



**ORIGINAL RESEARCH ARTICLE**

**Quality attributes of raw milk from White Fulani cattle in different locations of Yewa division in Ogun State, Nigeria**

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**ABSTRACT**

This study was conducted to assess the quality of raw milk from four locations of agro herdsmen settlement in Yewa zone of Ogun State. Thirty-two lactating White Fulani cows at first phase of lactation were used for this study. Eight cows were milked on each location which represented the treatments: TL<sub>1</sub> = Afobaje, TL<sub>2</sub> = Awela, TL<sub>3</sub> = Igbo, TL<sub>4</sub> = Isa Ope. The physical, chemical and sensory properties of raw milk were determined in a completely randomised design at ( $p < 0.05$ ). Data were analysed using analysis of variance and the means separated. The sensory characteristics were evaluated on a 5-point hedonic scale (1 = disliked extremely and 5 = liked extremely). The results of the physical properties showed that milk from TL<sub>2</sub> had the least foreign bodies and higher colour intensity. Milk samples from TL<sub>2</sub> and TL<sub>4</sub> had higher chemical composition (Moisture, Protein, Fat, Ash, Lactose and NPN) than milk from other locations, TL<sub>4</sub> had lower ( $p < 0.05$ ) microbial load. The sensory attributes (Colour, Flavour, Taste, Odour and Overall Acceptability) of milk from TL<sub>2</sub> were adjudged the most preferable and the milk was highly accepted. It was concluded that milk from TL<sub>2</sub> was preferred and recommended for consumption.

**Keywords:** Raw milk, Milk quality, White Fulani cattle, Yewa division

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**INTRODUCTION**

In most West African countries, white Fulani or “Bunaji” cattle breed provides more than 90% of the total annual domestic milk output (Walshe *et al.*, 1991). Cow milk is preferred as it contains high levels of protein, vitamins and minerals necessary for human body (Lindmark *et al.*, 2003). However, the nutrient composition of milk varies due to the seasonal variation and lactation period (Sevi *et al.*, 2004). Another major factor that affect milk composition is environmental temperature as reported by Sevi (2001) that high ambient temperature adversely affected the yield and composition of milk. Forages consumed by the animals prior and during lactation also has significant effect on milk nutrient composition as low quality forage intake cause reduction in milk nutrient (Belewu, 2006). Both environmental temperature and forage quality that affect milk composition and quality were reported as due to

regional and seasonal variations (Lacroix *et al.*, 1996). There is dearth of information on the regional or locational effect on the quality of white Fulani raw milk in Yewa zone of Ogun State.

**MATERIALS AND METHODS**

**Location of the study**

This study was conducted on farm among the agro-pastoralists that settled in Yewa zone of Ogun state in South western Nigeria. Yewa zone falls within latitude 7°15’N and longitude 3°3’E in a deciduous/derived savannah (Onakomaiya *et al.*, 1992).

**Animals and their management**

Thirty-two white Fulani cattle (Bunaji cows) breed kept by Fulani herdsmen, 8 cows from each location (4 locations) were used for this study.

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They were herded to the field in the morning after milking to graze on natural forages and were returned in the evening to the homestead.

### Milking procedure

Partial milking was done manually on the cows using hands between 9 and 10 am. The calves were used to stimulate milk let-down before milking the cows (Belewu, 2006).

### Sample collection

Raw milk samples were collected from white Fulani cows at 4 different locations of the herdsmen settlement, each location represented a treatment thus:

Afobaje – TL<sub>1</sub>

Awela – TL<sub>2</sub>

Igbo – TL<sub>3</sub>

Isaope – TL<sub>4</sub>

### Processing of raw milk

Raw milk was poured into a clean pot and heated (pasteurized) on a charcoal fire at 62°C for 15 minutes and cooled to 4°C (Belewu, 2006).

### Measurement of milk parameters

**Physical characteristics of milk:** The freezing and boiling points, specific gravity, foreign bodies in the milk and pH were determined following the procedures of AOAC (2000) and Belewu, (2006).

**Chemical characteristics:** The proximate composition and biochemical contents of the milk were determined according to AOAC (2000).

**Microbiological test:** This was carried out following the APHA (1992) procedures.

**Sensory evaluation:** The sensory evaluation of milk was carried out with 5-man taste panel using a score form. The panel evaluated the milk for colour, flavour, taste, odour and overall acceptability on a 5-point hedonic scale on which

1= disliked extremely and 5 = liked extremely following the procedures of Iwe (2010).

## RESULTS AND DISCUSSION

The physical properties of raw milk from four different locations in Yewa division of Ogun state are shown on Table 1. Significant ( $p < 0.05$ ) differences existed in the freezing point across the four locations with milk from Igbo (TL<sub>3</sub>) having higher ( $p < 0.05$ ) freezing point (-1.67) than milk from other three locations. Raw milk colour was significantly ( $p < 0.05$ ) higher in milk from Awela location two (TL<sub>2</sub>) compared with milk from the three other locations, while it had lower percentage ( $p < 0.05$ ) foreign bodies (0.01%). The results of milk freezing point, colour and foreign bodies in this study were in tandem with the report of Belewu (2006) who found that good milk would possess the physical attributes as obtained in the results of this study irrespective of the location or environment in which the milk is produced within the tropics. This shows that milk obtained from location TL<sub>2</sub> was good enough for use in terms of physical properties that were tested.

Table 2 shows the results of environmental factors in the studied area. The environmental factors that prevailed in TL<sub>2</sub> location, also favoured the physical quality of milk from that treatment location as the temperature was mild (20°C) and the humidity also appropriate (84%) for both the vegetation cover and the animals physiological make up. Table 3 presents the results of chemical properties of raw milk from White Fulani cattle in different locations of Yewa division in Ogun State. There were significant ( $p < 0.05$ ) differences in the proximate composition of milk due to location factor. Protein and ash contents of milk were significantly ( $p < 0.05$ ) higher in milk from locations TL<sub>2</sub> and TL<sub>4</sub> (Awela and Isaope) respectively, while moisture and fat contents were not significant ( $p > 0.05$ ) across the four locations.

**Table 1: Physical properties of raw milk from white Fulani cattle in different locations**

Variable	TL <sub>1</sub>	TL <sub>2</sub>	TL <sub>3</sub>	TL <sub>4</sub>	SEM
Freezing point (°C)	-2.17 <sup>b</sup>	-2.17 <sup>b</sup>	-1.67 <sup>a</sup>	-2.67 <sup>b</sup>	0.14
Boiling point (°C)	102.17	102.33	102.17	102.00	0.10
pH	6.22	6.20	6.30	6.28	0.19
Raw milk colour	2.67 <sup>b</sup>	3.85 <sup>a</sup>	2.17 <sup>b</sup>	2.10 <sup>b</sup>	0.17
Specific gravity	1.05	1.06	1.06	1.06	0.00
Foreign bodies (%)	0.02 <sup>b</sup>	0.01 <sup>c</sup>	0.02 <sup>b</sup>	0.03 <sup>a</sup>	0.00

Means on the same row with different superscripts are statistically significant ( $p < 0.05$ )

**Table 2: Environmental factor at four locations used**

Environmental factor	TL <sub>1</sub>	TL <sub>2</sub>	TL <sub>3</sub>	TL <sub>4</sub>
Temperature	23	20	21	20
Relative Humidity (%)	88	84	82	86
Vegetation cover	<i>Panicum maximum</i>	<i>Panicum maximum</i>	<i>Panicum maximum</i>	<i>Panicum maximum</i>

**Table 3: Chemical properties of raw milk from white Fulani cattle in different locations**

Variable	TL <sub>1</sub>	TL <sub>2</sub>	TL <sub>3</sub>	TL <sub>4</sub>	SEM
Moisture (%)	93.48	83.65	82.87	83.57	0.09
Protein (%)	3.48 <sup>b</sup>	4.59 <sup>a</sup>	3.48 <sup>b</sup>	4.49 <sup>a</sup>	0.02
Fat (%)	3.48	3.40	3.68	3.52	0.02
Ash (%)	0.53 <sup>b</sup>	0.67 <sup>a</sup>	0.57 <sup>b</sup>	0.60	0.01
Lactose (%)	4.15 <sup>b</sup>	5.48 <sup>a</sup>	4.37 <sup>b</sup>	4.22 <sup>b</sup>	0.02
NPN (%)	0.04 <sup>b</sup>	0.05 <sup>a</sup>	0.03 <sup>c</sup>	0.05 <sup>a</sup>	0.00
Ca <sup>2+</sup>	135.83 <sup>c</sup>	144.17 <sup>a</sup>	132.50 <sup>d</sup>	141.17 <sup>b</sup>	1.06
Fe <sup>2+</sup> (mg/100g)	0.68 <sup>b</sup>	0.72 <sup>a</sup>	0.65 <sup>b</sup>	0.52 <sup>c</sup>	0.02
PO <sub>4</sub> <sup>-</sup> (µg/100g)	84.17 <sup>b</sup>	92.83 <sup>a</sup>	84.50 <sup>b</sup>	80.17 <sup>c</sup>	1.04
Vit A (µg/100g)	71.67 <sup>d</sup>	85.00 <sup>b</sup>	74.17 <sup>c</sup>	85.83 <sup>a</sup>	1.30
Vit C (mg/100g)	2.03	2.13	2.32	2.48	0.04
Thiamine ((µg/100g)	3.83 <sup>b</sup>	5.50 <sup>a</sup>	4.33 <sup>b</sup>	5.47 <sup>b</sup>	0.02
riboflavin(µg/100g)	101.70 <sup>b</sup>	106.70 <sup>a</sup>	98.30 <sup>c</sup>	88.30 <sup>d</sup>	0.02
Niacin (µg/100g)	78.30 <sup>a</sup>	78.30 <sup>a</sup>	68.30 <sup>a</sup>	65.00 <sup>c</sup>	0.02

Means on the same row with different superscripts are statistically significant ( $p < 0.05$ )

Milk sugar (lactose) was significantly ( $p < 0.05$ ) higher in milk from location TL<sub>2</sub> as well as non-protein nitrogen (NPN), vitamins and minerals that were tested for in this study followed by those of milk from location TL<sub>4</sub> and were least ( $p < 0.05$ ) in milk from location TL<sub>3</sub>. These results could be due to the nutritional composition of the forage fed to the cows since the same grass *Panicum maximum* was prevalent at the four locations where this study was conducted it could also be as a result of the physiological well-being of the animal converting the feed into milk

based on the environmental conditions in each of the locations as indicated by Adewumi (1997). The microbial properties of milk from the four locations are shown on Table 4. There were significant ( $p > 0.05$ ) differences in the microbial loads of milk from four locations studied milk from location TL<sub>4</sub> had highest ( $p < 0.05$ ) microbial load either total viable fungal or coliform counts followed by milk from location TL<sub>1</sub> while milk from location TL<sub>2</sub> had the least ( $p < 0.05$ ) microbial loads. Many factors could be responsible for these results. One of such is the

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management practice by the herdsmen which could bother on the disease management of the animals. If any of the animals is infected, the microbial load could be high on the other hand, the environment, the hands of the milkers as well as the containers in which the milk was stored could contribute to the volume of microbe in the milk as indicated on Table 5. The result obtained from this study corroborated with the findings of Belewu *et al* (2005) who reported that handling of milk during preparation of yoghurt had influence on the compositional and organoleptic quality of the trial product. Milk from location

TL<sub>2</sub> had higher ( $p < 0.05$ ) colour intensity, flavour, taste and overall acceptability scores and least ( $p < 0.05$ ) odour score compared with milk samples from other three locations tested in this study (Table 6).

The taste panellists high score for milk from location TL<sub>2</sub> might be connected with high colour, taste, flavour and reduced odour for the milk sample based on the hedonic scale which states that 6 – 9 score represent that the product is liked extremely by the taste panellists. The results were in tandem with the finding of Agabriel *et al.* (2004).

**Table 4: Microbiological properties of raw milk from white Fulani cattle in different locations**

Variable	TL <sub>1</sub>	TL <sub>2</sub>	TL <sub>3</sub>	TL <sub>4</sub>	SEM
TVC(cfu/g)	3.60 x 10 <sup>5a</sup>	2.15 x 10 <sup>5b</sup>	2.50 x 10 <sup>5b</sup>	3.28 x 10 <sup>5a</sup>	0.21
TFC(cfu/g)	5.20 x 10 <sup>3b</sup>	3.22 x 10 <sup>3c</sup>	6.43 x 10 <sup>2a</sup>	6.28 x 10 <sup>2a</sup>	0.46
TCC(cfu/g)	1.55 x 10 <sup>4b</sup>	1.20 x 10 <sup>4b</sup>	1.53 x 10 <sup>4b</sup>	7.97 x 10 <sup>3a</sup>	0.60

Means on the same row with different superscripts are statistically significant ( $p < 0.05$ )

TVC = Total viable count, TFC = Total fungal count

TCC = Total coliform count

**Table 5: Microbial Organisms Isolated from Raw Milk**

Variable	TL <sub>1</sub>	TL <sub>2</sub>	TL <sub>3</sub>	TL <sub>4</sub>
TVC(cfu/g)	<i>Aeromonas</i> spp <i>Pseudomonas</i> spp	<i>Aeromonas</i> spp <i>Pseudomonas</i> spp	<i>Aeromonas</i> spp <i>Pseudomonas</i> spp <i>Protens</i> spp	<i>Aeromonas</i> spp <i>Pseudomonas</i> spp
TFC(cfu/g)	<i>Aspergillus</i> spp <i>Penicillium</i> spp <i>Rhizopus</i> spp	<i>Candida</i> spp <i>Rhizopus</i> spp	<i>Penicillium</i> spp <i>Rhizopus</i> spp	<i>Candida</i> spp <i>Rhizopus</i> spp
TCC(cfu/g)	<i>Aeromonas</i> spp <i>Pseudomonas</i> spp <i>Protens</i> spp	<i>Aeromonas</i> spp <i>Pseudomonas</i> spp	<i>Aeromonas</i> spp <i>Pseudomonas</i> spp <i>Protens</i> spp	<i>Aeromonas</i> spp <i>Pseudomonas</i> spp <i>Protens</i> spp

TVC =Total viable counts, TFC = Total fungal counts, TCC = Total coliform counts

**Table 6: Organoleptic properties draw milk from White Fulani cattle in different locations**

Variable	Treatment Location				SEM
	TL1	TL2	TL3	TL4	
Colour	2.67b	4.87a	3.17b	3.00b	0.15
Flavour	3.83b	4.90a	3.17b	3.33b	0.15
Taste	4.33b	5.53a	3.00c	1.50d	0.75
Odour	3.67a	2.17b	3.33a	3.27a	0.15
Overall Acceptability	4.30 <sup>b</sup>	5.80 <sup>a</sup>	2.17 <sup>c</sup>	2.00 <sup>c</sup>	0.66

Means on the same row with different superscripts are significantly ( $p < 0.05$ ) different.

## CONCLUSION

It can be concluded from the results of this study that different locations of agro pastoral herdsmen settlement had effect on raw milk characteristics. In this study milk sample from location TL<sub>2</sub> (Awela) had the most desirable qualities, hence it is recommended for consumption over milk samples from other locations.

## CONFLICT OF INTEREST STATEMENT

There is no conflict of interest among the authors as to the publication of this paper in Tropical Animal Production Investigation Journal.

## REFERENCES

- Adewumi, M.K. 1997 Feed resources and budgeting in the agro pastoral farming system in the derived savannah of Oyo state, Nigeria. Ph. D. thesis Department of Animal Science, University of Ibadan, Ibadan, Oyo state, Nigeria.
- Agabriel, C; Martin, B; Sibra, C, Bonnefoy, J. C; Montel, M.C; Didienné, R. and Hulin, S. 2004 Effect of production systems on the sensory characteristics of Cantal cheese: A plant-scale study. *Animal research* 53:221-234.
- A.O.A .C 2000 Official methods of Analysis of AOAC International 17<sup>th</sup> Edn. AOAC International, Gaithersburg, MD, USA
- APHA, 1992 Compendium of method for the microbiological examination of foods, 3<sup>rd</sup> Edn. Anne Public Health Assoc. in: C. Vanderzant and D.F. Splitsloesser (eds) Michigan, USA. Retrieved from <http://www.apha.org>.
- Belewu, M. A; Belewu, K.Y and Olatunji, S.A. 2005 Soy-coconut yoghurt: preparation, compositional and organoleptic qualities. *Bioscience Res. Bull.* 212: 129-137.
- Belewu, M. A. 2006 A functional approach to dairy science and technology. ADLEK PRINTING ENTERPRISES, Ilorin, Kwara State, Nigeria pp 86-95.
- Iwe, M.O. 2010 Handbook of sensory methods and analysis. Rojoint Communication Services Ltd, Enugu, Nigeria pp 5-18.
- Lacroix, C, Verret, P and Paquin, P. 1996 Regional and seasonal variations of nitrogen fraction in commingled milk. *Int. Dairy J.* 6:947-961.
- Lee, S.C; Yu, J. H; Jeong, C.L; Back, Y.J and Yoon, Y.C. 2006 The influence of mastitis on the quality of raw milk and cheese. *Korean J. Dairy Sci.* 13: 217-223.
- Lindmark– Manson, H; Fonden, R and Petterson, H.E. 2003 Composition of Swedish dairy milk. *Int. Dairy J. B:* 409-425.
- Onakomaiya, S.O; Oyesiku, K.A and Jegede, S.A 1992 Ogun state in Map. Rex Charles publications, Ibadan Oyo State Nigeria.

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- Sevi, A; Annicchiarico, M; Albenzio, L; Taibi, A; Muscio, A and dell Aquila, S. 2001 Effects of solar radiation and feeding time on behavior, immune responses and production of lactating ewes under high ambient temperature. *J. Dairy Sci.* 84:629-640.
- Sevi, A; Albenzio, M; Marino, R; Santillo, A and Muscio, A. 2004 Effects of lambing season and stage of lactation on ewe milk quality *Small Rum. Res.* 51: 251-259
- Walshe, M.J; Grindle, A; Nell, C. and bench man, M. 1991 Dairy development in sub-Saharan Africa. World Bank Tech. Paper no 135. Africa Tech Dept. Service.