2018 SCIENCELINE

Online Journal of Animal and Feed Research

Volume 8, Issue 5: 112-119 ; Sep 25, 2018 ISSN 2228-7701

COMPOSITION OF COLOSTRUM AND MILK OF WEST AFRICAN DWARF (WAD) DOES FED CASSAVA PEEL BASED-DIETS SUPPLEMENTED WITH AFRICAN YAMBEAN (*Sphenostylis stenocarpa*) CONCENTRATE IN THE HUMID ZONE OF NIGERIA

Magnus Izah ANYA and Pascal Ogar OZUNG

Department of Animal Science, University of Calabar, Calabar, Nigeria

Supporting Information

ORIGINAL ARTICLE
PII: S222877011800015-8
Received: June 19, 2018
Revised: September 07, 2018

ABSTRACT: Twelve pregnant West African Dwarf (WAD) does were used to determine the effect of cassava peel meal based diets supplemented with African yambean Meal (AYBM) concentrate on colostrum and milk yield composition. Four concentrate diets were formulated with AYBM at 0, 10, 20 and 30% levels designated as T_1, T_2, T_3 and T_4, respectively. The does were randomly assigned into four groups of three per treatment and assigned to the respective diets in a Completely Randomized Design (CRD) experiment. Lactation length for each doe was based on 135 days. Results showed that daily colostrum yield, total solids (TS), crude protein (CP), ash and energy compositions differed significantly ($P<0.05$) between the treatment groups. The mean colostrum yield per day (15.68 g), TS (18.52 %) and CP (5.41 %) were highest in diet T_3 (20% AYBM) than treatment T_2 (10% AYBM). Diet T_4 (30% AYBM) promoted the highest percent values for Butterfat (BF), solids-non-fat (SNF), ash and energy with values of 3.52%, 14.54%, 0.91% and 4.30MJ/Kg, respectively. Milk yield, TS, BF, CP, SNF, ash and energy composition differed significantly ($P<0.05$) between treatment groups. Milk yield (3.26 kg), SNF (9.96%) and energy constituent (3.91MJ/kg) values were highest for does fed 10% AYBM diet, while Diet T_4 (30% AYBM) promoted the highest TS, BF, CP and ash and the values were 15.03, 5.49, 4.89 and 1.04%, respectively. The study concludes that cassava peel meal based – diets supplemented with African yambean concentrate supported optimum colostrum and milk composition without deleterious effects. The study therefore recommends that 20% inclusion level of African yambean concentrate in cassava peel meal based- diets is ideal for effective colostrum yield and milk composition in West African Dwarf does.

Keywords: African Yambean, Colostrum, Milk Yield, Milk Composition, WAD Does

INTRODUCTION

In Nigeria and majority of other countries in the world, milk supply is basically from bovines while that from sheep, goats and camels is negligible. The Nigerian dairy industry is highly underdeveloped, being very rural/traditional and relying heavily on the importation of dairy products worth more than US$ 300 million per annum to meet the domestic demand of 1.45 billion litres (SAHEL, 2015).

The gap between supply and demand for dairy products is widening as a result of increase in population, urbanization, growing income, changing lifestyles and food preferences. Imports used to bridge part of the gap have also been declining as a result of devaluation of the Nigerian currency. Consequently local collection, processing and marketing of milk is becoming increasingly competitive (Anya, 2012).

As at 1990, the annual collectable milk from the national herd was approximately 550,000 tonnes (Anon, 1990). In 2013 estimates show that Nigeria only produced 591, 491 metric tonnes which cannot meet the projected demand. Small ruminants (sheep and goats) also produce milk, but in Nigeria limited information is available in the milk productivity of these animals especially of the West African dwarf goat in the humid tropical rainforest zone.

In Nigeria, the population of sheep and goats was put at 22 and 34 million respectively (RIM, 1990). However, the main emphasis is on meat and skin with little emphasis on milk production. This makes it difficult to access the full potential of our indigenous small ruminants in terms of milk production. The over 440 million goats (worldwide) produce an estimated 48 million metric tonnes of milk that is predominantly consumed locally or processed into various types of milk products. However, the report of FAO (1991) showed that Asia, Africa and Europe are the leading continents in term of goat milk production.

To cite this paper: Anya MI and Ozung PO (2018). Composition of colostrum and milk of West African Dwarf (WAD) does fed cassava peel based- diets supplemented with African yambean (*Sphenostylis stenocarpa*) concentrate in the humid zone of Nigeria. *Online J. Anim. Feed Res.*, 8(5): 112-119. www.ojafr.ir

Goats are very important for their milk production potentials, for their size, goats have a higher relative yield than cattle or buffalo. This is partly because of the goat's relatively larger udder size and volume. The udder of the goat is a greater proportion of the total weight of the animal and contains a higher total quantity of secretory tissues than cows. This leads to a larger daily intake of feed and larger proportion of milk produced per unit of body weight (Steele, 1996). Thus, the goat is a more energetically efficient producer of meat and milk than the cow, even under conditions of good grazing (Raun, 1982; Anya, 2012). Some goats are maiden milkers and unlike cows can continue to lactate for up to two years (higher lactation persistency) which entails that they do not have to be mated each year and have a more pronounced milk ejection reflex (Jennes, 1980; Steele, 1996). In view of these facts, goats may in the long-run displace cows. Milk production data is very useful for selection purposes; it is well established that females with high milk output promote faster growth and better survivability of kids. Available information indicates that WAD goats have a low milk production potential. However, studies by some workers (Nuru, 1985; Okonkwo, 2001; Ahamefule, 2005 and Ukpabi, 2007) indicated that WAD does may produce some considerable amounts of milk especially if well nourished.

In other climes, goat colostrum is increasingly becoming important not only for goats but as a health product with a competitive demand for humans. New born mammals acquire immunity to certain infections via colostrum. Immune globulins appear in blood within 3 hours after colostrum is fed. Normally all proteins are digested, but in colostrum the inhibitor allows the immune globulins to reach the intestines without destruction. In humans, colostrum is known to burn excess fat, builds up lean nuclear growth and promotes efficient cellular function, tissue repair and skin rejuvenation (Tropical Traditions, TT; 2010). Thus, goat colostrum is now being harvested widely and sold to health product companies manufacturing several colostrum based products. This is so because there are over 90 known health enhancing components including dopamine, serotonin and lactoferrin in goat colostrum (TMN, 2009).

This study therefore evaluated the composition of colostrum and milk of West African Dwarf (WAD) Does fed cassava peel based diets supplemented with varying concentrate levels of African yambean in the high rainforest (Humid) zone of Cross River State – Nigeria.

MATERIALS AND METHODS

Location of study

The study was carried out in the Sheep and Goat Unit of the Teaching and Research Farm, Faculty of Agriculture, University of Calabar, Calabar. Calabar is located on latitude $4^{0}57^{1}$N and longitude $8^{0}19^{1}$E of the equator. Annual temperature and rainfall ranges from 25 – 30^{0}C and from 1260 to 1280mm, respectively. The relative humidity is between 70 and 90% and Calabar is 98 metres above sea level (NMA, 2018).

Processing of cassava peel and African yambean seed meal

Cassava peels of TMS 30555 variety were collected fresh from the Department of Crop Science commercial "Garri" processing unit of the University of Calabar, Calabar. The peels were from 10-12 months old plants. The peels were properly sun dried for a period of 6 - 7 days during which they were regular turnings to give even drying to a moisture content of 10%. The peels could sometimes have tuber linings as a result of the method of removing the peels. The sun-dried cassava peels were then milled and used in the study as dried cassava peel meal (CPM). African yambean (*Sphenostylis stenocarpa)* seeds (Nsukka brown variety) were purchased from local famers in Obudu and Obanliku Local Government Areas in the Northern parts of Cross River State. The undecorticated brown seeds were boiled for 30 minutes. Water was made to boil at 100^{0}C in a large (mammoth) cooking pot before the seeds were poured in. The seeds were allowed to boil for 30 minutes. Water was decanted using local baskets and the seeds sun-dried on aluminum roofing sheets for 3 days before being milled and used as yambean seed meal (AYBM) to formulate the experimental diets.

Experimental diets, its proximate analysis and test ingredients

Four experimental diets designated as T_1, T_2, T_3 and T_4 were formulated as presented in Table 1. Diet T_1 was the control and contained no yambean seed meal (YBSM). Diet T_2, T_3, and T_4, contained 10, 20, and 30% of AYBM, respectively. The diets were allotted randomly to the four animal groups. Each animal within a group was offered 1kg of an assigned concentrate diet daily for 56 days. The concentrate diets were fed at 0800 hour daily. Clean drinking water was provided *ad-libitum* for each animal within the period. Each animal was provided with a salt lick block (TANLICK), a product of SKM Pharma (P) Limited JF-10, City Point, Infantry Road Bangalore – 560001 India. The salt lick had the following composition: Na, 35.96%; Zn, 0.25%; Fe, 0.30%; Mn, 0.20%; I, 0.003%; Co, 0.002%; Cu, 0.10% and Mg, 0.05%. All the experimental diets including CPM and AYBM were analyzed for proximate composition using AOAC (2000) methods.

To cite this paper: Anya MI and Ozung PO (2018). Composition of colostrum and milk of West African Dwarf (WAD) does fed cassava peel based- diets supplemented with African yambean (*Sphenostylis stenocarpa*) concentrate in the humid zone of Nigeria. *Online J. Anim. Feed Res*., 8(5): 112-119. www.ojafr.ir

Table 1 - Gross composition of experimental diets

Ingredients	Diets (%)			
	T_1	T_2	T_3	T_4
Cassava peel	46.00	46.00	46.00	46.00
African yambean seed meal	0.00	10.00	20.00	30.00
Wheat offal	33.00	23.00	13.00	3.00
Palm kernel cake	18.00	18.00	18.00	18.00
Bone meal	2.00	2.00	2.00	2.00
Salt	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00

Animal management

Twelve West African Dwarf (WAD) Does with average age of 18 months were selected from the goat herd of the Teaching and Research Farm of the University of Calabar, Calabar and used in this study. The average weight was 19.6±1.12 Kg (18.5-22.7 Kg). The does which were in their second parity were randomly divided into 4 groups of 3 animals each. Each group was assigned to one of the experimental diets (Table 1) in a Completely Randomized Design (CRD) experiment. Each animal was housed separately in cement floored pens measuring 1.85 x 1.70 m (3.15m^2). Dry hay material was used as bedding. During the first 4 months of pregnancy, the Does were zero-grazed with forage consisting mainly *Pennisetum purpureum*, *Pueraria phaseoloides* and *Centrosema pubesens*. Daily dry matter provision for each animal was based on 3% body weight. In the last trimester of pregnancy, each in-doe received 0.5kg of a concentrate diet in the morning (08:00hr) and 1.0 Kg *Pennisetum purpureum* in the afternoon (1400hr). This nutritional regime continued through parturition and into the 10th week of lactation for each Doe. Prior to parturition, routine spraying and deworming programmes were carried out including vaccination against *PPR* a viral disease of small ruminants endemic in the locality. Concentrate diets were placed in wooden troughs while water was provided *ad libitum* in plastic containers. The study was carried out in accordance with the code of ethics for animal experiments as stated in http://ec.europa.eu/environment/chemicals/lab_animals/legislation_en.htm.

Kid management

For each pregnant doe, each feeder pen also doubled as a maternity pen. At birth, each kid had umbilical cord cleansed with disinfectant and cut at a distance of about 2cm away from the naval flap and a tincture of iodine was added to aid healing and prevent entry of pathogens. Kid weights were recorded immediately after parturition using a 5 kg capacity sensitive top loader "Salter" scale. Colostrum was collected, measured and fed back to the kids using feeding bottles for first 4 days. Thereafter, new born kids were left to suckle their dams freely for the next 6 days. The date of kidding, parity and liter sizes of does were recorded. The sex of kid born to a doe was also recorded and from this, the litter composition of the dam per kidding was determined.

Milk measurements

Does were hand-milked daily (morning). However, the total amount of milk yielded per day was recorded as the morning daily yield of the Doe. The daily milk yield was then estimated for each doe on the assumption that actual daily production of Does can be met if the animals were milked twice a day. Thereafter, based on the concept of fixed yield responses to changing milk frequency (Erdman and Verner, 1995), the constant 0.6596 was used as a weighting factor on the morning milk yield. Each day's milk yield (S) was estimated as: $S = M + 0.6596M$; where, M is the morning milk yield (once-a-day milking).

Prior to each day's milking including the first 4 day period for colostrum sampling (Anya, 2012), kids were separated from their dams at 1800hr on the evening preceding the day of milking. Within this period of separation, kids were fed milk with the aid of feeding bottles. During colostrum and normal milking, the two halves of the udder of lactating does were hand milked daily from 700 to 0800hr. The quantity of milk harvested from a doe was measured using a graduated glass cylinder (500ml capacity) and weighed back to the nearest gram on a sensitive laboratory scale. Dams were allowed to nurse their kids in the morning after milking and in the afternoon before separation at 1800hr daily.

Milk sampling

Colostrum sampling was initiated on the first day of kidding for each lactating doe and terminated on the fourth day post-partum. Samples for daily colostrum yield for each Doe were analysed daily for lactose content before being bulked (10 ml each) and analysed for total solids (TS), butterfat (BF), crude protein (CP), solids-not-fat (SNF), ash and energy. The bulked colostrum samples were stored in a refrigerator at - 5^{0}C until required for analysis.

Lactation length for each Doe was based on 135 days. Milk sampling was initiated on the 10^{th} day for each lactating doe and terminated on the 79^{th} day post-partum. Samples from daily milk yield for each doe were analyzed daily for lactose content before being bulked and analyzed weekly for ST, BF, CP, SNF, ash and energy. The bulked samples were after stored in a refrigerator (-5^{0}C) until required for analysis. The weekly milk production was a summation of each 7-day milk yield per doe while the weekly determinations (analysis) represented each doe milk profile for the week. The weekly lactose contents of milk of a doe was determined as average of daily lactose determinations.

Analytical procedure

The colostrum and milk samples were analyzed for lactose, TS, BF, CP (N x 6.38), SNF, ash and gross energy. TS were determined by drying about 5 g of milk sample to a constant weight at 105 ^{0}C for 24 hours. Lactose content was determined from fresh samples by the Marrier and Boulet (1959) procedure. BF was obtained by the Roese-Gottlieb method (AOAC, 1980). Milk protein (N x 6.38) was determined by the semi-micro distillation method using Kjeldahl and Markham's apparatus. Ash content was obtained by drying and ashing a weighed milk sample (10 ml) to a constant weight at 550 ^{0}C for 48 hours. SNF was determined as the difference between TS and butterfat. Milk energy Y (M/kg) was computed using the multiple regression equation. $Y = 0.386F + 0.205\ SNF - 0.236$ (MAFF, 1975); where F and SNF represent percentages of fat and solids-not-fat, respectively.

Statistical analysis

The data on colostrum and milk yield and composition were analysed using the analysis of variance (ANOVA) procedures for a Completely Randomized Design (Morris, 1999). Significant means were separated using methods as outlined by Steel and Torrie (1980).

RESULTS AND DISCUSSION

Proximate composition of experimental diets and test ingredients (CPM and AYBM)

The result of the proximate composition of experimental diets, cassava peel meal and African yambean meal is presented in Table 2.

Colostrum yield and composition

The average daily colostrum yield and composition of Does fed concentrate diets containing varying levels of African yambean seed meal are summarized in Table 3. Colostrum yield (g) differed significantly ($P<0.05$) among treatment groups. The colostrum yield of animals fed the control diet (T_1) was the lowest (14.28 g) followed by diet T_2 (14.43 g), diet T_3 (15.68g) and diet T_4 (14.46 g), respectively. Goats fed diet with 20 % AYBM produced the highest mean daily colostrum yield of 15.68 g which differed ($P<0.05$) from the yield of other treatment groups. In this study, diet T_3 promoted the highest colostrum yield over the 4 day period while the control diet was the least. This showed that AYBM based-diets promoted higher colostrum yields compared to the control. Furthermore, among the AYBM based diets, it is possible that more ruminal acetate was produced in does fed diet T_3 hence the high colostrum yield recorded for this treatment group in comparison with the yield of goats fed either diets T_2 or T_4.

Percent TS was higher ($P<0.05$) in the colostrum of does fed AYBM diets than the control group. Does on diet T_3 had the highest percent TS (18.52) that was significantly different ($P<0.05$) from those on control diet (17.37). However, TS was similar ($P>0.05$) for does on diets T_3 and T_4, while TS for does on diet T_4 was not different from those on diet T_2. The percent TS obtained for colostrum in this study (18.08±0.55) falls within the range of 19.2% reported by Akinsoyinu et al. (1977) for WAD goats.

BF percent of colostrum was highest and lowest in does fed 30% (3.52) and 10% (3.22) AYBM diets respectively while the values of 3.22% and 3.12% obtained for diet T_3 (20% AYBM) and the control group (T_1) respectively did not differ ($P>0.05$) significantly. The butterfat percentage for colostrum obtained in this study was low when compared to 8.3% reported by Akinsoyinu et al. (1977) for WAD goats. The non-concurrent values reported may be due to differences in parity, perhaps litter size and the varying diets used in different studies.

The CP and SNF concentrations were significantly higher ($P<0.05$) in the colostrum of does fed AYBM diets than in the control. While colostrum protein was highest (5.41%) for diet T_3 (20% AYBM), SNF values were highest (14.54%) in diet T_4 (30% AYBM). The CP and SNF concentrations in colostrum are generally influenced by diet quality. The relatively higher values obtained for these constituents in does fed AYBM diets tend to confirm that these diets were superior to the control. However, the values for total protein obtained in this study for colostrum agrees with the value of 5.1% reported by Akinsoyinu et al. (1977) for WAD goats.

To cite this paper: Anya MI and Ozung PO (2018). Composition of colostrum and milk of West African Dwarf (WAD) does fed cassava peel based- diets supplemented with African yambean (*Sphenostylis stenocarpa*) concentrate in the humid zone of Nigeria. *Online J. Anim. Feed Res.*, 8(5): 112-119. www.ojafr.ir

Lactose concentration for colostrum in this study did not differ (P>0.05) significantly among the treatments. Lactose concentration in colostrum is however influenced by diet quality. Results obtained reveal that all the diets were of good quality but AYBM diets were superior to the control.

Colostrum ash (%) and energy (MJ/Kg) were fairly similar for all treatment groups. Values obtained were 0.78%, 3.87MJ/Kg; 0.80%, 3.98MJ.Kg; 0.81%, 3.98MJ/Kg; and 0.91%, 4.30MJ/Kg for diets T_1, T_2, T_3 and T_4 respectively. The mean value for ash 0.83± 0.12% agrees with the value of 0.82±0.01% reported by Akinsoyinu (1974) for WAD goats, but higher than 0.55+ 0.14% reported by Ahamefule et al. (2003). However, colostrum ash of diet T_4 was significantly (P<0.05) different compared to other diets. Milk energy (MJ/kg) of colostrum followed the same pattern like that of ash (%), with diet T_4 being superior (P<0.05) compared to other diets.

Table 2 - Proximate and energy composition of experimental diets, cassava peel meal (CPM) and African yambean seed meal (AYBM)

Composition (% DM)	Diets					
	T_1	T_2	T_3	T_4	*CPM	*AYBM
Dry matter	89.44	89.35	89.42	89.62	90.10	88.50
Crude protein	10.56	10.96	11.36	11.44	3.22	22.10
Crude fibre	12.47	11.05	10.31	10.11	14.73	5.92
Ether extract	4.50	4.61	4.80	4.94	0.91	7.53
N-free extract	51.38	53.61	54.33	54.62	65.67	47.67
Ash	10.35	9.12	8.62	8.49	5.57	5.28
Gross energy (kcal/g)	3.45	3.42	3.31	3.28	3.60	5.23

*Test ingredients

Table 3 - Effect of the experimental diets on colostrum yield and composition of WAD goats

Parameter	Diets				
	T_1	T_2	T_3	T_4	SEM
Colostrum yield (g)	57.50^b	57.63^b	62.71^a	58.26^b	1.23
Daily colostrum yield (g)	14.28^b	14.41^b	15.68^a	14.46^b	0.33
Total solids (%)	17.37^b	18.02^{ab}	18.52^a	18.42^{ab}	0.26
Butterfat (%)	3.12^b	3.22^b	3.22^a	3.52^a	0.09
Protein (N x 6.38) (%)	5.09^b	5.11^a	5.41^a	5.12^b	0.08
SNF (%)	14.16^b	14.51^{ab}	14.51^{ab}	14.54^a	0.09
Lactose (%)	2.28	2.29	2.30	2.30	0.02
Ash (%)	0.78^b	0.80^b	0.81^b	0.91^a	0.03
Energy (MJ/kg)	3.87^b	3.98^b	3.98^b	4.30^a	0.09

^{ab} Means on the same row with different superscripts differ significantly (P<0.05). SEM = Standard error of mean

Milk yield and composition

The average weekly milk yield and composition of does fed concentrate diets containing varying levels of African yambean are summarized in Table 4. Milk yield (kg) differed significantly (P<0.05) among treatment groups. The milk yield of goats fed the control diet (T_1) was the lowest (2.58kg) but similar (P>0.05) to the average yield (2.71kg) obtained for does fed diet T_4 (30% AYBM). The does fed diet T_3 (20% AYBM) had average weekly yield of 2.97kg which did not differ significantly (P>0.05) from the yield of the group fed diet T_2. Animals fed diet T_2 (10% AYBM) produced the highest mean milk yield of 3.26kg which differed significantly (P<0.05) from the yield of other treatment groups. In raising ruminant animals either for milk or meat production, there is a fundamental antagonism between milk synthesis and fattening. Diets that promote efficient weight gain, would most times naturally lead to poor milk synthesis and vice versa (Rai, 1980; Ahamefule, 2005). This according to Preston (1986); Mathewman (1995) and McDonald et al. (1995) is related to the metabolism pattern and production of ruminal volatile fatty acids associated with diets fed.

To buttress this point, Preston (1986) and Ahamefule (2005) reported that diets that lend themselves more easily to production of propionate than acetate in the rumen would tend to encourage weight gain than milk synthesis in ruminants. The converse is also true. This is an indication that more ruminal propionate than acetate was produced in does fed diet T_4; hence the low milk production recorded for this treatment group in comparison with the yields of goats fed either diets T_2 or T_3. It is also possible that more ruminal acetate than propionate was produced in goats fed diet T_2, hence the comparatively higher milk yield observed for the does placed on this diet. Generally, the inclusion of AYBM in the diets improved milk yield compared to the control. This observation was in line with the reports of Ahamefule (2005) and Ukpabi (2007).

Table 4 - Effect of the experimental diets on milk yield (kg) and composition of WAD goats					
Parameter	Diets				
	T_1	T_2	T_3	T_4	SEM
Total milk yield (kg)	2.58^b	3.26^a	2.97^{ab}	2.71^b	0.15
Total solids (%)	14.70^b	14.71^b	15.01^a	15.03^a	0.09
Butterfat (%)	4.89^b	4.44^b	4.93^b	5.49^a	0.22
Protein (N x 6.38) (%)	4.34^b	4.66^b	4.67^b	4.89^a	0.12
SNF (%)	9.27^b	9.96^a	9.58^{ab}	9.95^a	0.16
Lactose (%)	4.29^a	4.23^b	4.32^a	4.30^a	0.01
Ash (%)	0.88^b	0.91^b	0.99^b	1.04^a	0.04
Energy (MJ/kg)	3.62^b	3.91^a	3.62^b	3.90^a	0.08

[ab] Means on the same row with different superscripts differ significantly (P<0.05). SEM = Standard error of mean

The mean weekly milk yield (2.83+0.31kg) obtained for WAD goats in the first 10 weeks of lactation was rather low but comparable to the value of 3.33±1.07kg reported by Akinsoyinu (1974) for the same breed. The non-concurrent values may be due to differences in parity and perhaps litter size. Fifty percent of Does used in this study were in their second parity while fifty percent had single births. The Does used by Akinsoyinu (1974) had multiple births and were mostly in either their 2nd, 3rd or 4th parity. Litter size and parity have been identified as strong factors influencing milk yield and composition in lactating animals (Csapo et al., 1994; Steele, 1996; Akpa et al., 2001; Ahamefule, 2005; Williams et al., 2010).

Percent TS was higher in the milk of goats fed AYBM diets (T_2, T_3 and T_4) than in the control group. There was however no significant differences (P>0.05) observed in the % TS values of goats fed the 10% (14.71) and the control group (14.70) and between goats fed the 20% (15.01) and those on 30% (15.03) AYBM diets. Milk TS of goats fed 30% AYBM diet (15.03) was higher and differed significantly (P>0.05) from those on diet T_1 and T_2 but similar (P<0.05) to those on diet T_3. BF percent was highest and lowest in milk of goats fed 30% (5.49) and 10% (4.44) AYBM diets respectively while the values of 4.93% and 4.89 obtained for diet T_3 (20% AYBM) and the control group (T_1) did not differ (P>0.05) significantly. However, the values for fat content (%) obtained in this study compares favourably with the fat content of 4.82 – 5.79% reported by Ahamefule and Ibeawuchi (2005) for lactating WAD does fed pigeon pea-cassava peel based diets. BF and TS, like most other milk constituents, are generally influenced by the type of diet of lactating animals (Akpa et al., 2001; Williams et al., 2010) as well as yield (Ibeawuchi, 1985). Other investigations (Jenness, 1980; Ahamefule et al., 2003; 2004; Ahamefule, 2005; Ukpabi 2007) had confirmed negative correlations between yield and butterfat which agrees with the findings of this study. For instance, butterfat values was lowest in the milk of Does fed diet T_2 (4.44%) which promoted the highest weekly yield (3.26 kg). Also, the TS value of the group fed diet T_2 was among the lowest (14.71). In a contradictory swift, BF and TS values in this study were highest in the milk of does fed 30% AYBM (T_4) (5.49; 15.03% respectively) but the trend was not the same for the control group with the lowest yield. This peculiar contradictory trend observed in this study is in line with the reports of Ahamefule (2005) with pigeon pea-cassava peel based diets and Ukpabi (2007) with mucuna bean. This trend of high BF and TS in the milk yield of lactating WAD goats fed this legume could be due to the high crude protein and ether extract content of the seed meals used in the various diets fed. There is good evidence that in small ruminants about 75% of the fatty acids in milk arise from dietary fat. A dietary source of lipid can reduce considerably any imbalance caused by relative deficiencies of glycogenic energy and amino acids in the end products of rumen digestion. Thus, for many feeding systems in the tropics, the level of fat in the diet could be a primary constraint to milk production (Preston, 1986).

The CP, SNF and lactose concentrations were significantly higher (P<0.05) in milk of Does fed AYBM than the control. While milk protein was highest (4.89%) in diet T_4 (30% AYBM), SNF value was highest (9.96%) in goats fed diet T_2 (10% AYBM) while lactose was highest in goats fed diet T_3 (20% AYBM). The CP, SNF and lactose concentration in milk are generally influenced by diet quality. The relatively higher values obtained for these constituents in goats fed AYBM diets tend to buttress the fact that these diets were of superior quality to the control. The similar values (P>0.05) for CP of AYBM diets confirms earlier reports that increasing the CP of diets does not necessarily increase the protein content of milk (Sutton, 1981). Lactose content did not differ significantly (P>0.05) between diets T_1 and T_4. The values for does on diets T_3 and T_4 did not also differ significantly (P>0.05) but were higher than 4.29% recorded for diet T_1. The result of this study indicated that the inclusion of AYBM in the diets improved on the lactose content of goat milk. The high values obtained in this study may not be unconnected with the high concentrate intake, which probably promoted more production of propionic acid in the rumen fluid. This eventually resulted in more lactose output because of its glycogenic effects (Allen, 1977; Matenga et al., 2003). Similar results were reported by Ukpabi (2007) with mucuna seed meal.

Meanwhile, the mean value of 14.86±0.25%; 4.94±0.24 and 4.34±0.16% obtained respectively for TS, BF and lactose for WAD goats in a 10-week lactation, were lower than the respective values of 19.21±0.46; 7.31±0.21 and 6.60±0.19% reported by Akinsoyinu (1974) for WAD goats within the same lactation length. However, the values obtained for TS, BF and lactose in this study compare favourably with 14.92±0.27; 5.21±27 and 4.65±0.13% respectively reported by Ahamefule (2005) with pigeon pea meal based diets. Mean milk protein value (4.64±0.09%) obtained in this study was however superior to that reported by Akinsoyinu (1974) but comparable to 4.44±0.07% (Ahamefule, 2005) and slightly lower than 4.76±0.12% (Ukpabi, 2007). Differences in dietary planes and compositions have been reported to be responsible for variations in milk yield and composition observed even within the same breed (Ibeawuchi, 1985; Akpa et al., 2001; Ahamefule, 2005; Williams et al., 2010).

The ash content in the milk differed significantly between diets (P<0.05). However, the ash contents increased with increasing level of AYBM in the various diets. Values obtained were 0.88; 0.91; 0.99 and 1.04% for diets T_1, T_2, T_3, and T_4 respectively. The mean value of 0.95±0.09% obtained in this study was higher than 0.82±0.01% and 0.55±0.14% reported by Akinsoyinu (1974) and Ahamefule et al. (2003) respectively, but comparable to 0.93±0.08% reported by Ahamefule and Ibeawuchi (2005) for WAD goats, and 0.94±0.05 obtained for WAD sheep (Ahamefule et al., 2003).

Milk energy (MJ/Kg) was significantly (P<0.05) higher in lactating does fed AYBM diets than the control group. Does fed diet T_2 (10% AYBM) recorded the highest energy concentration in milk (3.91) while the control group posted the least value (3.62). A strong positive relationship exists between BF, SNF and energy (Jennes, 1980). This implies that milk high in BF percent should be expected to be high in energy as well. This observation however did not seem to agree with the milk energy values obtained in this study. Milk samples from does fed 10% AYBM diet had the least BF content (4.44) but highest milk energy (3.91MJ/kg) because SNF was highest in the milk of diet T_2. Milk energy is a function of BF, SNF and milk volume in the milk of (Ibeawuchi, 1985; Ahamefule and Ibeawuchi, 2005) hence the result obtained for diet T_2. Though the goats fed 10% AYBM diet had the least BF content, the group produced averagely the highest volume of milk (3.26kg) and highest SNF (9.96%) among the treatment groups which may be responsible for the significantly higher milk energy obtained for animals in the group. However, the mean milk energy value (3.76±0.15MJ/kg) obtained for WAD goats in this study was higher than 1.96±0.17 MJ/kg reported by Ahamefule (2005), but seem to agree with the findings of Ukpabi (2007).

CONCLUSION AND RECOMMENDATION

From the results of this study, it can be concluded that cassava peel meal based – diets supplemented with African yambean concentrate supported optimum colostrum and milk composition without deleterious effects. Therefore, it is recommended that 20% inclusion level of African yambean concentrate in cassava peel meal based-diets is ideal for effective colostrum yield and milk composition in West African Dwarf Does. Farmers are strongly advised to utilize these feedstuffs in diets meant for small ruminants in the tropical rainforest zone of Nigeria, where these ingredients are abound.

DECLARATIONS

The work is original and has not been submitted elsewhere for publication. The authors declaration form has been signed by the authors as recommended.

Corresponding Author
E-mail: pascalozung@yahoo.com, Tel: +2348062246745

Authors' Contribution
Anya M.I. and Ozung P.O. contributed equally in the design and conceptualization of the research work. The field work and laboratory aspects of the research were carefully handled by both authors, likewise the statistical analyses and finally documentation of the research findings. All authors read and approved the final manuscript.

Conflict of interests
The authors declare that there is no conflict of interest in this work.

REFERENCES

Ahamefule FO, Ibeawuchi JA and Ejiofor CA (2003). A comparative study of the constituent of cattle, sheep and goats milk in a hot humid environment. *Discovery and Innovation*, 15:64-68.

Ahamefule FO, Ibeawuchi JA and Okonkwo CI (2004). Comparative evaluation of the constituent of colostrum and milk of the West African Dwarf sheep and goats reared in a humid tropical environment. *Nigerian Agricultural Journal,* 35:118-126.

Ahamefule FO (2005). Evaluation of pigeon pea-cassava peel based diets for goat production in south eastern Nigerian. Ph.D Thesis, College of Animal Science and Animal Production, MOUAU, Umudike Nigeria.

Ahamefule FO and Ibeawuchi JA (2005). Milk yield and composition of West African Dwarf (WAD) goes fed pigeon-pea-cassava peel based diets. *Journal of Animal and Veterinary Advances*, 4(2): 991-999.

Akinsoyinu AO (1974). Studies in protein and energy utilization by the West African Dwarf Goats. Ph.D. Thesis. University of Ibadan, Nigeria. Pp. 127-181.

Akinsoyinu AO, Mba AU and Olubajo FO (1977). Studies on milk yield and composition of West African Dwarf goats in Nigeria. *Journal of Dairy Research*, 44: 57-62.

Akpa GN, Osulor PN, Nwani PI and Lakpini CAM (2001). The influence of milking frequency and efficiency of milk production in red Sokoto goats. *J. sustain. Agric. Environ.* 3 (2): 127-133.

Allen RS (1977). Lipid metabolism. In: Swenson, M.J. (Ed.) *Duke's Physiology of Domestic Animals,* 9th Edition. Comstock. Publishing Associates, Ithaca, Pp. 336-345.

Anon (1990). The History of Dairy Development in Nigeria National seminar on Dairy Production. Hill Station Hotel, Jos, 9-10th August, 1990.

Anya MI (2012). Evaluation of African yambean (*Sphenostylis stenocarpa*) seed meal as feedstuff for goat production in the humid zone of Nigeria, Ph.D Thesis MOUAU, Umudike, Abia State, Nigeria.

AOAC (1980). Association of Official Analytical Chemists. *Official Methods of Analysis*, 13th edition, Washington, D.C

AOAC (2000). Association of the Official Analytical Chemists. *Official Methods of Analysis*, 17th edition, Washington D.C.

Csapo J, Csapo- kiss Z, Martin TG, Szentpeteri J and Wolf G (1994) Composition of colostrum from goats, ewes and cows producing twins. *International Dairy Journal*, 4 (5): 445-458.

Erdman RA and Verner M (1995). Fixed yield responses to increasing milking frequency. *Journal of dairy science*, 78: 1199-1203.

FAO (1991). Food and Agriculture Organization of the United Nations; Livestock and Livestock Products. Quarterly Bulletin of Statistics, 4(3):39, FAO. Rome, Italy.

Ibeawuchi JA (1985). A study on variation of some milk constituents of Friesian cows at Vom, *Nigerian Journal of Animal Production Resources*, 5: 113-124.

Jennes R (1980). Composition and characteristics of goat milk, Review: *J. Dairy Science,* 63: 1605-1630.

MAFF (1975). Ministry of Agriculture, Food and Fisheries. Energy Allowance and Feeding Systems for Ruminants. Technical Bulletin 33. H.M.S.O. London

Marrier J and Boulet M (1959). Direct analysis of lactose in milk and serum. *J. Dairy Science* 42: 1390-1391.

Mathewman RW (1993). *Dairying*. Macmillan Tropical Agricultural services. University of Edinburgh, U.K.

Matenga VR, Ngongoni NT, Titterton M and Maasdorp BV (2003). Mucuna seed as a feed ingredient for small ruminant and effect of ensiling on its nutritive value. *Tropical and sub-tropical Agroecosystem,* 1: 97-105.

McDonald P, Edwards RA, Greenhalgh JFD and Morgan CA (1995). *Animal Nutrition*. 5th edition, Longman Publishers, Edinburgh U.K. 607Pp.

NMA (2018). Nigerian Meteorological Agency, Weather Report, Margaret Ekpo International Airport, Calabar, Nigeria.

Nuru S (1985). Trends in small ruminant production in Nigeria. Adu, I.F., Osinowo, A.O., Taiwo, B.B.A and Alhassan, W.S. (eds.). *Proceedings of the National Conference on Small Ruminant Production*, Zaria Nigeria, 6th-10th October, Pp. 35-51.

Okonkwo CI (2001). Comparative evaluation of the constituent of colostrum and milk *of* the West African Dwarf sheep and goats in a humid tropical environment. B. Agric. Thesis. MOUAU, Umudike- Abia State, Nigeria.

Preston TR (1986). Better utilization of crop residence and by-products in animal feeding research guidelines. 2: A practical manual for research workers. FAO Animal production and health paper 50/2 Pp. 23-24.

Rai MM (1980). *Diary: Chemistry and Animal Nutrition*. Kelyani Publishers, New Delhi.

Ruan NS (1982). The emerging role of goats in world food production. *Proceedings of third International Conference in Goat production and Diseases*, Tucson, Arizona p.133.

RIM (1991). Nigerian National Livestock Survey, Federal Department of Livestock and Pest Control Services, Abuja, Nigeria. P. 287.

SAHEL (2015). How fresh is our milk? Sahel capital partners and advisory limited. Vol. 9 P.1 Jan, 2015.

Steel RGD and Torrie JH (1980). *Principles and Procedures of Statistics. A biometric approach*. 2nd edition, McGraw Hill Book Co. Inc., New York U. S. A.

Steele M (1996). *Goats: The Tropical Agriculturist*. Macmillan Publishers, Oxford.

Sutton JD (1981). Concentrate feeding and milk composition. In: *Recent Advances in Animal Nutrition*. Haresign. W. (Ed). Butterworth, London. Pp. 35-45.

TT (2010). Tropical Traditions, Goats milk and colostrum. MT Capra whole food nutritionals

TMN HEALTH (2009). Goatein, IG Protein with Colostrum.

Ukpabi UH (2007). Evaluation of mucuna seed meal based diets for goat production in south-eastern Nigeria. Ph.D Thesis. MOUAU, Umudike, Abia State, Nigeria.

Williams TJ, Osinowo AO, Onadeko SA, Smith OF, James IJ, Ikeobi C.O.N and Onagbesan OM (2010). Effect of time of milking on milk yield in West African Dwarf goats. *Proceedings of 35th Annual Conference of Nigerian Society for Animal Production*, 14th -17th March, University of Ibadan, Nigeria. Pp. 540-542.