Available online at www.elixirpublishers.com (Elixir International Journal)

Bio Technology

ISSN: 2229-712X

Elixir Bio Technology 177A (2023) 56837-56843

Evaluation of Baobab Multi-nutrient Block Concentrate as a Dietary Supplement for Enhancing Milk Production and Quality in Red Sokoto Goats

Okunlola D. O[1], Ojo T.Y[2] and Fasola A.A[3]

[1]Department of Animal Nutrition and Biotechnology,Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria

[2]Department of Animal Production and Health, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria

[3]Department of Animal Science, University of Ibadan, Ibadan, Oyo State, Nigeria.

ARTICLE INFO

Article history:

Received: 11 March 2023;
Received in revised form:
22 April 2023;
Accepted: 30 April 2023;

Keywords

Baobab Multinutrient Block Concentrate,
Red Sokoto Goat,
Panicum Maximum,
Milk Yield,
Mineral Composition.

ABSTRACT

Baobab Multi-nutrient Block Concentrate (BMBC) as dietary supplement for enhancing milk production and quality in Red Sokoto goats (RSG) was evaluated. The formulation consists of Baobab pulp and seed 25%, wheat offal 25% palm kernel cake (PKC) 20%, Urea 5 %; salt 5%; molasses 10% and cement 10%, respectively, Sixteen (16) lactating RSG previously crossed with South Africa Boer bucks were randomly selected, balanced for weight and grouped into 2 comprising of Eight (8) animals each. Group A were allowed access to BMBC (- BMBC), while Group B were allowed access to BMBC (+BMBC). *Panicum maximum* was fed on zero grazing at 4% of individual animals' body weight. Daily milk yield and samples were taken to analyze for Total solids, Crude protein, Fat and Ash and selected minerals (Ca, K, Mg, Na and P). The results were significantly affected ($P<0.05$). Milk yield for RSG +BMBC ranged from 398.75 – 428.50g/day with mean average of 412.69g/day ahead of RSG – BMBC with value range of 312.75 – 335g/day; with mean average of 324.12g/day. Milk composition (%) values for RSG +BMBC were 18.50, 6.05, 5.75, 0.98 and 5.72, RSG – BMBC 12.05, 3.58, 3.30, 0.82 and 4.35 for total solids, protein, fat, ash and lactose, respectively. Mineral values(mg/g) recorded for Ca, K, Mg, Na and P in RSG+BMBC were 250.00, 342.50, 88.45, 92.86 and 96.95, compared to RSG – BMBC with 231.00, 330.00, 75.53, 84.13 and 91.10, respectively. This results showed that BMBC enhanced the yield and composition and mineral values of lactating RSG.

Introduction

Multi-nutrient blocks are supplements for ruminants (goats, sheep and cattle) grazing on low-quality pastures and for animals that are fed low quality forages. However, multi-nutrient blocks can as well be moulded for specific purpose; to meet the nutritional requirement of animals production purpose such as dairy (milking) or breeding. This is mainly due to array of nutrients packaged in them by nutritionists or researchers to augment nutrient requirement or for the purpose of improvement via research. Multi-nutrient block is rich in minerals such as calcium, phosphorous and other minerals that are not naturally found in grass. These minerals are important for growth, reproduction and increase in milk production in dairy animals. It it also rich in protein, as such; it supplies protein needed by animals for growth. Multi-nutrient blocks also supplies energy needed by animals to increase production of meat and milk. Common recipes for Multi nutrient blocks Urea, Sugar cane molasses, Bran or forage, Salt/minerals , Binding material such as cement and other feed resource or materials as may be targeted by nutritionists or researchers. The technique involved in moulding of multi-nutrient blocks consists of mixing the required feed ingredients in a container and pouring the mixture into moulds and leaving to solidify into blocks(Bheekhee *et al*., 1999). The block should contain nutrients that by pass rumen and such materials include molasses and urea (Leng, 1986; Waruiru, 2004, Mohammed *et al*., 2007).

Multi-nutrient blocks are fed to ruminants globally to improve meat and milk production, especially where natural pastures are scarce due to prolong dry season or natural disaster such as drought or outbreak of wild fire which destroys natural or established pastures. Where animals loose weight known or unknown reason(s); feeding of multi-nutrient blocks becomes inevitable because, weight loss has negative economic repercussions, since it reduces the rate of conceptions, and consequently the number of births and physical condition of adult animals, causing mortality and stunted growth of young animals (Mackinon and Rocha 1987, Cronjé 1990, Faftine and Zanetti, 2010). Most of the feed resource identified suitable for production of Multi-nutrient blocks are naturally existing. A good example of such naturally existing feed resource which may have been underutilized is Baobab fruit *(Adansonia digitata)*

Baobab (*Adansonia digitata L.*) is a deciduous tree with multipurpose uses, native to arid Central Africa (Yazzie *et al.*,1994) but with wide distribution in most of Sub-Sahara Africa's semi-arid and sub-humid regions as well as in western Madagascar (Diop *et al*., 2006). The fruits which consist of large seeds embedded in a dry, acidic pulp and shell are abundantly available during dry season. The dry baobab fruit pulp has high values of medicinal properties. Aside being nutritious, it has high values for carbohydrates, energy, calcium, potassium (very high), thiamine, nicotinic acid and vitamin C (very high) (Arnold *et al*., 1995). The pulp is a rich source of calcium, vitamin B and C (Ajayi *et al.*, 2003). Baobab fruit pulp has a particular high antioxidant capability mainly because of its high natural vitamin C content, which is equivalent to 6 oranges per 100g (Joerg and Mathias, 2005). Seeds contain about 5% lysine, 1% methionine and 1.5% cystine (Osman, 2004). The high vitamin C and antioxidant content of the fruit pulp may have a role to play in the extension of shelf-life for foods and beverages, as well as cosmetics. The food/beverage industry could introduce baobab fruit pulp into foods in order to act as a preserving ingredient by preventing oxidation of lipids in the food (Afolabi and Popoola, 2005). Medicinal properties of baobab (*Adansonia digitata L.*) of Baobab fruit cannot be overemphasized. Ramadan *et al*. (1993) reported the analgesic effect of baobab pulp. It also has hepatoprotective property Al-Qarawi *et al*., (2003). Anti-microbial activity of Baobab pulp powder prevents the growth of pathogenic bacteria such as Salmonella sp., Bacillus sp. and Streptococcus sp. (Afolabi and Popoola, 2005), as such poised to extend the shelf life of the product(s) to which it is included.

Good and adequate feeding regime using non-conventional feedstuff such as baobab (*Adansonia digitata L*) fruit is a pointer to accomplish balanced ruminant feed especially in the dry season when fresh forages are scarce and where available; characterized with poor nutritional value. Folktales among Fulani herdsmen has it that Baobab fruit pulp enhances milk yield and milk letdown among Zebu cows. Therefore, efforts should be intensified to examine its potential and exploit such to improve milk production in Nigeria indigenous breeds of goats.

Cattle are generally acclaimed as the major and most important dairy animal the world over. This is probably due to their relatively high milk yield, however, improvements has been made in milk production by goats, to augment the deficit in milk and dairy products consumption by humans; due to the ever increasing human population.

The importance of goat milk cannot be overemphasized due to its numerous benefits over cattle milk. Goat's milk is unique and superior when compared with conventional cow's milk. Goat milk contains slightly higher amounts of calcium, phosphorus, potassium and chlorine than cow's milk (Bath *et al.*, 1981). It has smaller fat globules and smaller softer cud, it is easier to digest than cow's milk, and it is an ideal substitute for those who suffer allergy to cow lactalbumin. Goat milk can be frozen without a great change in quality (Bath *et al*., 1981). The glycerol ether content is higher in goat's milk than in cow's milk. This is important in the newborn (Ahrne *et al*., 1980). In addition, the membrane of the milk fat globules is much more fragile in goat's milk than in cow's milk. This is important in the prevention of rancidity and off flavor in milk (Patton *et al.*, 1980).

Therefore, efforts to improve a known breed such as Red Sokoto goat which has been identified as good milker; using multi-nutrient block is a step in the right direction. Hence, the focus of this study; where Baobab Multi-nutrient block concentrate (BMBC) was fed to milking Red Sokoto goats to enhance the breed's milk quantitative and qualitative performance. The blocks are offered to animals in a hard wooden box slightly larger in dimension than that of the block, to prevent biting of the block by animals.

MATERIALS AND METHODS

Experimental site

This study was carried out at sheep and goat unit, Ladoke Akintola University of Technology (LAUTECH) Teaching and Research Farm Ogbomoso, it lies on $8^{0}10^{1}$ North of the equator and longitude $4^{0}10^{1}$ East of the Greenwich Meridian within the derived savannah region of Nigeria. The altitude is between 300m and 600m above sea level while the mean temperature and rainfall are 27°C and 1247mm respectively (Ayinla and Adetoye, 2015).

Sample collection and preparation of baobab multi-nutrient block

Milled Baobab pulp and seed, Wheat offal, Palm kernel cake (PKC), Urea, Salt, Molasses and cement were all sourced locally and were all processed by grinding using a milling/grinding machine.

Mixing of feed ingredients

Mixing of the ingredients was done by hand in a 200L drum cut to a height of 25 cm. Twenty (20) liters of water was used. Approximately 20 kg of ingredients were mixed per batch in order to get a homogenous mixture as outlined by Aarts *et al*. (1990). The urea fertilizer was dissolved completely for about 20-30 min. The binder was dissolved in another bucket and after being mixed together and were later all poured into the drum which already contained the dissolved molasses. The whole solution was stirred and mixed properly to obtain a homogenous mixture. Other ingredients were added as follows; Milled Baobab pulp and seed, palm kernel cake and finally wheat offal. Each ingredient was added only after a homogenous mixture of other ingredients was attained as described by Mohammed *et al*, 2007.

Moulding of Baobab multi-nutrient blocks

The homogenous mixture was placed in wooden container moulds measuring 15x15x10 cm (Allen, 1992). The material block was pressed manually using hand. The surface of the wooden mould was covered with polythene sheet to facilitate de-moulding and cleaning of the surface. Blocks formed were removed immediately from the moulds and all blocks were sun dried in the open air under shade. Each mould weighed 1kg.

Texture assessment Baobab multi-nutrient blocks

According to Leng, (1992) and Mohammed *et al*, (2007), hardness and compactness of the blocks were the physical assessment to carry out, and this was tested four days after de-moulding. The forth day observation showed high moisture content characterized with soft texture. The softness aside moisture content could be due to the milky nature of Baobab pulp. Professionals were engaged to carry out the second phase of assessment on three parameters of rating namely: Soft (S), Medium (M) and Good (G). This was done two (2) weeks by pressing the middle of the blocks with thumb. Ease of break (EOB) was used to assess compactness.

Laboratory Analysis

Samples from the moulded blocks BMBC, total solids, crude protein, fat and ash content of the milk were analyzed for as described by AOAC (2003). Mineral Analysis was carried out by wet digestion of samples using Atomic Absorption Spectro-photometer (AAS).

Experimental animals

Sixteen (16) lactating Red Sokoto goats (RSG) were used for this study. The animals were randomly selected among Thirty two (32) milking animals following mass kidding resulting from a breeding program where RSG does were synchronized and mated naturally by South Africa Boer bucks. Selected animals were balanced for weight and grouped into 2 comprising of Eight (8) animals. Group A were controlled group without access to BMBC, while the other group (Group B) were allowed access to 1kg BMBC at a time under strict monitoring. All animals were allowed access to *Panicum maximum* on zero grazing feeding system at 4% of individual animals' body weight.

Milk collection (Milk yield determination)

Animals were hand milked once daily between 7.00 and 9.00 hr. Milk off-take was measured daily using a measuring cylinder and, daily milk yield was estimated as a summation of milk off-take and intake by the kids over a 12 week period (84 days).

Milk let-down was stimulated by allowing the kids to suckle for 5 minutes from each doe after which the doe will be milked. Weight of the kids were taken before and immediately after suckling to estimate milk intake. Kids were separated from does after milking and part of the milk collected was fed back to the kids using a nipple-bottle.

Milk Sample collection for quality examination

Milk sampling was initiated a week after parturition and terminated on the 56th day (8 weeks) post partum for each lactating doe. Sample from daily milk yield from each doe was weighed on sensitive scale and stored in a refrigerator (-5^{o}C). At the end of 8th week of samples collection; quality of the milk was examined by determining the Total solids, Crude protein, Fat and Ash samples from each treatment and were analyzed for; using standard procedures.. Mineral Analysis was carried out by wet digestion of samples using Atomic Absorption Spectro-photometer (AAS)

Experimental Design

The experiment was conducted in a completely randomized design with two treatments and Eight (12) replications each, to test the hypothesis that there were differences between treatment with and without supplementation with multi-nutrient blocks.

Statistical Analysis

Data collected was subjected to analysis of variance (ANOVA) using the procedure of SAS (2003) package to test the effect of BMBC on milk yield and composition of the experimental animals. The difference between treatment means was obtained by subjecting all parameters to the Student t test (Snedecor and Cochran 1967).

Results and Discussion

Results

Table 1 shows Chemical composition of Guinea grass (Panicum maximum), Baobab pulp and seed *(Adansonia digitata L.)* and Baobab Multi-nutrient Block Concentrate (BMBC). The dry matter content of the BMBC (85.90 %) was within the range of 88.16 % recorded by Asaolu and Okeowo, (2013) in a study on Moringa Multi-nutrient Block (MMNB) supplementation to West African Dwarf goats and the value was mid-way between literature values (71.1 - 95.0 %) for urea molasses multi-nutrient blocks with comparable locally available materials such as gliricidia, leucaena, moringa and poultry litter (Onwuka, 1999; Mohammed *et al*., 2007; Aye and Adegun, 2010; Mubi *et al*., 2011; Aye, 2012). Such dry matter levels were regarded as quite high and indicative of reasonable extents of drying (Onwuka, 1999). The Crude protein level (16.50%) recorded in this study is suggestive of a greater potentials of BMBC as adequate concentrate for use as supplement in production ration, especially in dairy animal nutrition. Following the nutrient composition of Baobab fruit, BMBC is poised to meet the nutritional needs of ruminant with reference to maintenance and production purposes.

Table 2 shows the components (%) of Baobab Multi-nutrient Block concentrate (BMBC). The proportion of ingredients in the formulations were 25, 25, 20, 5,5,10 and 10% for milled Baobab pulp and seed, wheat offal, Palm kernel cake (PKC), urea, salt, molasses and cement, respectively. The technique and formulation were simple and could be carried out by smallholder farmer to improve their herd. Cement in the composition served as a binder and mineral source to the experimental animals. The 10% cement used in this study is lower than 15% used by Mohammed *et al*., 2007 in a study on Multi-nutrient blocks, but same level of inclusion by Hadjipanayiotou *et al*. (1993a). The composition and order of ingredient mixing in this study agreed with recommended procedures by (Aarts *et al*., 1990; Hadijipanayiotou, 1996).

Table 3 shows influence of BMBC on milk yield of lactating RSG. The yield of animals on BMBC clearly showed improvement resulting from the impact of BMBC. The yield ranged from 398.75g/day to 428.50g/day. This was far ahead of the values recorded by the group of RSG on *Panicum maximum* alone without BMBC. The difference in yield value ranged from 78.40g/day to 100.40g/day while the percentage increase was put at 26.61% - 31.30%.

Table 4 shows milk constituents and mineral composition of RSG fed BMBC. The total solids, protein, fat, ash and lactose values for animals on BMBC recorded 18.50, 6.05, 5.75, 0.98 and 5.72%, compared to lower values of 12.05, 3.58, 3.30, 0.82 and 4.35, respectively. Mineral values recorded for Ca, K, Mg, Na and P in +BMBC RSG were 250.00 mg/g, 342.50 mg/g, 88.45 mg/g, 92.86 mg/g and 96.95 mg/g compared to – BMBC RSG which had 231.00 mg/g, 330.00 mg/g, 75.53 mg/g, 84.13 mg/g and 91.10 mg/g, respectively.

Discussion

The basal diet Panicum maximum offered to goats in this study was based on zero grazing at 4% of their body weight. The lactating RSG goats fed BMBC in this study relished the cconcentrate as the intake was highly significant. It may be inferred that the acceptability of the Baobab multi-nutrient block concentrate (BMBC) by the animals in group B was due to the sweetness of BMBC due to the high content of vitamin C and mineral component of the BMBC. Baobab fruit has been reported to be a rich source of vitamin C, antioxidants, minerals and medicinal substances (Nour *et al.*, 1980; Vertuani *et al*., 2002; Kaboré *et al*., 2011). The belief among Fulani herdsmen in the southwest of Nigeria, that baobab fruit pulp enhances milk yield and milk flow in humans and cattle may be related to its medicinal and antioxidant properties.

Milk yield in +BMBC RSG in this study was comparatively higher than –BMBC. The +BMBC RSG yield recorded a ranged value of 398.75g/day to 428.50g/day ahead of –BMBC with record value range of 312.75g/day to 335g/day. This huge difference in milk yield could be directly liked to the influence of Baobab fruit which is the test ingredient in the Multi-nutrient block concentrate and the early stage of lactation when this experiment was conducted. Milk production increased during early lactation and reach its peak and reduces as the animal approach dry season. However, feeding a nutrient packed feed resource such as Baobab fruit has tendency to enhance milk yield, prolong lactation length and by extension delay dryness in lactating ruminants. High milk yield in RSG fed BMBC alongside basal diet in this study compared goats without BMBC supplement,. supports the claim by Fulani herdsmen that baobab fruit possess intrinsic factors that enhances milk production the cow. The results of this study supports the findings of Bui Xuan An *et al*., (2019) in a similar study on Multi-nutrient blocks (MUB) as supplement for milking cows fed forages of low nutritive value in south Vietnam. Okunlola and Olorunnisomo (2016) in a study on the Influence of baobab fruit in the diet on intake, milk yield and milk composition in Red Sokoto goats also recorded increase in milk yield with increased inclusion level of Baobab fruit in the diet.

Composition of the milk was largely influenced by the BMBC intake of the goats which increased compared to the other group without BMBC. The protein content of the milk increased due to the effect of BMBC. This was influenced by the higher protein intake of goats from BMBC. The fat content of the milk also increased in animals served concentrate. The fat content milk produced by goats fed BMBC in this study was 5.75%. This was higher than the range of 3.38 - 4.45% recorded by Okunlola and Olorunnisomo (2016) in an experiment on the influence of baobab fruit in the diet on intake, milk yield and milk composition in Red Sokoto goats, but agreed with the value reported by other researchers (Akinsoyinu *et al*., 1981; Zarhraddeen *et al*., 2007; Alawa and Oji, 2008) for Red Sokoto goats. The ash and lactose content of the milk however, were also influenced by BMBC intake. Although, it has been reported that lactose concentration in milk is not easily altered by nutrition (Ahamefule *et al*., 2003; 2012). Alawa and Oji, 2008 also put fat content of Red sokoto goats in an experiment at 5.7%, Mba *et al*., 1975, put it at 5.32% . Lactose content of milk by RSG fed BMBC in this study was a testament to high plane of nutrients in Baobab fruit. It was reported that Baobab fruit is very rich in carbohydrates, energy, calcium, potassium (very high), thiamine, nicotinic acid and vitamin C (Arnold *et al*., 1995). The pulp is a rich source of calcium, vitamin B and C (Ajayi *et al*., 2003). These attributes could be linked to the improved milk composition recorded in this study.

Mineral composition (Ca, K, Mg, Na and P) of milk produced by lactating RSG offered BMBC supplement was significantly higher than RSG without supplement. Mineral values recorded for Ca, K, Mg, Na and P in +BMBC RSG were 250.00 mg/g, 342.50 mg/g, 88.45 mg/g, 92.86 mg/g and 96.95 mg/g compared to – BMBC RSG which had 231.00 mg/g, 330.00 mg/g, 75.53 mg/g, 84.13 mg/g and 91.10 mg/g, respectively. This results showed that BMBC influenced experimental animals milk mineral composition This could be traced to the nutritional potentials of Baobab, as well as the breed of experimental animals. Zamberlin *et al*. (2012) linked milk mineral composition to animal breed and feed quality; among others.

Minerals (Micro and Macro) plays vital roles in many physiological processes. Magnesium for example plays roles such as metabolism of proteins and nucleic acids, neuromuscular transmission and muscle contraction, bone growth and blood pressure regulation. Calcium is crucial for bone and teeth formation and functions (Zamberlin *et al*., 2012), Na functions in the osmo-regulatory status of animals. Qin, *et al*. (2009). Several reports have been made of K and Ca as leasing minerals in milk (Ahamefule, 2012 and Yoo *et al*. 2013). Hence, adequate potassium to calcium ratios are important for nutrition and development, ditto to phosphorus, sodium and magnesium due to their roles in various body activities.

Following the yield, composition and mineral values recorded in this study, BMBC is justified as productive concentrate suitable for quantitative and qualitative enhancement of performance of lactating ruminants.

Conclusion

Finding from the study shows Baobab multi-nutrient block concentrate (BMBC) as a good feed supplement in diet of lactating Red Sokoto goats as it enhanced quantity and quality of the milk produced. The fat content of milk produced by the experimental animals makes it suitable for manufacturing dairy products like butter, yoghurt and ice cream. Availability of Baobab fruits mainly in the dry season makes it a dependable resource feed to mitigate poor nutrition in dairy animal production in the off season. Its use as concentrate like BMBC or as supplementary feed will compliment dry season scarcity of fresh and nutritious forages which usually orchestrates cattle herders-farmers clash. There is a popular assertion that 'we are what we eat'. Therefore, considering various health benefits of Baobab fruit both to human and livestock, feeding it as supplement in any form or composition will enhance better performance in ruminants, especially dairy animals.

Table 1. Chemical composition of Guinea grass (Panicum maximum), Baobab pulp and seed (Adansonia digitata L.) and Baobab Multi-nutrient Block Concentrate (BMBC)

Constituents (%)	Guinea grass	Baobab pulp and seed (BPS)	Baobab Multi-nutrient Block (BMBC)
Dry matter	24.60^{c}	89.80^{a}	85.90^{b}
Crude protein	6.40^{c}	13.20^{b}	16.50^{a}
Crude fiber	33.40^{a}	12.00^{b}	11.00^{b}
Ether extract	1.25^{b}	9.00^{a}	8.40^{a}
Ash	10.60^{a}	7.56^{b}	5.65^{c}
Nitrogen free extract	48.4^{b}	58.20^{a}	58.85^{a}
Neutral detergent fiber	35.80^{c}	50.60^{a}	46.20^{b}
Acid detergent fiber	64.50^{a}	26.00^{b}	20.50^{c}
Acid detergent lignin	13.80^{a}	10.00^{b}	10.90^{b}

^{abc} Means within each row with different superscript are different ($P<0.05$)

Table 2. Components (%) of Baobab Multi-nutrient Block Concentrate (BMBC)

BMBC Ingredients	Percentage composition
Baobab Pulp and Seed	25.00
Wheat offal	25.00
Palm kernel cake (PKC)	20.00
Urea	5.00
Salt	5.00
Molasses	10.00
Cement	10.00

Table 3.Influence of BMBC on Milk yield of RSG

RSG	Control (No supplement)	+ BMBC Supplement	Differences	
	Milk yield (g/day)		(g/day)	(%)
A1	335.20	428.50	93.30	27.83
A2	324.50	415.00	90.50	27.89
A3	320.80	421.20	100.40	31.30
A4	315.90	400.80	84.90	26.88
A5	333.10	411.50	78.40	23.54
A6	330.55	420.40	89.85	27.18
A7	320.15	405.35	85.20	26.61
A8	312.75	398.75	86.00	27.50
Mean	324.12	412.69	88.57	24.02
SE ±	±5.00	±7.20	±2.50	-

Table 4. Milk constituents and mineral Composition of RSG fed BMBC

BMBC	Milk constituents (%)					Mineral composition (mg/100g)				
	Total Solids	Protein	Fat	Ash	Lactose	Ca	K	Mg	Na	P
– BMBC	12.05	3.58	3.30	0.82	4.35	231.00	330.00	75.53	84.13	91.10
+BMBC	18.50	6.05	5.75	0.98	5.72	250.00	342.50	88.45	92.86	96.95

Lactose was calculated as Total Solid – (Protein + Fat + Ash), Calcium(Ca), Potassium (K), Magnesium (Mg), Sodium (Na), Phosphorus (P)

Drying of Baobab pulp and seed for Baobab Multi-nutrient Block

REFERENCES

Aarts, G.R., R. Sansoncy and G.P. Levieux, 1990. Guide for Manufacture and Utilization of Molasses Urea Blocks. Guide for Manufacture and Utilization of Molasses Urea Blocks. Italy.

Afolabi, O. R. and Popoola, T. O. S. (2005). The Effects of Baobab Pulp Powder on the Flora Involved in Tempe Fermentation. *European Food Research and Technology,* 220(2): Pp.187-190.

Ahamefule F.O., Ibeawuchi J.A. and Ejiofor C.A. (2003).A comparative study of the constituents of cattle, sheep and goat milk in a hot humid environment. *Disc. Innov*. 15(1/2), 64-68.

Ahamefule F.O.,Odilinye O and Nwachukwu E.N. (2012) Milk Yield and Composition of Red Sokoto and Wea Dwarf Does Raised Intensively in a Hot Humid Environment. *Iranian Journal of Applied Animal Science* 2(2), 143-149.

Ahrné, L., Björck, L., Raznikiewicz, T., & Claesson, O. (1980). Glycerol ether in colostrum and milk from cow, goat, pig, and sheep. *Journal of Dairy Science*, *63*(5), 741-745.

Ajayi, I.A., Dawodi, F.A., Oderinde, R.A. (2003). Fatty acid composition and metal content of Adansonia digitata seeds and seed oil. *La Rivista Italiana delle Sostanze Grasse,* 80, 41-43.

Akinsoyinu, A.O., Tewe, O.O., Ngere, L.O., Mba, A.U., 1981. Milk composition and yield of Red Sokoto (Maradi) goats. *Trop. Anim. Prod.*, 6(2), 186-187. http://www.fao.org/livestock/agap/frg/tap62/62_186.pdf

Alawa J.P. and Oji U.I. (2008).Effect of pendulous udder enlargement on yield of Red Sokoto goats. *J. Anim. Vet. Adv*.7, 870-87.

Allen, M., (1992). Making Molasses urea feed block a short guide to the technique. *Asian Livestock* XVII, 6: 68-71.

Al-Qarawi, A.A., Al-Damegh, M.A. El-Mougy, S.A. (2003). Hepatoprotective Influence of *Adansonia digitata* Pulp. *Journal of Herbs, Spices & Medicinal plants*, 10 (3), 1-6

AOAC. 2003.Official methods of analysis of the association of official's analytical chemists, 17thedn.Association of official analytical chemists, Arlington, Virginia.

Arnold T.H.; Well M.J.; Wehmeyer A.S. (1985): Koisan food plants: taxa with potential for economic exploitation. *In*, G.E. Wickens; J.R. Goodin; D.V. Field (eds.), Plants for arid Lands, Allen and Unwin, London: 69-86.

Asaolu, V.O and and Okewoye, A.T. (2013). Moringa multinutrient Block supplementation effects on feed utilization by West African Dwarf goats fed a Basal diet of Cassava peels. *Science Focus* 18 (1): Pp 63 – 72

Aye, P. A. and Adegun, M. K. (2010). Digestibility and growth in West African Dwarf (WAD) sheep fed gliciridia based multinutrient block supplements. *Agricultural and Biology Journal of North America* 1 (6): 1133 – 1139

Aye, P. A. (2012). Production of gliricidia and leucaena-based multinutrient blocks as supplementary feed resource in South Western Nigeria. *Agriculture and Biology Journal of North America*, 3 (5): 213 - 220.

Ayinla, A.K. and Adetoye, A.S. (2015). Climatic pattern and design for indoor comfort in Ogbomoso, Nigeria. *Journal of Environment and Earth Science.* 5(17):30-37.

Bath, D.L., Dickinson, F.H., Tucker, H.A. and Appleman, R.D. (1981). Dairy cattle: principles, principles, problems and profits. Third Edition

Bheekhee H (1999). Urea molasses multinutrient blocks (UMMB) as a feed supplement for ruminants. AMAS, Agricultural Reseacrh Council, Réduit, Mauritius, pp 251-253. Retrieved July, 29, 2010 from http://www.gov.mu/portal/sites/ncb/moa/farc/amas99/p2.pdf

Cronjé P B (1990) Supplementary feeding in ruminants- A physiological approach. *South African Journal of Animal Science* 20(3): 110 – 117.

An B X, Hieu L T and Preston T R (1991): Multi-nutrient blocks (MUB) as supplement for milking cows fed forages of low nutritive value in south Vietnam. *Livestock Research for Rural Development. Volume 3, Article #16.*

Bheekhee, H., B. Hulman, R.K. Boodoo, R. Ramnauth, L. Heung, R. Yeun, R. Fakim and B. Dobee,(1999). Development and Field Evaluation of Animal Feed Supplementation Packages for Improving Meat and Milk Production in Ruminant Livestock Using Locally Available Feed Resources. Livestock Research Department, Agricultural Research and Extension Unit, Food and Agricultural Research Council, Quatre Bornes, Mauritius, Pp: 1-9.

Diop. S. A. (2006). The African baobab tree (*Adanonia digitata*).Principal characteristic of Baobab Tree. *Science Journal* 61: 55 – 69.

Fatine, O. L. J. and Zanetti, A. M. (2010). Effect of multinutrient block on feed digestibility and performance of goats fed maize stover during the dry season in south of Mozambique. *Livestock Research for Rural Development*, *Volume 22*, *Article #162.* Retrieved June 10, 2013, from http://www.lrrd.org/lrrd22/9/faft22162.htm.

Hadjipanayiotou, M., L. Verhaeghe, M. Allen, A.R. Kronfoleh and M. Al-Wadi.(1993). Urea blocks. I. Methodology of block making and different formulae tested in Syria. *Livestock Res. Rural Dev*., 5: 6-15.

Hadjipanayiotou, M., (1996). Hadjipanayiotou, M. (1996). Performance of friesian heifers on urea blocks and of clio's ewes on blocks and other supplements. *Livestock Res. Rural Dev.*, 8: 1-9.

Kaboré, D., Sawadogo-Lingani, H., Diawara, B., Compaoré, C.S., Dicko, M.H., Jakobsen, M., (2011). A review of baobab (*Adansonia digitata*) products: Effect of processing techniques, medicinal properties and uses. *Afr. J. Food. Sci.*, 5(16), 833-844.

Leng, R.A., (1986). Drought Feeding Strategies and Practice. Penambul Books, Armidale, New Southwest Wales, Australia, Pp: 149-151.

Leng, R. A. (1992). Drought feeding strategies: Theory and practice. Penambul Books, Armidale. 162 p

Mackinon D and Rocha A 1987 Reproduction, mortality and growth of indigenous sheep and goats in Mozambique. In: Wilson R T and Bourzat D (editors). Small Ruminants in African Agriculture. ILCA: Addis Ababa, Ethiopia. Pp.154-162

Mba A.U., Boyo S.S. and Oyenuga V.A. (1975). Studies on the milk composition of West African Dwarf, Red Sokoto and Saanen goats at different stages of lactation. *J. Dairy Res*. 42, 217-226.

Mohammed, I. D., Baulube, M. and Adeyinka, I. A. (2007). Multinutrient blocks 1: Formulation and production under a semi-arid environment of North East Nigeria. *Journal of Biological Sciences*, 7 (2): 389 – 392. http://scialert.net/fulltext/?doi=jbs.2007.389.392&org=11

Mubi, A. A., Kibon, A. and Mohammed, I. D. (2011). Effects of multinutrient block supplementation on the performance of grazing Yankasa sheep in the wet season of guinea savanna region of Nigeria. *International Journal of Sustainable Agriculture*, 3 (3): 103 - 106.

Nour, A.A., Magboul, B.I., Kheiri, N.H. (1980). Chemical composition of baobab fruit *(Adansonia digitata L.).Tropical Sciences*, 22, 383-388.

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.

Onwuka, C. F. I. (1999) Molasses blocks as supplementary feed resources for ruminants. *Arch. Zootech.* 48: 89 - 94.

Osman, M.A. (2004). Chemical and Nutrient Analysis of Baobab (Adansonia digitata) Fruit and Seed Protein Solubility. *Plant Foods for Human Nutrition*, 59, 29-33.

Patton, S., Long, C. and Sokka, T. (1980). “Effect of storing milk on cholesterol and phospholipids of skin milk”. *J. Dairy Sc* 63: 697 -700.

Qin, L. Q. ; Wang, X. P. ; Li, W. ; Tong, X. ; Tong, W. J. (2009). The minerals and heavy metals in cow’s milk from China and Japan. *J. Health Sci.,* 55, 300-305.

Ramadan, A., Harraz, F.M., El-Mougy, S.A. (1993). Anti-inflammatory, analgesic and antipyretic effects of the fruit pulp of Adansonia digitata. *Fitoterapia*, 65, 418-422.

SAS. 2003. Statistical Analysis Systems, User’Guide,Version 8 ed., SAS Institute Inc.SAS Campus Drive Cary, North Carolina, USA.

Snedecor G.W and Conchran W.G (1967). Statistical Methods, 6th edition. Allied Pacific, Bombay.

Vertuani, S., Braccioli, E., Buzzoni, V., Manfredini, S. (2002). Antioxidant capacity of Adansonia digitata fruit pulp and leaves. Acta Phytotherapeutica, 2 (V), 2-7.

Waruiru, R.M., 2004. The influence of supplementation with urea-molasses blocks on weight gain and nematode parasitism of dairy calves in Central Kenya. *Vet. Res. Commun.*, 28: 307-315.

Yazzie, D., VanderJagt, D.J., Pastuszyn, A., Okolo, A., Glew, H. (1994). The Amino Acid and Mineral Content of Baobab *(Adansonia digitata L.)*Leaves. *Journal of Food Composition and Analysis*, 7, 189-193.

Yoo, S. H. ; Kang, S. B. ; Park, J. H. ; Lee, K. S. ; Kim, J. M. ; Yoon, S. S. (2013). Effect of heat-treat methods on the soluble calcium levels in the commercial milk products. *Korean J. Food Sci. Anim. Resource*, 33, 369-376.

Zamberlin S., Neven A., Jasmina H., Dubravka S. (2012). Mineral elements in milk and dairy products, *Mljekarstvo* 62 (2), 111-125.

Zahraddeen, I.S., R. Butswat and S.T. Mbap, (2007). Evaluation of some factors affecting milk composition of indigenous goats in Nigeria. *Livest. Res. Rural* Dev. Vol. 19.