65 | 91.25 | 91.23 | 91.35 |
| OM | 91.19 | 90.82 | 92.80 | 90.56 | 90.45 | 90.48 |
| Ash | 8.81 | 9.18 | 7.20 | 9.44 | 9.55 | 9.52 |
| CP | 13.89 | 16.14 | 14.83 | 14.32 | 14.08 | 14.32 |
| EE | 3.19 | 0.87 | 6.78 | 5.40 | 5.09 | 5.52 |
| CF | 28.92 | 30.53 | 10.38 | 14.99 | 17.00 | 14.17 |
| NFE | 45.19 | 43.28 | 60.81 | 55.85 | 54.28 | 56.47 |
| Fiber fractions | | | | | | |
| NDF | 40.97 | 74.45 | 34.91 | 36.38 | 37.67 | 36.39 |
| ADF | 31.32 | 59.66 | 20.43 | 23.08 | 24.61 | 22.85 |
| ADL | 8.37 | 11.20 | 7.10 | 7.41 | 7.58 | 7.38 |
| Cellulose | 22.95 | 48.46 | 13.33 | 15.67 | 17.03 | 15.47 |
| Hemicellulose | 9.65 | 14.79 | 14.48 | 13.30 | 13.06 | 13.54 |

*CH: Clover hay, MS: Moringa oleifera stems, CFM: Concentrate feed mixtures, R1: CH+CFM, R2: CH+CFM inclusion 25% MS and R3: CH inclusion 25% MS+CFM.*

**Table (2): Digestibility coefficients and nutritive value of the experimental rations.**

| Item | Experimental rations | | | ±SE |
|---|---|---|---|---|
| | R1 | R2 | R3 | |
| Digestibility coefficients, % | | | | |
| DM | 72.94$^{a}$ | 63.02$^{c}$ | 69.28$^{b}$ | 0.86 |
| OM | 79.07$^{a}$ | 66.68$^{c}$ | 73.90$^{b}$ | 1.33 |
| CP | 77.27$^{a}$ | 70.75$^{c}$ | 75.08$^{b}$ | 0.59 |
| EE | 87.10 | 84.11 | 84.04 | 3.41 |
| CF | 66.90$^{a}$ | 50.88$^{b}$ | 52.68$^{b}$ | 3.30 |
| NFE | 58.97$^{a}$ | 52.76$^{b}$ | 56.87$^{ab}$ | 1.44 |
| NDF | 66.04$^{a}$ | 50.16$^{c}$ | 57.36$^{b}$ | 1.18 |
| ADF | 67.04$^{a}$ | 50.09$^{b}$ | 57.65$^{ab}$ | 3.11 |
| Cellulose | 76.32 | 73.08 | 80.61 | 3.38 |
| Hemicelluloses | 72.51$^{a}$ | 59.71$^{c}$ | 65.31$^{b}$ | 3.93 |
| Nutritive values, % | | | | |
| TDN | 65.39$^{a}$ | 59.34$^{b}$ | 61.52$^{b}$ | 0.88 |
| DCP | 11.07$^{a}$ | 9.96$^{c}$ | 10.75$^{b}$ | 0.08 |

*a,b and c: Means in the same row with different superscripts are significantly different (P<0.05).*

**Table (3): Effect of the experimental rations on rumen pH, NH3 and TVFA's.**

| Item | Experimental rations | | | ±SE |
|---|---|---|---|---|
| | R1 | R2 | R3 | |
| pH | | | | |
| Zero time | 6.45 | 6.75 | 6.85 | 0.15 |
| 3 hours | 5.85[a] | 5.90[a] | 5.55[b] | 0.13 |
| 6 hours | 6.40 | 6.35 | 6.25 | 0.13 |
| Mean | 6.23 | 6.33 | 6.22 | 0.08 |
| Ammonia (mg/100ml) | | | | |
| Zero time | 25.20[a] | 18.20[b] | 16.80[b] | 0.08 |
| 3 hours | 36.40[b] | 32.20[b] | 44.80[a] | 0.24 |
| 6 hours | 28.00 | 29.20 | 42.00 | 0.40 |
| Mean | 29.87[ab] | 26.53[b] | 34.53[a] | 0.17 |
| Total volatile fatty acids, (TVFA's) ml/equiv. | | | | |
| Zero time | 14.40 | 19.20 | 19.80 | 1.96 |
| 3 hours | 22.10 | 21.80 | 23.10 | 0.08 |
| 6 hours | 17.00 | 11.80 | 10.60 | 0.72 |
| Mean | 17.83 | 17.60 | 17.83 | 0.13 |

*a and b: Means in the same row with different superscripts are significantly different (P<0.05).*

**Table (4): Effect of experimental rations on rumen volatile fatty acids fractionation.**

| Item | Experimental rations | | | ±SE |
|---|---|---|---|---|
| | R1 | R2 | R3 | |
| Acetic | | | | |
| Zero time | 52.35[b] | 61.72[a] | 47.38[c] | 0.55 |
| 3 hours | 59.21[b] | 66.58[a] | 49.22[c] | 0.57 |
| 6 hours | 50.80[b] | 52.20[a] | 48.88[c] | 0.52 |
| Mean | 54.12[b] | 60.17[a] | 48.49[c] | 0.85 |
| Propionic | | | | |
| Zero time | 20.75[b] | 14.68[c] | 26.34[a] | 0.57 |
| 3 hours | 29.71[b] | 29.31[b] | 32.44[a] | 0.57 |
| 6 hours | 27.31[a] | 22.92[b] | 27.11[a] | 0.57 |
| Mean | 25.92[b] | 22.30[c] | 28.63[a] | 0.55 |
| Butyric | | | | |
| Zero time | 18.89[a] | 15.59[b] | 18.28[a] | 0.52 |
| 3 hours | 22.14[b] | 17.10[c] | 31.33[a] | 0.52 |
| 6 hours | 19.89[b] | 21.87[a] | 22.00[a] | 0.57 |
| Mean | 20.31[b] | 18.19[c] | 23.87[a] | 0.58 |
| Acetate : propionate ratio | 2.09[b] | 2.70[a] | 1.70[c] | 0.06 |

*a, b and c: Means in the same row with different superscript are significantly different (P<0.05).*

**Table (5): Blood parameters of growing lambs fed the experimental rations.**

| Item | Experimental rations | | | ±SE |
|---|---|---|---|---|
| | R1 | R2 | R3 | |
| Total protein, g/dl | 6.65 | 6.70 | 6.25 | 0.02 |
| Albumin, g/dl | 4.85[ab] | 4.95[a] | 4.45[b] | 0.17 |
| Globulin, g/dl | 1.80 | 1.75 | 1.80 | 0.08 |
| Urea, mg/dl | 34.50 | 34.00 | 34.50 | 0.28 |
| Creatinine, mg/dl | 0.95 | 0.90 | 0.95 | 0.58 |
| AST, IU/l | 28.00[a] | 17.50[b] | 13.00[c] | 0.57 |
| ALT, IU/l | 21[a] | 18[b] | 20[a] | 0.07 |

*a,b and c: Means in the same row with different superscripts are significantly different (P<0.05).*

**Table (6): Effect of experimental rations on growth performance of growing lambs.**

| Item | Experimental rations | | | ±SE |
|---|---|---|---|---|
| | R1 | R2 | R3 | |
| Body change | | | | |
| Initial body weight (IBW), kg | 31.25 | 29.95 | 29.00 | 1.84 |
| Average daily gain, g | 205.13 | 223.85 | 211.77 | 24.32 |
| Total gain, kg | 18.46 | 20.14 | 19.05 | 2.19 |
| Final body weight (FBW), kg | 49.71 | 50.10 | 48.05 | 3.04 |
| Feed Intake | | | | |
| DM, kg | 1.48[a] | 1.22[b] | 1.33[ab] | 0.09 |
| TDN, kg | 0.97[a] | 0.72[b] | 0.83[ab] | 0.05 |
| DCP, kg | 0.165[a] | 0.071[b] | 0.089[b] | 0.006 |
| Feed conversion g/g | 7.24 | 6.60 | 7.00 | 0.55 |

*a and b: Means in the same row with different superscripts are significantly different (P<0.05).*

# تأثير التغذية على سيقان المورينجا على الأداء الإنتاجى للحملان النامية

**عادل عيد محمد محمود**

***قسم الإنتاج الحيوانى – كلية الزراعة – جامعة القاهرة -12613- جيزة – مصر***

هدفت هذه الدراسة إلى تقييم تأثير التغذية على سيقان المورينجا على المأكول والهضم وأداء النمو وقياسات الدم للحملان النامية. سبعة وعشرون حمل رحمانى بمتوسط وزن بداية 30 كجم قسمت إلى ثلاث مجموعات ( تسع حيوانات بكل مجموعة). غذيت الحملان فى مجموعة المقارنة على دريس البرسيم بنسبة 1% من الوزن الحى مع مخلوط العلف المركز بنسبة 3% من الوزن الحى، بينما الحملان فى المجموعات التجريبية غذيت على 25% سيقان مورينجا كنسبة من العلف المركز و 25% من سيقان المورينجا من دريس البرسيم فى العليقة الثانية فى العليقة الثالثة على التوالى. أشارت النتائج إلى أرتفاع قيم الهضم والقيم الغذائية مع عليقة المقارنة، فى حين أن العليقة الثانية أظهرت قيم منخفضة و كانت قيم المعاملة الثالثة متوسطة.

أختلفت قيم درجة حموضة الكرش وتركيز الأمونيا بشكل معنوى بين المجموعات المختبرة عند 3ساعات بعد التغذية. لم تسجل فروق معنوية تركيز الأحماض الدهنية الطيارة الكلية بين المجموعات المختبرة قبل التغذية وبعدها. كذلك لم تسجل درجة حموضة الكرش والأمونيا فروق معنوية قبل التغذية وبعد 6 ساعات من التغذية. كان تركيز حمض الخليك مختلف بشكل معنوى بين العلائق، ولكن كان الأختلاف مرتفع مع العليقة الثانية مقارنة بالعليقة الأولى والثالثة. على العكس كان تركيز حمض البروبيونيك والبيوتريك مرتفع بشكل معنوى عند التغذية على العليقة الثالثة وتبعت بالعليقة الأولى ثم الثانية. وقد أنعكست هذه التركيزات على النسبة بين الخليك والبروبيونيك والذى كانت مرتفعة بشكل معنوى مع العليقة الثانية ( 2.70) مقارنة بالعليقة الثالثة والأولى. لم يسجل كل من البروتين الكلى، الجلوبيولين واليوريا والكرياتنين فروق معنوية، فى حين أوضحت المقاييس الأخرى للدم وجود فروق معنوية بين المحموعات المختبرة. فى نفس الوقت كانت كل قيم مقاييس الدم للحيوانات فى الحدود الطبيعية لصحة الحيوان. كانت قيم متوسط معدل النمو اليومى والنمو الكلى كالتالى 205.13، 223.85 ،211.77 جم و 18.46، 20.14، 19.05كجم مع العليقة الأولى والثانية والثالثة على الترتيب ، مع عدم وجود فروق معنوية بين المجموعات. العلائق المحتوية على سيقان المورينجا (العليقة الثانية والثالثة) حققت أعلى كفاءة غذائية مقارنة بعليقة الكنترول مع فروق معنوية عالية. ونستخلص من هذه الدراسة أن سيقان المورينجا تعتبر مناسبة لتغذية الأغنام ويمكن استخدمها فى أن تحل محل جزء من دريس البرسيم أو مخلوط العلف المركز بدون أى تأثير سلبى على أداء الحملان الرحمانى.