AUCTORES
Globalize your Research

Journal of Nutrition and Food Processing

Ibrahim Bushara *

Open Access

Research Article

Influence of Feeding Baobab Seed Cake on Milk Production and Quality of Desert Goats

I Bushara [1]* and Dalia, A. M. Al Basheir [2]

[1]Department of Animal Production, Faculty of Natural Resources and Environmental Studies, University of Kordofan El-Obied, Sudan.

[2]Faculty of Animal Production, University of East Kordofan, Sudan.

Corresponding author: Ibrahim Bushara, Department of Animal Production, Faculty of Natural Resources and Environmental Studies, University of Kordofan El-Obied, Sudan.

Received date: April 15, 2025; Accepted date: April 22, 2025; Published date: April 30, 2025

Citation: I Bushara and Dalia, A. M. Al Basheir, (2025), Influence of Feeding Baobab Seed Cake on Milk Production and Quality of Desert Goats, *J. Nutrition and Food Processing,* 8(6); **DOI:10.31579/2637-8914/312**

Abstract:

The study was conducted in Al-Newala Village south ELObied town, Sheikan locality in North Kordofan state, Sudan. The milk production and composition of desert goats fed varying levels of baobab (Adansonia digitata) seed cake supplement was investigated over a period of 135 days. Twenty-four (24) adults pregnant does of Desert goats were randomly allotted to four dietary treatments with six animals per replicate in a completely randomized design to determine the quantity and quality of milk produced. The does were of similar initial body weight. They were randomly assigned to four supplementary feeding treatments. Group A was used as a control (un supplement as in farmer practice), the second group B was supplement with diet of 65% baobab seed cake, group C with diet of 55% baobab seed cake and group D was supplemented of 45% baobab seed cake. All does in all groups were subjected to natural grazing. The results indicated that supplementation with baobab seed cake had a highly significantly ($P<0.05$) effected milk production on 90 days, total milk production and daily milk yield. The does in group B had registered highest significantly ($P<0.05$) more milk (116.92 Lb) than those in group C and D as 114.15 Lb and 107.97 Lb respectively. The least milk was produced by the A group (control) of (79.73Lb) and which was significantly ($P<0.05$) less than supplemented groups. The daily milk production indicated that the does supplemented with baobab seed cake yielding significant ($P<0.01$) higher milk than control groups as 0.88,1.30, 1.27 and 1.20 Lb for group A, B, C and D respectively. The data indicated that supplementation had exerted a significant ($P<0.05$) effect on fat during 605-90 days with higher fat percentage in group C in 30-60 days as 3.75% and group D as 3. 57%. Protein % showed significant ($P<0.05$) effect during 0-30 and 60-90 days, where high percentages were in group C with 3.77%. Lactose and as content secured non-significant effected by baobab seed cake supplementation. In conclusion supplementation with baobab seed cake diet to Sudanese Desert goats during dry season improved milk production and inclusion of baobab seed cake at 65 % in the diet of Desert goats gave the highest milk yield.

Key words: desert goat; supplementation; baobab seed cake; milk production; Sudan

Introduction

Goat production plays a very vital role in the livelihood of rural populations in Sudan as it contributes significantly to improvement of family nutrition and health. The Desert goat is indigenous goat breeds found in western Sudan. Records of its dairy performance in the natural environment it produces a low quantity of milk when compared with other goat breeds [1]. The nutritional role of milk and milk products in human diet is well documented [2]. Milk from ruminants is a good alternative to augment animal protein intake. Increased awareness of the importance of milk in tropical areas has led to increased demand for milk and its products [3]. The rising demand for milk and its products in the tropics has made it imperative to find means for increasing local milk production, even outside their natural habitat/environment; this practice helps in performance evaluation of animals in locations outside their domain [4].

Milk quality and quantity is very dependent on the type of feed used in farming [5]. Generally, farmers in Sudan have minimal sources of feed for their domestic animals. Feeding system mainly depends on the use of forage, native grasses, legumes and field grass originating from the surrounding environment with limited sources and low nutritional quality (protein content) affect productivity. Under such systems livestock production is constrained by scarcity and fluctuating quantity and quality of the year-round feed supply during the dry season [6 -7]. As a result, animals consume higher quantity of less palatable species and protein content, which consequently results in loss of body weight and low milk

production. In order to maximize opportunities presented for milk production by goats, so it is significant to improve the quality of feed and explore new kind feed sources to increase the quality of milk. [8].

Promotion of concentrate feeding to improve low quality dry season feeds is limited by high competition with humans as well as soaring cost. It was reported that high competition for consumption of conventional protein sources between human beings and the livestock industry in the last two decades has resulted in an inadequate supply of dietary proteins [9]. Feeding of ruminant livestock generally becomes a challenge to farmers during dry season but due to their small herds the small scale farmers are the hardest hit given the high feed costs, especially energy and protein sources. So it is significant to improve the quality of feed and providing adequate good-quality feed and explore new kind feed sources to increase the quality of milk and maintain their productivity while mitigating climate change [8]. The problem of feed shortage can be addressed by the use of locally produced good quality alternative non- conventional feed materials which are nutritious and affordable [10]. Therefore, there is a need to exploit non-conventional protein sources. Research on low-cost and locally available indigenous protein sources is very important, especially those which do not attract competition with human beings and the ever-expanding intensive livestock production. The use of local indigenous multipurpose tree products and by-products, such as seed cakes and leaf meals is one such possible alternative. Utilization of non-conventional feedstuffs especially when it encourages a shift to other ingredients that are not edible to man but readily available will reduce the cost of feed and maximize the returns from small ruminant production [1].

Reports have indicated that one of the potential low-cost and locally available protein sources in small ruminant diets is Adansonia digitata (baobab) seed [11]. Baobabs trees are widespread all over the hot, drier regions of tropical Africa and are prevalent Sudan and are commonly considered as an African symbol [11-12]. Baobab seeds are rich in protein and contains substantial amount of energy [11]. Baobab seed cake (BSC) has a crude protein content of about 17% [13], which is inadequate for it to be used as a sole protein source in mid-lactating dairy cows. The supplementation of animal rations with a protein source is necessary to meet the protein and amino acid requirements of the animal for a better performance. Many studies have evaluated the effect of Baobab seed cake (BSC) on cows and ewes. To our knowledge, there are few published studies on the effects of Baobab seed cake (BSC) in the lactating goat. However, there is limited information about the feeding value of Adansonia digitata seedcake as feed for goats in Sudan. Furthermore, no studies have investigated the effect of the incorporation of Baobab seed cake (BSC) and ground nut cake mixture in the goats' diet. In this study aims to evaluate the effects of diets supplemented with Baobab seed cake (BSC) on desert goat milk production performance and quality in North Kordofan state, Sudan.

Materials and Methods

The experiment was conducted in Al-Newala Village (Longitudes 30.34˚-30.05˚ N, Latitudes 12.93˚-13.34˚E), about 35 km south ELObied town, Sheikan locality in North Kordofan state. Average temperature varies between 30-35oC during most of the year with peaks of above 40oC during April, May and June. The rainy season extends from July to October with maximum rainfall in August. Long-term averages annual rainfall is about 280 mm.

Experimental design and duration

The study involved three experimental groups and one control group, which made a total of four treatments. A completely randomized design was used for the experiment, with six replicates of pregnant doe's of Desert goats per treatment. animals were randomly distributed to 4 treatments. The experiment lasted for 135 days (7 days pre-experimental period, 45 days for last months of gestation period, and 90 days after kidding).

Experimental animals and feeding management

The study was carried out on Twenty four (24) adult pregnant doe's of Desert goats were used from the last month of pregnancy until 90 day of lactation. The goats were collected from small-scale farmers from in Al Newala Village. The does were of different in age with a range of >1 year to three years of age. The target goats were ear tagged, weighed and randomly divided into four groups A, B, C and D each group component of (6) does according body weight. All groups were treated against endo- and ecto-parasites, and vaccinated against food and mouth disease, Anthrax and Hemorrhagic Septicemia. All goats were housed in partially shaded pens, constructed from local materials of woods and were equipped with clean water troughs.

All goats depending on pasture to maintained their roughage and they were daily turned to grazing from 8.00A.m to 6.00p.m. These goats were fed experimental diets containing different levels of baobab seed cake in a formulated diet (Table 1). Group A were used as control with, and managed according to the prevailing traditional system which relies mainly on grazing with no supplementation. Group B, beside allowed to grazing similar to the control group were managed with ration 1. Group C, managed with grazing and supplementing with ration 2, last group D were managed with grazing and supplement with ration 3. Supplementation of groups B, C and D were performed during night after grazing time by rate of 200gm/head/day. Animals were hand milked twice daily.

Milk production

Collection of milk from each lactating doe commenced 7 days after parturition to allow for colostrums intake by the kids. Milking was done by hand twice daily at 7am and 5pm in the presence of the kids for 90 days. Milk let-down was stimulated by the suckling the kid for 5 minutes after which the doe was milked. The milk was weighed using a precision scale (with a sensitivity of 0.1 g). Weight of the kids was taken before and immediately after suckling to estimate milk intake. Kids were separated from does after milking. Milk yield was calculated as the summation of milk off-take and intake by the kid

Milk Composition

Fresh milk samples were taken every 15 days interval for chemical analysis for 60 days. The Milk samples (20 ml) from each does in all group were collected in sterile containers and kept in a refrigerator adjusted at 5 C0 pending the analysis for chemical composition. The analysis has been done according to methods of [14]; the crude protein was determined by the Kjeldahl method as described by [14]. Crude fiber determination was carried out using trichloroacetic acid (TCA) method. Fat content of milk was analyzed by Gerber method as described by [15]. Ash was determined according to [14]. Lactose and solids, not fat contents, were determined by difference. Analysis was done in the laboratory of Animal Production of ELObied agricultural Research Station, North Kordofan state, Sudan.

variables	N	0-30 days	30-60 days	60-90days	Total milk	Daily milk
Animal Groups						
Group A	6	24.52[b]	33.22[b]	22.17[c]	79.73[b]	0.88[b]
Group B	6	36.22[a]	45.82[a]	34.55[a]	116.92[a]	1.30[a]
Group C	6	35.37[a]	44.05[a]	34.37[a]	114.15[a]	1.27[a]
Group D	6	35.93[a]	41.93[a]	30.10[b]	107.97[a]	1.20[a]
Overall mean ± SE	24	33.01±1.69**	41.25±1.50**	30.30±0.84**	90.04±2.35**	1.50±0.04**

[a b c d] values in same column with different superscripts differ at P<0.01

Chemical composition of supplementation rations and feeds

Proximate composition of the ingredients used in concentrated ration formulation, supplemented diets (ration 1, 2 and 3) and some grasses in wet and dry season samples were analyzed following standard procedures, according to Association of the Official Analytical Chemists, [16] (Table.1 and 2).

Components (%)	Ration 1 (group B)	Ration2 (group C)	Ration 3 (group D)
Sorghum grains	5	5	5
Baobab seed cake	65	55	45
Groundnut Cake	20	30	40
Wheat Bran	9	9	9
lick salt	0.25	0.25	0.25
Common salt	0.75	0.75	0.75
Chemical composition of the experimental feed stuffs			
DM%	96.40	96.40	96.30
CP %	30.57	28.20	26.30
CF%	31.48	28.45	23.64
EE %	6.20	6.00	5.07
NFE %	48.28	25.68	35.66
Ash%	5.30	5.04	5.00

Table 1: Ingredients of the experimental feed stuffs

Plant species	DMI	CP	CF	EE	NEF	Ash	ME(Mj/Kg
Cenchrus biflorus	88.9	3.3	73.7	29	11.3	11.1	5.93
Eragrostis termula	93.3	2.9	80.5	0.8	9.00	6.8	5.95
Schoenefeldia gracilis	93.3	2.2	79.2	0.8	11.1	6.7	6.03
Cenchrus setigrus	96.3	4.7	80.8	1.0	9.8	3.7	6.29

Table 2: Chemical analysis of some grasses in dry season in the study area

Statistical analysis:

The experimental design adopted for this study was the completely randomized design. All data collected were subjected to analysis of variance procedure using the General Linear Model (GLM) applicable to the experimental design and significant means were separated by Duncan's multiple range tests, following the procedures of SPSS [17].

Results

Effect of supplementation of baobab seed cake on milk yield

The weekly milk yield of the goats for the 12 weeks of lactation is in Table (3). Supplementation of baobab seed cake had significantly (P <0.05) effect milk production on 90 days and total milk and daily milk yield. The does in group B had registered highest significantly (P < 0.05) more milk (116.92 Lb) (51.96 Kg) than those in group C and D as 114.15(50.73Kg) and107.07 Lb (47.59Kg) respectively. The least milk production was produced by group A of 79.73 Lb (35.44 Kg) and which was significantly (P <0.05) less than that produced by supplemented groups with baobab seed cake.

Also daily milk production was highly significant (P <0.05) affected by baobab seed cake where group B which with 65% baobab seed cake had better milk production with 1.30 Lb (35.44 Kg). The daily milk production indicated that the does supplemented with baobab seed cake yielding significantly (P<0.01) higher milk than control groups.

The weekly milk yield of the desert goats for the 12 weeks of lactation is shown in (Figure 1). Milk yield increased steadily from the first week of lactation to the sixth week, then dropped for C, D and A groups, whereas sharp declined was noticed in group A. The supplemented groups showed better milk curve with long persistency yielding. The peak for the weekly milk yield was recorded at the 6th week of lactation for all the treatments except for the control (A).

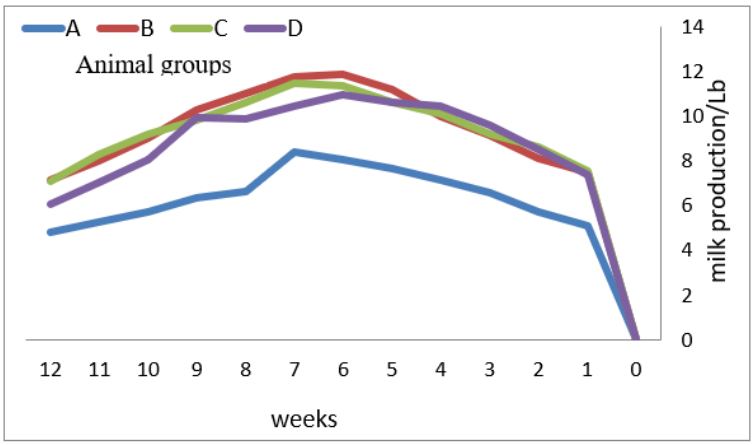

Figure 1: Effect of baobab seed cake on lactation curve of desert goats

Effect of supplementation with baobab seed cake on milk composition

The effect of supplementation on milk chemical composition of experimental desert goats is illustrated in Table (4). The data indicated that supplementation had exerted a significant (P<0.05) affect on fat and protein percentage during 60-90 days. Higher fat percentage during all period of 90 days was noticed in group C in 30-60 days as 3.75% and group D as 3.57%. Protein% showed significant (P<0.05) effect during 0-30 and 60-90 days, where high percentages were in group C with 3.77%. Lactose and as content secured non significant affected by baobab seed cake supplementation. Beside this, supplemented groups showed higher lactose and lower ash content compared with control group.

		Fat			Crude Protein		
Animal Groups	No.	0-30	30-60	60-90	0-30	30-60	60-90
A	6	3.30	3.62	3.18^{b}	3.40^{ab}	3.48	3.43^{b}
B	6	3.30	3.50	3.48^{ab}	3.45^{ab}	3.55	3.60^{ab}
C	6	3.38	3.75	3.22^{ab}	3.23^{b}	3.77	3.62^{ab}
D	6	3.12	3.52	3.57^{a}	3.65^{a}	3.60	3.75^{a}
Overall means+SE	24	3.28± 0.17	3.60±0.10	3.36±0.13*	3.44±0.11*	3.60±0.09	3.60±0.1*
^{abc} Values in same column with different superscripts differ at P<0.05							

Table 4: Effect of supplementation on milk composition%

Discussion

Milk production and composition are more depending on composition of the diet fed to animal, the energy balance and energy reserved of the animal. The average total milk production for Desert goats in this study was 104.69±3.36 Lb (46.53 Kg), with daily milk of 1.16±0.04 Lb (0.52 Kg) in a lactation period of 90 days, this level of production was comparable with that reported by [18]for Taggar goats, and lower than that reported by [1-4-8] and higher than that reported by [5]for West African Dwarf Goats Offered Moringa oleifera Herbage Supplement.

The present study indicated that there were highly significant differences in milk yield and daily milk yield between goats of different nutritional supplements with Baobab seed cake during early lactation. Milk yield was highest when baobab was fed at 65 % inclusion in the diet and least when no baobab (control) was fed. Although milk yield of goats fed baobab at 55% or 45 % inclusion was significantly different from each other, it was higher than that of control animals. Milk yield of goats in this study increased with addition of baobab to the diet and was directly proportional to protein intake by the supplemented animals compared to control group. This online with findings of [3-8-19]. Also [5] showed that nutrition improvement with multipurpose trees could be a means of increasing milk yield. Okunlola and Olorunnisomo [3] that the milk yield was significantly affected (P<0.05) with supplementation of Baobab seed cake. The supplementation that offered during third period of gestation had positive effect on sustain milk production since around 70% of fetal growth and most of glandular development and mammary tissue occur in this period. For this reason, a strategic supplement of high protein and energy quality should be offered, this fact agreed with [20-21] who reported that good nutrition is a prerequisite high milk yield and a successful rearing system. On the other hand, undernourishment in gestation and lactation in goats can have negative effects on milk yield [22]. Luana et al. [23] concluded that the diet nutritive value and nutritional planes during gestation affect tissue mobilization for support of milk production in early lactation. Generally the nutritional plane and dietary composition during breeding and gestation (3 to 4 week before parturition) may affect milk yield and reproductive performances which on lines with [24]. Because it may also influence the ruminal microbiome and ruminal fermentation, which subsequently could impact milk production when switched to lactation diets. It was hypothesized that different nutritional planes during gestation may influence Lactational performance and energy utilization in lactating goats fed different lactation diets.

Contrary to the current results [25] found inclusion of Baobab seed cake in the diets of lactating cows reduces milk yield. Also this result disagrees with the earlier reports of similar work on goats, [23-26] they found that the result from different supplementation showed no significant effect (P> 0.05) of milk production. The dietary concentrate level and nature of specific concentrate and forage feedstuffs impact level of milk production and characteristics of milk [23]. Does on framer's practice (control group)

had lower milk yield compared with fed groups, this may be due to less nutrient requirements to meet mammary growth and milk production. Does on control flock began to mobilize their reserve more than does on fed group with baobo seed cake. This significant positive response in milk production observed in does supplemented due to sufficient energy intake by those females that allow for improved production, this agree with the findings of [27] who reported that supplementing goat ration will increase milk production. This reinforces the argument for the good adaptive response of Desert local goats to erratic feeding conditions. Evidence has been found that under grazing conditions in difficult areas goats adjust their diet selection according to their nutritional needs, especially when the cost of gestation increases the demand for nutrients. The different in milk yield could be due the composition of the diet, type of livestock, and study area was responsible for the variations with the finding in this study, or may be attributed to feed intake and varying inclusion levels of baobab seed cake in the experimental diets.

The lactation curve characteristics of Desert goats showed that the milk production increased for all treatments during early lactation and reached its peak at the 6th week of lactation to reach mid lactation and then subsequently decreased until the 90th day of lactation. Daily milk yield showed significant decrease with advancing lactation, whereas, persistency of milk yield continued three weeks. This appears to be a genetic trait and may not be easily influenced by nutrition as reported by [28], where peak yield tended towards early lactation for local goats. The trend of lactation curve of Desert does in this study is similar to the report of [1-5], this was within the 2 to 5 weeks peak yield reported for Red Sokoto goats by [29] and comparable to 30 days reported for Saanen goats by Souza et al. [30], and not agreed with [4-28] who reported peak yield of milk occurred around 4th week of lactation during the 12-week. The increase in milk production is in line with the combination of several protein feed ingredients in the ration of donations from baobab seed cake and groundnut cake to maintain cells in the mammary gland and the production of hormones and enzymes that play a role in milk biosynthesis. The inclusion levels did not markedly affect yield in the Desert goats used because protein or energy supplements are usually more effective in enhancing milk yield in high genetic dairy goats such as Damascus than they do in low genetic non-dairy or non selected breeds such as Desert goat. The Desert goat used in this study has not been selected and developed for dairy production.

In this study the values observed for milk components are within the normal range for the goat species, so the composition of the milk (fat and protein) was largely affected by the dry matter intake of the animals of baobab seed cake in the diet, this attributed to the impact of baobab seed cake on ruminal fermentation through enhancing small chain fatty acids and microbial nitrogen production. Similar results recorded by [3-4-8-19-26-31] that the quality of milk produced from these goats fluctuates according to the type of feed given. Also Póti et al. [32] reported that different feeding strategies have different impact on the chemical composition of goat milk. Contrary to these results [20-33] stated that the composition of milk was not affected by the distributed diet. The absence of diet effects on milk chemical composition could be due to the lack of effects of long-chain unsaturated fatty acids of diets on ruminal bacterial activity [33]. The alternative feed resources are known for their high content in fiber and secondary compounds as phenols and tannins that could affect milk yield and quality by influencing chemical composition and fatty acid precursors in rumen and blood, which agreed with [33].

Fat content varied from 3.28 to 3.60 %, and significantly ($P<0.05$) higher in does fed baobab seed cake rations than does on grazing only. The milk fat is directly affected by protein and energy intake. This results in harmony with [3-19] who found fat in the milk increased with inclusion of baobab fruit in the diet and varied from 3.38 to 4.45 %., and Sayed-Ahmed et al. [31] who partial replacement of Berseem hay by Moringa oleifera (25% and 50%) in goat rations significantly increased ($P<0.05$) milk fat yield, and he concluded these improvements followed Moringa oleifera inclusion might due to the high digestibility of dry matter intake, crude protein and crude fiber. Arief et al. [8] reported that enzymes help in the process of milk fat synthesis, where enzymes are proteins. An increased protecting protein supplement increases the number of enzymes to improve the process of milk fat synthesis. In the present study, however, milk fat content is lower at early lactation than at later stages probably because of declining milk yield which made the fat content more concentrated. This type of trend is characteristic of low yielding goats or non-dairy goats [34] or non-selected breeds of animals whose peak yield is usually the initial yield at the beginning of lactation which agreed with [23], where milk fat content decreased with advancing lactation. During early lactation, milk fat content is high not only because nutrients are partitioned towards mammary gland for milk production, but also because transfer of triacyglycerols to milk is more efficient at the beginning of lactation than at later stages. The significant of fat content in this study were not in line with many authors [20-23-35] they stated that milk fat content did not differ between supplemented groups.

The protein content in this study varied from 3.44 to 3.60 %. The protein and fat content of the milk increased with higher levels of baobab seed cake in the diet. This was influenced by the higher protein intake of goats as the level of baobab fruit increased in the diet, the range of protein reported her with in line with [3-4-19-36]. The milk protein content is a trait that changes during lactation and tends to behave inversely to milk yield, reaching minimum values in the second month of lactation, which coincides with the period of maximum milk production. The protein value across treatment contradicts report of [8-23] the result showed that the supplementation treatments did not significantly affect milk protein ($P>0.05$). Also [34-37] who reported that goats milk protein content was not markedly changed in responses to dietary energy (as fat) supplementation.

Milk lactose almost followed the trend of protein. The Lactose content in this study varied from 4.44 to 4.33 % and there were no significant differences in lactose content of the milk in goats fed different levels of baobab in the diet which on harmony with [3-8] who reported that it has been noted that lactose concentration in milk is not easily altered by nutrition. This results were not in line with the work of [19-35-37] who observed that addition of energy (as sunflower seeds) to goat's ration showed significantly higher lactose content through suckling and lactation. The levels of lactose in supplemented groups are the same as control, this is caused by the protein content of feed in the treatments are still able to meet the needs of the goat and the same as the control treatment. Feed protein will be remodeled into amino acids that are absorbed in the intestine to be converted into glucose in the liver through the process of gluconeogenesis, thereby increasing glucose levels in the blood and then increasing milk lactose levels. Ash content also varied from 0.77 -0.78%. also ash wan not affected by feeding baobab seed cake. These results were confirm by [4-37] that ash values were not influenced ($P>0.05$) by graded level of baobab pulp and seed in the experimental diets. Disagreed with this El Otmani et al. [333] found that

supplementation had significant affect on ash content. Baobab seed cake can be affordable to smallholder farmers who have access to it. Thus, baobab seed cake is a promising non-conventional protein source that has the potential to limit costs of livestock production to all farmers in the tropical region where it is found. However, there is need for sustainable harvesting of baobab to avoid negatively impacting on the environment or upsetting ecosystems especially wild animals which feed on the fruits

Conclusion

Addition of baobab seed cake to the diet of desert goats increased milk yield of the lactating goats. Protein and fat content of goat milk increased while ash and lactose content was not altered with addition of baobab seed cake to the diet. Baobab seed cake enhanced milk production in desert goats.

References

1. Akpa, G.N., Asiribo, E.O., Oni, O.O. and Alawa, J.P. (2001). The influence of non-genetic factors on the shape of lactation curves in Red Sokoto goats. Anim. Sci., 72: 233-239.
2. AOAC.(1990). Official Methods of Analysis. Vol. I. 15th Ed., Association of Official Analytical Chemists, Arlington, Virginia.
3. AOAC.(2000). Association of Official Analytical Chemists. Official Methods of Analysis, Association of Official of Analytical Chemists. 17th ed. Association of Official Analytical Chemists; Gaithersburg, MD, USA.
4. Acheampong-Boateng,o., Mikas, M.S., Benyi, K. and Amey, A. K.A.(2008). Growth performance and carcass characteristics of feedlot cattle fed different level of Macadamia oil cake. Tropical animal health and production, 40(3):175-179.
5. Arief, Rudimansyah, Sowmen, S. and Rizqan, R. P. (2020). Milk production and quality of Etawa crossbreed dairy goat that given Tithonia diversifolia, corn waste and concentrate based palm kernel cake. Biodiversitas, 21: 4004-4009.
6. Belewu, M.A., Fagbemi, T., Dosumu, O.O. and Adeniyi, M.O. (2008). Physico-chemical and anti-nutritional properties of some lesser known tree and leguminous seeds, International Journal of Agricultural Research, 3: 237-242.
7. Belkasmi, F. et al. 2023. Effects of the level and composition of concentrate supplements before breeding and in early gestation on production of different hair sheep breeds. Animals 13, 814 (2023).
8. Bushara, I and Fathia G.I. Godah. 2018. Effect of supplementary feeding with residual of sesame capsule to lactating Desert goat during dry period in North Kordofan state, Sudan. Advances in Biology & Earth Sciences,3(1): 47-59.
9. Bushara, I., M.B. Elemam, O.M.A. Abdelhadi, A.O. Idris and A.M. Abu Nikhiala. (2011). Effect of parity on the productivity of Taggar goats. American-Eurasian J. Agric&Environ.Sci., 10(4): 515-518.
10. Chávari, A. C. T.; Marques, R. O.; Cañizares, G. I. L.; Brito, E. P.; Gomes, H. F. B.; Lourençon, R. V.; Meirelles, P. R. L. and Gonçalves, H. C. 2020. Yield, composition, and fatty acid profile of milk from Anglo Nubian goats fed a diet supplemented with vegetable oils. Revista Brasileira de Zootecnia 49:e20200071. https://doi.org/10.37496/rbz4920200071
11. Chilliard Y., Ferlay, A., Rouel, J. and Lamberet, G. A. (2003). Review of nutritional and physiological factors affecting goat milk lipid synthesis and lipolysis. J. Dairy Sci., 86:1751–1770.
12. Chiofalo, B.; Liotta, L.; Zumbo, A.; Chiofalo, V. (2004). Administration of olive cake for ewe feeding: Effect on milk yield and composition. Small Rumin. Res., 55, 169–176.
13. Eknas, M., Kolstad, K., Volden, H. and Hove, K. (2006). Changes in body reserves and milk quality throughout lactation in dairy goats. Small Rumin. Res. 63, 1–1.
14. El Otmani, S., Chebli, Y., Chentouf, M., Hornick, J.and Cabaraux, J.(2021). Effects of olive cake and cactus cladodes as alternative feed resources on goat milk production and quality. Agriculture 11,3.https://dx.doi.org/10.3390/ agriculture11010003
15. Fawzi, M. AL-Dabbas and Azmi, D. Hawari. (2011).The effect of fat supplementation in shami goat diets on milk production and composition, does body weight and growth performance of their Suckling Kids. Pakistan Journal of Biological Sciences, 14:725-728.
16. Frank, Chilanga., Fanny, Chigwa., Richard, Phoya. and Maxwell, Chiphwanya. (2022). The Potential of Acacia polyacantha Leaf Meal and Adansonia digitata Seedcake for Small Ruminant Feeding in Arid and Semi-Arid Parts of Malawi. EC Veterinary Science 7 (9): 04-11.
17. Gebauer, J. and Luedeling, E. (2013). A note on Baobab (*Adansonia digitata* L.) in Kordofan, Sudan. Genet Resour Crop Evol, 60:1587-1596.
18. Celi P, Di Trana A, Claps S. (2008). Effects of perinatal nutrition on lactational performance, metabolic and hormonal profiles of dairy goats and respective kids. Small Rum. Res; 79(2–3):129–136. doi: https://doi.org/fb7zwv
19. Goetsch, A.L., Zeng, S.S. and Gipson, T.A. (2011) Factors affecting goat milk production and quality. Small Rumin Res., 101: 55-63.
20. Ikyume, T. T., Eigege, N. N., Bashi, D. T., Oche, N. P., Abdulraheem, A. I., Ojabo, M. and Akalika, I. P. (2018). Growth performance, blood profile and economics of production of west african dwarf goats fed fermented baobab (*Adansonia digitata*) seed meal. Journal of Animal Husbandry and Dairy Science., 2(1):030-36.
21. Jangool, R.H.,Adawi,I. and Siddig, F.S. (2018).Effect of feeding Bt cotton seed cake on Nubian gota milk characteristic, Gezira state, sudan. Open academic journal of Advanced Science and Technologgy.,2(1):9-13.
22. James, C.S.(1995). Determination of the fat content of dairy products by the Gerber Method. Analytical Chemistry of Food, (Blackie Academic and Professional, an imprint of Chapman and Hall, Glagow).
23. Keles, G.; Yildiz-Akgul, F.; Kocaman, V. (2017). Performance and milk composition of dairy goats as affected by the dietary level of stoned olive cake silages. Asian Australas. J. Anim. Sci. 2017, 30, 363–369.
24. Lalabe, B. C., Olusiyi, J. A. and Afolabi, K. D. (2017). Effects of soaking on the nutritive value of Raw Full fat rubber (Hevea brasiliensis) seed. Nigerian Journal of Agriculture, Food and Environment. 13(2):78-82.
25. Khalifa, E. I., Behery, H. R., Hafez, Y. H. , Mahrous, A. A., Fayed, Amal, A. and Hassanien, Hanan, A. M. (2013). Supplementing non-conventional energy sources to rations for improving production and reproduction performances of dairy

zaraibi nanny goats. Egyptian Journal of Sheep & Goat Sciences, 8 (2): 69- 83.

26. Lefrileux, Y., Morand-Fehr, P. and Pommaret, A. (2012). Capacity of milk yielding goats to utilize cultivated pastures. INRA. Animal Production., 25(3): 277-290.
27. Luana P., Ribeiro, S., Patra, A. K., Puchala, R.,. Merkel, R. C and Goetsch, A. L. (2023). Interaction between gestational plane of nutrition and lactation diet composition on lactation performance of Alpine goats of different parities. Scientific reports. 13:16211 www.nature.com/scientificreports. https://doi.org/10.1038/s41598-023-43450-x
28. Neves, Isabel das., Carlos Elysio Moreira da Fonseca., Fernando César Ferraz Lopes., Mirton José Frota Morenz., Marco Antônio Sundfeld da Gama., Vinícius Carneiro de Souza. and Aline Barros da Silva. (2019).Milk fatty acid composition of dairy goats fed increasing levels of Flemingia macrophylla hay. Semina: Ciências Agrárias, 40(1): 293-310, DOI: https://doi.org/10.5433/1679-0359.2019v40n1p293
29. Madzimure, J., Musimurimwa, C., Chivandi, E., Gwiri, L. and Mamhare, E. (2011). Milk yield and quality in Guernsey cows fed cottonseed cake-based diets partially substituted with Baobab (*Adansonia digitata* L.) sees cake. Tropical animal health and production, 43:77-82.
30. Maldonado–Jáquez, J.A., Granados–Rivera, L. D., Hernández–Mendo, O., Gallegos–Sánchez, J., Mora–Flores, J. S. and Torres–Hernández, G. (20230. Productive potential of local grazing does and their offspring under a pre and post–partum feeding supplementation program. Revista Científica, FCV-LUZ / Vol. XXXIII., 1-7. https://doi.org/10.52973/rcfcv-e33273
31. Mohamed, A. H. 2016. Effects of grazing on Bt cotton residues on feed intake and milk characteristics of dairy cows in Gezira State, Sudan," MSc Thesis, University of Gezira, 2016
32. Marete A.G., Mosi R., Amino J. and Janga J. (2014). Characteristics of lactation curves of the Kenyan Alpine dairy goats in smallholder farms. Open J. Anim. Sci. 4: 92-102.
33. Nudda, A.; Buffa, G.; Atzori, A.S.; Cappai, M.G.; Caboni, P.; Fais, G.; Pulina, G. (2019). Small amounts of agro-industrial byproducts in dairy ewes diets affects milk production traits and hematological parameters. Anim. Feed Sci. Technol., 251, 76–85.
34. Ojoawo, O.T., Akinlade, J.A., Akingbade, A.A., Aderinola, O.A. and Okunlola, D.O. (2021). Reproductive and Lactation Characteristics of West African Dwarf Goats Offered Moringa oleifera Herbage Supplement. Iranian Journal of Applied Animal Science, 11(4):789-797.
35. Okunlola, D.O., Olorunnisomo, O.A., Amuda, A.J., Nuga H.A., Akinloye, A.M. and Balogun, N.O. (2015). Milk Yield and Composition of Red Sokoto Goats Fed Varying Levels of Baobab (Adansonia digitata) Fruit Meal Supplement in the Diet. Journal of Biology, Agriculture and Healthcare, 5(17):121-126.
36. Okunlola, D.O. and Olorunnisomo, O.A. (2016). Influence of baobab fruit in the diet on intake, milk yield and milk composition in Red Sokoto goats. Scientific Journal of Animal Science, 5(1): 192-198.
37. Okunlola, D. O., Amuda, A. J. and Shittu, M. D.(2018). Nutritional effects of Baobab (Adansonia digitata L.) Pulp-seed Meal on the Reproductive Index of Red Sokoto Goats. *Annual Research & Review in Biology. 28(1): 1-6*
38. Oloche, J., Ujor, A., Oche, E.E.and Oloche, J.J.(2020). Performance and toxicological effects of cooked baobab (Adansonia digitata L.) seed meal on West African dwarf goats. Nigerian J. Anim. Sci.22 (3): 296-306.
39. Otaru, S. M., Adamu, O. W., Ehoche, O. W. and Makun, H. J. (2011). Effects of varying the level of palm oil on feed intake and milk yield and composition and postpartum weight changes of Red Sokoto goats. Small Rumin. Res., 96:25-35.
40. Pazla R, Jamarun N, Zain M, Arief. (2018a). Microbial protein synthesis and in vitro fermentability of fermented oil palm fronds by *Phanerochaete chrysosporium* in combination with *Tithonia* (*Tithonia diversifolia*) and elephant grass (*Pennisetum purpureum*). Pak J Nutr 17: 462-470.
41. Póti, P., Pajor, F., Bodnár, Á., Penksza, K. and Köles, P. (2015). Effect of micro-alga supplementation on goat and cow milk fatty acid composition. Chilean Journal of Agricultural Research, 75(2): 259-263.
42. Sayed-Ahmed, M. E., Mona E. Farag; F. A. El-Sayed and A. M. Shaarawy. (2018). Evaluation of using Moringa oleifera plant in goat rations and its impact on productive and reproductive performance. Egyptian Journal of Sheep & Goat Sciences, 13(3): 1-21.
43. Skenjana, A., Van Ryssen, J.B.J. and Van Niekerk, W.A. (2006). Invirto digestibility and in situ degradability of avocado meal and Macadamia waste products in sheep. South Africa J of Anim Sci, 36(Suppl 1):78-81.
44. Slaèanac, V., Hardi, J., Luèan, M., Komleniæ, D. K., Krstanoviæ, V. and Jukiæ, M. (2011). Concentration of nutritional important minerals in Croatian goat and cow milk and some dairy products made of these**.** Croat. J. Food Sci. Technol. 3 (1): 21-25.
45. Souza, R., Alcalde, C.R., Oliveira, C.A.L., Labio Molina, B.S., Maceo, F.A.F., Gomes, L.C., Hygino, B., Possama, A.P.S. (2014). Lactation curves and economic results of Saanen goats fed increasing dietary energy levels obtained by the addition of calcium salts of fatty acids. Rev. Brasil. Zoot., 43(2), 73-79.
46. Suranindyah YY, Dzaky HAK, Nu'man F, Rochijan. (20180. Milk production and composition of Etawah crossbred, Sapera and Saperong dairy goats in Yogyakarta, Indonesia. Int J Dairy Sci 13 (1): 1-6.
47. SPSS, Windows for Version 11.5. (2005). (Microsoft corporation). Trends SPSS Inc. Michigan Avenue, Chicago, IL.19-182.
48. Terramoccia, S.; Bartocci, S.; Taticchi, A.; Di Giovanni, S.; Pauselli, M. 2013. Use of dried stoned olive pomace in the feeding of lactating buffaloes: Effect on the quantity and quality of the milk produced. Asian Australas. J. Anim. Sci. 2013, 26, 971–980.
49. Vorbach, C., Capecchi, M.R and Penninger, J.M. (2006). Evolusi kelenjar susu dari sistem kekebalan tubuh bawaan. BioEssays 28 (6): 606-616. *[Indonesian]*

DOI:10.31579/2637-8914/312