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Milk Yield (Offtake), Composition and Microbiological Quality in West African Dwarf Goats Fed Concentrate Diets with Varying Levels of Moringa oleifera Leafmeal and Seedmeal

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Abstract
The study was carried out to investigate the effect of feeding varying inclusion levels of *Moringa oleifera* leafmeal (MOL) and defatted *Moringa oleifera* seedmeal (DMOS), on milk yield (offtake), milk proximate composition and milk microbilolgical quality of sixteen lactating West African Dwarf (WAD) goats. The completely randomized design with four dietary treatments and three does per treatment was used. Average milk yield ranged from 116.00 g/day to 186.00 g/day (early lactation), 78.00 to 170 g/day (mid lactation) and 32.00 to 184.00 g/day (late lactation). Highest mean milk yield was 174.00 g/day for diet T3 (0.30% (MOL) and 0% (DMOS)). Ranges of the milk proximate composition were: 13.50 to 17.22% (total solids), 3.60 to 6.05% (fat), 3.17 to 5.45% (protein), 9.88 to 11.17% (solids-not-fat), 0.73 to 0.82% (ash) and 4.93 to 6.36% (lactose). There exist significant ($P<0.01$), but negative correlations between milk yield versus fat and protein ($r = - 0.691, - 0.643$ respectively). Total viable bacterial counts ranged from 1.9×10^6 to 8.6×10^8 cfu/ml. Total coliform counts ranged between 3.7×10^6 and 3.3×10^9 cfu/ml. Total fungal counts ranged from 3.1×10^3 to 3.4×10^5 cfu/ml. This experiment revealed that the inclusion of *Moringa oleifera* leafmeal and seedmeal in the concentrate diets of lactating WAD goats resulted in highest mean milk yield (offtake) at the 0.30% (MOL) and 0% (DMOS) dietary level. The raw milk was of poor microbiological quality ($>5.0 \times 10^6$).
Keywords: Milk yield (offtake), quality, goats

1. Introduction

In Nigeria, the West African Dwarf goats are kept by smallholder farmers mainly for meat production since these goats are well known for multiple births with twins and triplets. These goats have low genetic potential for milk production, thus milk obtained from them are usually used as a source of milk offtake for household consumption (Tona *et al*., 2015a). These authors (Tona *et al*., 2015a), observed average milk yield of between 40.00 and 205.00 g/day in WAD goats. The values of 185.30 to 340.05 g/day were also reported for WAD goats in another research (Bawala *et al*., 2006). The low milk yield (offtake) values were attributed to the small body size of the WAD goat breed (Tona *et al*., 2015a). The ranges of values of the proximate composition of WAD goat milk reported in the research of Tona *et al*. (2015a) were as follows: 4.01 to 4.14 % fat, 3.47 to 3.76 % protein, 12.67 to 13.07 % total solids, 8.66 to 8.94 % solids-not-fat, 4.22 to 4.41 % lactose and 0.78 to 0.87 % ash. These authors fed 0 %, 20 % and 30 % dietary levels of palm kernel cake to WAD goats.

One of the major constraints to small ruminant production in Nigeria was mentioned to include inadequate and poor quality feed (Abdu *et al*., 2014). The ensiling of feedstuffs (such as *Panicum maximum* grass) is one of the ways of solving this and other problems like the seasonal scarcity of native pastures. There has been a search for the use of unconventional and less expensive feed ingredients to mitigate the problem of inadequate and poor quality feeds. *Moringa oleifera* leaves and seeds are noted for their high content of crude protein, essential vitamins, minerals and amino acids (Makkar and Becker, 1997; Gidamis *et al*., 2003). However, Akinbamijo *et al*. (2006) stated that the value of the *Moringa oleifera* tree and its benefits as a high quality supplement in ruminant feeding systems have not been fully known nor exploited.

Food products of animal origin play an important role in providing sufficient and balanced nutrition for human beings (Tasci, 2011). These authors (Tasci, 2011), further stated that milk is often described as a complete food because it contains protein, carbohydrates, fat, vitamins and minerals. Milk, although is very nutritious also serves as a good medium for the growth of many microorganisms, especially pathogenic bacteria. Good quality milk means that the milk is free from pathogenic bacteria, harmful toxic substances, and of good flavour with a normal composition, adequate in keeping quality and low in bacteria counts (Tasci, 2011). Raw milk, immediately after milking usually has bacterial counts below 10^2 ml^{-1}. However, milk contamination sources include the internal and external surfaces of the udder. Other external sources include skin of the lactating animal, milking equipment, workers hands and clothing and the use of contaminated water (Tasci, 2011). Other previous researchers (Gemechu *et al*., 2014), stated that the microbial load and types of bacteria found in milk shortly after milking are influenced by factors such as animal cleanliness and health, season,

ambient temperature, storage and the milker's personal health. Milk produced at smallholder farms in Nigeria is usually consumed or marketed without any form of pasteurization or quality control measures, thus it is necessary to investigate the microbial quality of the raw milk. Ahmed *et al*. (2016) also stated that undesirable microbes that are found in dairy products cause spoilage and these include coliform bacteria, lactic acid bacteria (such as *Staphylococcus aureus*) and yeasts and moulds.

Thus, the aim of this study is to evaluate the milk yield (offtake), proximate composition and milk microbial quality of WAD goats fed concentrate diets with varying inclusion levels of *Moringa oleifera* leafmeal and seedmeal.

2. Materials and Methods

2.1 Study Site and duration of the experiment

The experiment was carried out at the Goat Unit, Teaching and Research Farms Directorate, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria. This was during the period of about twenty weeks between June and November, 2015. Daily milk collection from the experimental goats was carried out for eighteen weeks.

2.2 Experimental Animals, Management and Experimental Design

Twelve lactating WAD goats in their second parity were used for the study. The animals were selected from one of the goat herds in the Goat Unit of the College Farm. The average initial body weight of the goats was 20.25 ± 0.75 kg and each doe with its kid(s) were housed in an individual well ventilated pen. The farm house is open sided, wooden, roofed and had slated floor. The completely randomized design with four dietary treatments and three does per treatment was employed.

2.3 Experimental Diets and Feeding

The does were offered weighed amounts of a basal diet of ensiled *Panicum maximum* grass (about 5% of their body weights) at 8.00 am. The concentrates were fed in four dietary treatment groups as follows: T1 (0% *Moringa oleifera* leafmeal (MOL) and 0% *Moringa oleifera* seedmeal (DMOS)), T2 (0.15% MOL and 0.15 % DMOS), T3 (0.30% MOL and 0% DMOS) and T4 (0% MOL and 0.30 % DMOS). The ingredients composition of the concentrate diets is presented in Table 1. Each experimental lactating doe was offered about 5% of its body weight (400 g/day) of the concentrate diets twice daily, at 8am and 1pm. Salt licks and water were provided *ad libitum*.

Table 1. Ingredients composition of concentrate diets at different inclusion levels of *Moringa oleifera* leafmeal (MOL) and defatted *Moringa oleifera* seedmeal (DMOS)

Ingredients	Dietary levels of *Moringa oleifera*			
	T1 (0% MOL and 0% DMOS)	T2 (0.15% MOL and 0.15% DMOS)	T3 (0.30% MOL and 0% DMOS)	T4 (0% MOL and 0.30% DMOS)
Maize	34.00	34.00	34.00	34.00
Palm kernel cake	30.00	30.00	30.00	30.00
Wheat offal	32.00	31.70	31.70	31.70
Bone meal	1.00	1.00	1.00	1.00
Salt	1.50	1.50	1.50	1.50
Premix	1.50	1.50	1.50	1.50
MOL	0.00	0.15	0.30	0.00
DMOS	0.00	0.15	0.00	0.30
Total	100.00	100.00	100.00	100.00

2.4 Milking of Lactating Goats

The hand milking of the goats was carried out once daily, between 8.00 and 9.00 am, for 18 weeks. The kids were separated from their dams at 7.00 pm the previous day to allow the does retain enough milk for the next morning milk production. Milk yield was measured using a calibrated measuring cylinder and the daily milk yield was recorded for each lactating goat. The milk of each experimental animal was also stored in sterilized sample bottles and kept in the refrigerator at about 4^{o}C and then taken to the laboratory for determination of milk proximate composition and milk microbiological quality.

2.5 Laboratory analysis of diets and milk samples

2.5.1 Chemical composition of diets

Chemical composition of the ensiled *Panicum maximum* grass and the concentrate diets at the four dietary levels was determined. Dry matter was determined by oven drying samples at 105^{o}C for 24 hours to a constant weight,

and ash by igniting the samples in a muffle furnace at 600^{o}C for 8 hours. Nitrogen, crude fibre and ether extract were determined according to the methods of AOAC (2005). Crude protein was calculated (N x 6.25) and NFE was also calculated (100 – (% CP + % CF + % EE + % Ash + % moisture)). Neutral detergent fibre (NDF) and acid detergent fibre (ADF) were measured by the methods of van Soest *et al.* (1991). Hemi cellulose (HC) was calculated (HC = NDF – ADF). Non fibrous carbohydrate was calculated (100 – (% NDF + %CP + %EE + % ash)).

2.5.2 Proximate composition of milk samples

Milk samples were analysed for proximate composition by analysing for total solids, fat (Gerber method), nitrogen and ash (AOAC, 2005). Percent protein (N X 6.38), solids-not-fat (%SNF) was calculated by difference (%SNF = %TS - % Fat). Percent lactose was determined by using Fehlings solution method (Triebold, 2000).

2.5.3 Analysis of microbiological characteristics of raw milk

The media used in the laboratory analysis of micro-biological properties of raw milk samples in this study included the following: MacConkey Agar for coliform organisms, Pseudomonas Agar for pseudomonas, Potato dextrose Agar for fungi, Nutrient Agar for aerobes, Mannitol salt Agar for staphylococcus and de Mannns Rogosa and Sharpe (MRS) for anaerobes.

2.5.4 Standard plate count

In the standard plate count, one ml of the milk sample (and in any dilution level) is dispensed into a sterile Petri dish using a sterile pipette. Then 15 – 20 mls of sterile nutrient agar is added and the two mixed thoroughly by swirling gently. The dish is then incubated in an incubator at 37^{o}C for 24 hrs. The number of colonies growing in the agar plate were then counted. (N.B.: This method is suitable for enumerating small number of bacteria, hence is suitable for low count samples. This is usually used for pasteurized milk or good quality raw milk.)

2.5.5 Isolation of microorganisms from the raw milk samples

One ml each of the milk samples were measured out and subjected to serial dilutions within the ranges of 10^{-1} and 10^{-4}. One ml of each sample was then thoroughly mixed with 9 mls of sterile distilled water to give 10^{-1} dilution. Then next, 1 ml of the 10^{-1} dilution was also pipetted out and mixed with another 9 mls of sterile distilled water, screw capped to give 10^{-2} and repeated to give 10^{-3} and 10^{-4} dilutions repeatedly. A sterile pipette was used to measure out 1 ml out of the 10^{-3} and 10^{-4} dilutions. It was pipetted into sterile Petri dishes and molten agar at 45^{o}C was poured onto it. It was swirled gently for even distribution of the inoculum in the agar. After solidification, the plates were then inverted and incubated in an incubator at 30^{o}C. Plates containing the nutrient agar were allowed to stay over night while that of potato dextrose agar was incubated for 3 days. The bacteria will grow on the nutrient agar while fungi will grow on the potato dextrose agar.

2.5.6 Total bacteria and fungi count and identification

This is done by counting the different colonies on the different agar plates after incubation and multiplying with the dilution factor. Identification of the isolates is done after examining the cultural, morphological, biochemical, physiological characteristics, including microscopic and macroscopic examination of the various isolates.

2.6 Statistical Analysis

Data collected were subjected to one way analysis of variance (ANOVA) procedure of SPSS (2012). Significant means were separated using the Duncan's multiple range test of the same software. Simple correlation analysis was also carried out using the method of SPSS (2012) statistical package. Mean differences were considered significant at $P<0.05$.

3. Results and Discussion

3.1 Chemical composition of experimental diets

The chemical composition of the ensiled *P. maximum* grass (basal diet) and that of the concentrate diets is presented in Tables 2 and 3. The dry matter contents of the diets are high and ranged from 90.30 to 91.20%. Dietary crude protein contents were also high and ranged between 13.20 and 22.70%. The ranges of other nutrients in the diets were as follows: 1.90 to 7.20% of ether extract; 13.50 to 15.60% of crude fibre; 3.22 to 8.30% ash content and the non fibrous carbohydrates contents were between 5.95 and 25. 18%. The crude protein contents of the diets were adequate and met the recommended range of 14 to 18% crude protein for lactating goats (NRC, 1981). These also satisfied the minimum of 8% crude protein necessary to provide the minimum ammonia levels required by rumen micro-organisms to support optimum rumen activity (Norton, 1995). The crude protein contents of diets T2, T3 and T4 could be seen to have been improved by the inclusion of the *Moringa oleifera* leafmeal and the defatted *Moringa oleifera* seedmeal. Similar increases in the crude protein content of diets were observed in the research of Tona *et al*. (2013) who included graded levels of *Moringa oleifera* leafmeal in the diets of West African Dwarf goats. The range of 3.22 to 8.30% ash content of the diets, observed in this study was within the range of 6.68 to 9.48% ash content recommended for ruminant feeding (Ogunbosoye *et al*., 2015). The crude fibre (CF), neutral detergent fibre (NDF) and acid detergent fibre (ADF) levels of the experimental diets ranged from 13.50 to 22.85% CF, 52.65 to 58.95% NDF and 37.05 to 40.44%

ADF. The CF content of the diets was within the range of 4.41 to 34.02% observed in the diets of lactating West African Dwarf goats by (Bawala *et al*., 2006) in a previous research. The nitrogen free extract (40.70 – 49.43%), hemi-cellulose (12.21 – 21.10%) and non fibrous carbohydrates (5.95 – 25.18%) in this current research were observed and these served as sources of energy for the experimental animals.

Table 2. Chemical composition of ensiled *Panicum maximum* grass (basal diet) fed to lactating West African Dwarf goats

Parameters	Percentage (%)
Dry matter	90.60
Crude protein	13.20
Ether extract	1.90
Crude fibre	22.85
Ash	3.22
Nitrogen free extract	49.43
Neutral detergent fibre	56.50
Acid detergent fibre	37.75
Hemi-cellulose	18.75
Non fibrous carbohydrates	25.18

Table 3. Chemical composition of concentrate diets at different inclusion levels of *Moringa oleifera* leafmeal (MOL) and defatted *Moringa oleifera* seedmeal (DMOS)

	Dietary levels of *Moringa oleifera*			
Parameters (%)	T1 (0% MOL and 0% DMOS)	T2 (0.15% MOL and 0.15% DMOS)	T3 (0.30% MOL and 0% DMOS)	T4 (0% MOL and 0.30% DMOS)
Dry matter	90.30	90.60	91.20	90.90
Crude protein	18.50	19.50	22.70	20.10
Ether extract	4.70	3.60	7.20	5.20
Crude fibre	15.60	14.50	13.50	15.00
Ash	8.30	7.10	7.00	7.70
Nitrogen free extract	43.30	45.90	40.70	42.90
Neutral detergent fibre	58.95	58.15	57.15	52.65
Acid detergent fibre	39.34	37.05	37.66	40.44
Hemi-cellulose	19.61	21.10	19.49	12.21
Non fibrous carbohydrates	9.55	11.65	5.95	14.35

3.2 Milk Yield of the Lactating West African Dwarf Goats

The milk yield of the West African Dwarf goats during the early, mid and late lactation periods is shown in Table 4. There were significant ($P<0.05$) differences among the milk yield values at the different inclusion levels of the *Moringa oleifera* leafmeal (MOL) and the defatted *Moringa oleifera* seedmeal (DMOS). There was no definite trend in the milk yield values during the early, mid and late lactation periods. However, mean milk yield could be seen to be significantly highest in the T3 (0.30% MOL and 0% DMOS) with the value of 174.00 g/day, which is followed by T4 (0%MOL and 0.30%DMOS) with 146.00 g/day, next is T2 (0.15%MOL and 0.15%DMOS) with 124.00 g/day and the lowest mean milk yield was observed for T1 (0% MOL and 0% DMOS) with76.66 g/day. It could be inferred that the inclusion of the *Moringa oleifera* leafmeal and the defatted *Moringa oleifera* seedmeal in the concentrate diets resulted in higher milk yield. Other previous authors, Tona *et al*., (2015a) observed average milk yield of between 40.00 and 205.00 g/day in WAD goats. The values of 185.30 to 340.05 g/day were also reported for WAD goats in another research (Bawala *et al*., 2006). The low milk yield (offtake) values were attributed to the small body size of the WAD goat breed (Tona *et al*., 2015a).

Table 4. Milk Yield (offtake) (g/day) of West African Dwarf goats fed different inclusion levels of *Moringa oleifera* leafmeal (MOL) and defatted *Moringa oleifera* seedmeal (DMOS)

		Dietary levels of *Moringa oleifera*				
Stage of lactation	Week of lactation	T1 (0% MOL and 0% DMOS)	T2 (0.15% MOL and 0.15% DMOS)	T3 (0.30% MOL and 0% DMOS)	T4 (0% MOL and 0.30% DMOS)	SEM
Early	1st - 6th	120.00^{c}	116.00^{d}	168.00^{b}	186.00^{a}	4.17
Mid	7th - 12th	78.00^{d}	122.00^{b}	170.00^{a}	114.00^{c}	2.67
Late	13th - 18th	32.00^{c}	134.00^{b}	184.00^{a}	138.00^{b}	5.47
Mean		76.66^{d}	124.00^{c}	174.00^{a}	146.00^{b}	4.10

^{a,b,c,d} Means in the same row with different superscripts are significantly different (P<0.05)

3.4 Proximate Composition of Raw Milk and Pearson Correlation between Milk Yield (Offtake) and Proximate Composition

The proximate composition of raw milk (Table 5), and the Pearson correlations between milk yield (offtake) and some proximate components (Table 6) are as presented. The experimental animals fed diet T1 (0% MOL and 0% DMOS) had the highest (P<0.05) percentages of total solids (17.22%), fat (6.05%), protein (5.45%) and solids-not-fat (11.17%). While the experimental animals fed diets T2, T3 and T4 (with varying levels of MOL and DMOS) had lower values of milk proximate components except for lactose. These probably showed that diet T1 (without *Moringa oleifera* leafmeal or seedmeal) served as better sources of most of the milk nutrients manufacture in the udder. The lactose value of 6.36% was highest (P<0.05) at the T3 (0.30% MOL and 0% DMOS). The ranges of values for the proximate composition of raw milk of WAD goats observed in the current study are comparable to the values of 3.27% crude protein, 4.74% fat, 11.63% total solids and 0.70% ash for WAD goat milk, reported in the research of Zahraddeen *et al*. (2007). As shown in Table 6, there exist significant (P<0.01), but negative correlations between milk yield versus fat and protein (r = - 0.691, - 0.643 respectively). Similarly, Tona *et al*. (2015b) observed strong and negative correlations between total milk yield versus milk fat and milk protein (r = - 0.998; - 0.599 respectively) in grazing White Fulani cows fed dietary levels of soya milk residue. Significant (P<0.01) and positive correlations among the milk proximate components are also found as presented in Table 6.

Table 5. Proximate composition of milk of West African Dwarf goats

Parameters (%)	Dietary levels of *Moringa oleifera* (%)				SEM
	T1 (0% MOL and 0% DMOS)	T2 (0.15% MOL and 0.15% DMOS)	T3 (0.30% MOL and 0% DMOS)	T4 (0% MOL and 0.30% DMOS)	
Total solids	17.22^{a}	13.50^{b}	14.10^{b}	13.51^{b}	1.053
Fat	6.05^{a}	3.62^{b}	3.67^{b}	3.60^{b}	0.017
Protein	5.45^{a}	3.17^{c}	3.25^{c}	3.67^{b}	0.022
Solids-not-fat	11.17^{a}	9.88^{b}	10.43^{ab}	9.91^{b}	0.828
Ash	0.79	0.80	0.82	0.73	0.017
Lactose	4.93^{c}	6.14^{ab}	6.36^{a}	5.51^{bc}	0.682

^{a,b,c} Means in the same row with different superscripts are significantly different (P<0.05);
Means without superscripts are not significantly different (P>0.05)

Table 6. Pearson correlations of milk yield and composition of West African Dwarf goats

Variables	Milk yield	Total Solids	Fat	Protein	Solids-not-fat	Ash
Milk yield						
Total solids	-0.485					
Fat	-0.691**	0.887**				
Protein	-0.643**	0.757**	0.952**			
Solids-not-fat	-0.155	0.878**	0.557**	0.373		
Ash	0.116	0.501**	0.122	-0.101	0.774**	
Lactose	0.430	0.056	-0.391	-0.594**	0.506**	0.056

**= P<0.01

3.5 Microbiological Quality of Raw Milk of West African Dwarf Goats

The total viable bacterial counts varied from 1.9 x 10^6 cfu/ml in T4 (0%MOL and 0.30%DMOS) to 8.6 x 10^8 cfu/ml in T3 (0.30%MOL and 0%DMOS) and the organisms *Bacillus species*, *Pseudomonas species* and *Staphylococcus species* were identified as shown in Table 7. The total viable bacterial counts exceeded the grade of between 1.0 x 10^6 and 5.0 x 10^6 cfu/ml and could be graded as fair to poor (see Table 8). Similarly, in an earlier research work, Adetunji *et al*. (2003) reported high total viable bacteria count of 3.3 x 10^{10} cfu/ml in market sold fermented milk and the bacteria species identified included *Bacillus mycoides* and *Staphylococcus aureus*. Also, in this research, the total coliform counts were high and ranged from 3.7 x 10^6 to 3.3 x 10^9 cfu/ml and the coliform organisms identified were *Aeromonas species* and *Salmonella species*. The observed values of total coliform counts in the current study were above the safety limit of over 5.0 x 10^6 cfu/ml (as shown in Table 8), and this shows that the milk of the experimental goats were of poor hygienic quality. Similarly, higher coliform count of 3.36 x 10^{11} cfu/ml was reported by other researchers (Adewumi and Idowu, 2014) in the raw milk from hand milked White Fulani cows. Two species of fungal organisms, *Rhizopus species* and *Aspegiillus species* with total fungal counts ranging from 3.1 x 10^3 to 3.4 x 10^5 cfu/ml were detected in the present research. However, these counts were below the safety limit of 5.0 x 10^6 and could be rated to be within the acceptable grades. In the study by Adewumi and Idowu (2014), there were observed higher yeast and mould fungi counts of 5.31 x 10^{11} cfu/ml in raw milk. The presence and identification of high cfu/ml counts of bacteriae, coliforms and fungi in the raw milk samples harvested in this study showed the need for the pasteurization of the raw milk in order to ensure that it is safe for human consumption.

Table 7. Microbiological qualities of raw milk of West African Dwarf goats

	Dietary levels of *Moringa oleifera*			
Parameters	T1 (0% MOL and 0% DMOS)	T2 (0.15% MOL and 0.15% DMOS)	T3 (0.30% MOL and 0% DMOS)	T4 (0% MOL and 0.30% DMOS)
Total viable bacterial count (CFU/ml)	1.8 x 10^7	5.0 x 10^6	8.6 x 10^8	1.9 x 10^6
Organism identified	*Bacillus sp.*, *Pseudomonas sp.*	*Bacillus sp.*, *Pseudomonas sp.*	*Bacillus sp.*, *Pseudo-monas sp.*, *Staphylococcus sp.*	*Bacillus sp.*, *Pseudomonas sp.*
Total coliform count (CFU/ml)	3.3 x 10^9	3.7 x 10^6	1.8 x 10^8	2.3 x 10^8
Organism identified	*Aeromonas sp.*, *Salmonella sp.*	*Aeromonas species*	*Aeromonas species*	*Aeromonas species*
Total fungal count (CFU/ml)	1.9 x 10^4	3.1 x 10^3	2.7 x 10^4	3.4 x 10^5
Organism identified	*Rhizopus sp.* , *Aspergiillus sp.*	*Rhizopus sp.* , *Aspergiillus sp.*	*Rhizopus sp.* , *Aspergiillus sp.*	*Rhizopus sp.* , *Aspergiillus sp.*

Table 8. International standards index (ISI) specifications for raw milk
(Source: Kutty and Khamer, 2004)

Standard plate count	Grade
Below 2.0 x 10^5	Very good
Between 2.0 x 10^5 and 1.0 x 10^6	Good
Between 1.0 x 10^6 and 5.0 x 10^6	Fair
Over 5.0 x 10^6	Poor

4. Conclusion

This research has shown that the inclusion of *Moringa oleifera* leafmeal and seedmeal in the concentrate diets of West African Dwarf goats resulted in highest mean milk yield (offtake) at the 0.30% *Moringa oleifera* leafmeal and 0% defatted *Moringa oleifera* seedmeal dietary level. Highest percentages of milk nutrients (total solids, fat, protein and solids-not-fat) were observed in the experimental goats fed the diet without the inclusion of *Moringa oleifera* leafmeal (0%) and defatted *Moringa oleifera* seedmeal (0%). Strong and negative correlations were observed between the milk yield (offtake) per day versus milk fat and milk protein (r = - 0.691, - 0.643 respectively). The presence of the high cfu/ml counts of bacteriae, coliforms and fungi in the raw milk of the experimental West African Dwarf goats suggest the need for the pasteurisation of the raw goat milk in order to ensure that it is fit for human consumption.

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