

NUTRITIVE ASSESSMENT OF MILK FROM FULANI HERDS IN THE DERIVED SAVANNA ZONE OF NIGERIA

Abstract

The quality assessment of fresh cow milk collected from Fulani herds in Ogbomoso, Arolu, Ife-Odan, Oyo and Iseyin in the derived Savanna Zone of Nigeria were carried out in a Completely randomized design with emphasis on the nutrient composition and microbial loads. Four fresh cow milk samples from separate settlements (rugas) were collected from Ogbomoso, Arolu, Ife-Odan, Oyo and Iseyin and preserved for seven days with 0.01cm Potassium Permanganate and kept in the refrigerator at 4°C before laboratory analyses. The moisture content of fresh cow milk from different locations ranged between 87.46-88.62%, the crude protein 3.26-3.85%, ash 0.65-0.75%, crude fat 3.49-3.55%, Lactose 0.46-0.64% and solid-non-fat 8.3-9.7%. Mineral composition of the milk showed that potassium content from different locations ranged between 0.46-0.64percent, Calcium 0.21-0.23%, Magnesium 0.16-0.19%, Zinc 2.34-2.83%, Iron 0.32-0.56%, Copper 1.31-1.61%, Selenium 0.04-0.06%, Lead 0.00-0.14% and Cobalt 0.10-0.26%. Samples of fresh cow milk collected from Ogbomoso, Arolu and Ife-Odan had no traces of Salmonella and *E. Coli* and thus contained low level of microbial count. Therefore, it can be concluded from this Study that with the exceptions of the microbial counts, and lead contents there were no differences in all other parameters considered among the various locations in the zone.

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43 **Introduction**

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45 Protein of animal origin as constituted in meat, milk, cheese and egg provides concentrated

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47 sources of amino acid in suitable proportion for human needs. FAO (1998), reported that an

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49 average human being requires a minimum of 7.5g of animal protein per kilogram body

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51 weight daily to stay healthy. However, an average Nigerian consumes only 3.5g per kilogram

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53 body weight daily (FAO/WHO, 1985). Milk is defined as white liquid produced by female of

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55 the warm blooded animals essentially for the feeding of their young ones (Oyewole, *et al.*

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57 , 1997). Milk is very important in human diet and act as a good source of protein for body growth,

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60 repair and other vital functions. Milk is often described as nature's most

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62 perfect single food for newborn mammals and an important food supplement for adult

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64 (Apelegan, 2012).

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66 Cow milk is rich in calcium and potassium mineral elements (Chamberlin, 1989). Milk fats are

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68 useful in the production of butter and cheese (Adeneye, 1991). Cow milk is also a good source

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70 of protein and vitamins most especially thiamine, riboflavin and cyanocobalamin which are of

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72 practical importance in human diet (Beck, *et al.* 2003).

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74 The cattle owned by the fulanis constitute the majority of the national herd (Rim, 1992), and

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76 in Nigeria, milk production is almost entirely from range cattle owned by Fulani pastoralists

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78 (Alemede and Sadiq, 2008a), though milk production from cattle have been reported as the

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80 traditional source of milk for human consumption in Nigeria (Ibeawuchi, *et al.*, 2003) and the

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constitute about one-sixth of all the food eaten by man.

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convulsions and digestive disturbance including replacement of damaged cell and tissues ¶
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(Lacent, 1988).

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113 milk they produce is of low yield and poor quality. Fulani, is a prominent tribe in Nigeria and
114 is indigenous tribe of the northern Nigeria. Their primary occupation is nomadism and 60% of
115 total cattle in Nigeria are owned by them (Akinlade, et al., 2009). Since substantial milk
116 production is
117 still in their hands, this study is therefore designed to investigate the nutritional quality of milk
118 of indigenous cows traditional managed by Fulani herdsmen in the derived savanna zone of
119 Nigeria.
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128 **Materials and methods**

129 *Description of the Study Environment*

130 Milk samples were collected at Ogbomoso, Arolu, Ife-Odan, Oyo and Iseyin which are
131 located in the derived savanna zone of Nigeria. ~~Ogbomoso: This environment has an annual~~
132 ~~rainfall of 1247mm and latitude 8° North and longitude 4° 15 East, temperature of 27°C, 300-~~
133 ~~600mm above sea level. Ife Odan: Temperature: 330e /91.4°e wind: 5.8 km/h east/northern. It is~~
134 ~~96km away from Ibadan. Cloud: scattered at 1500ft, latitude: 7.83o, longitude 4.13°. The time~~
135 ~~zone in Ife Odan is Africa/ Lagos, sunshine at 6:40 and sunset at 18:23. Iseyin: Latitude at 8.5°~~
136 ~~latitude 4.55° Longitude at an average elevation of 290m, temperature of 36°e. It has an annual~~
137 ~~rainfall of 210mm. Oyo has a temperature of 28°e, Latitude 8°, Longitude 4° and an annual~~
138 ~~rainfall of 1316mm, (World weather online, 2012).~~
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150 *Materials/ Sample Collection*

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152 An average of 200ml of cow milk each was collected from each Fulani household settlement
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154 popularly called ‘ruga’ and 4 ‘rugas’ were considered per location in completely randomized
155 design covering five different locations; Ogbomoso, Arolu, Ife-Odan, Oyo and Iseyin. Milk
156 Sample was collected from total milk collected from each site. Potassium Permanganate
157 (0.01cm³) were used to preserve the samples for seven days in the refrigerator before they were
158 taken to the laboratory for analysis.

160 *Chemical Analysis:*

162 The proximate composition were analyzed according to the recommended methods of
163 A.O.A.C., (2005). The mineral concentrations were determined using a Kemtech Analytical
164 Alpha-4 Model atomic absorption spectrophotometer for Ca, Fe, Mg, Zn and Cu while flame
166 emission spectrophotometer (Kemtech Analytical Alpha-4 model) was used to determine K
168 using appropriate instrumental conditions for each element. Phosphorus was determined using a
170 UNICAMUV-1 Model visible spectrophotometer

175 *Detection of Enteric Bacteria on Selective Media*

177 Quantitative analysis for the detection and isolation of enteric microorganism was done by
178 plating the serially diluted milk samples on selective media. MacConkey agar (LOT no.
180 0000112122) was used to isolate Gram negative lactose fermenting (coliforms) and non-
182 fermenting microorganism. The media contains crystal violet dye and bile salts which inhibit
184 Gram positive bacteria. Lactose fermenting (pink) isolates on MacConkey agar was sub-
186 cultured, gram stained, and confirmed on eosin methylene blue (EMB) agar (LOT no.
188 0000129529). Lactose fermenters such as *Escherichia coli* and *Enterobacter aerogenes* can be
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Deleted: . A ruga is a typical shed made up of mud and covered with ¶
¶ dry grasses used as roofing sheet’

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¶ (0.01cm³

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¶ used prevented alteration in the chemical and mineral composition of the fresh cow milk ¶
¶ as well as changes that could occur in colour, texture and bacterial growth of the milk samples.

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differentiated on this media on the basis of size and the presence of a green metallic sheen
(Atlas *et al.*, 1995). *E.coli* colonies in this medium are small and have a metallic sheen, whereas
E.aerogenes colonies usually lack the sheen and are larger (Chatterjee *et al.*, 2006). The lactose
non-fermenting Gram negative non-coliform (colorless) isolates were also sub-cultured and
confirmed on selective media. Salmonella shigella (SS) agar (LOT no. 0000125020) was used
for the isolation of salmonella and shigella sp. Representative salmonella colonies with typical
black appearance were carried out using supplied indole motility (SIM) medium (LOT no.
0000133572).

Statistical Analysis

Data obtained were subjected to analysis of variance using General linear model of SAS,
2000. The significant means were separated using Duncan multiple range test (Duncan 1995).

Results:

Proximate composition

Table 1: Shows the proximate composition of fresh milk samples collected from
different locations (Ogbomoso, Arolu, Ife odan, Oyo and Iseyin zone). There were significant
($P<0.05$) effect of location on proximate composition of the milk. The moisture contents
did not show any difference among the locations, though the values obtained from Iseyin and
Arolu were higher (87.46-88.62%). The crude protein contents in the fresh cow milk samples
ranged from 3.26-3.85%.

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251 Higher crude protein contents of 3.85, 3.65 and 3.56% were recorded for Oyo, Ogbomoso and
252
253 arolu areas respectively. While the least value of 3.26% was recorded for Iseyin location.

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255 The ash content which is reflection of the mineral contents of the milk samples showed
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257 significant ($P < 0.05$) differences and it ranged from 0.65 – 0.75%. The higher values were

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259 recorded for samples collected from Oyo, Arolu and Ogbomoso (0.75, 0.73 and 0.71%)

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261 respectively. The value recorded was significantly lower than the value of (4-13%) reported by

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263 Ajai *et al.*, (2012) also similarly lower than the value (0.78%) reported by Tona *et al.*, 2013.

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265 The crude fat contents of the milk sample collected from different locations (Ogbomoso,

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267 Arolu, Ife odan, Oyo and Iseyin) showed no significant ($P > 0.05$) difference. Lactose were

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269 5.82, 5.88, 5.91 and 4.73 for Ogbomoso, Arolu, Ife Odan, Oyo and Iseyin respectively.

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271 The value of solid nonfat (SNF%) of raw cow milk collected from different locations

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273 of Ogbomoso, Arolu, Ife odan, Oyo and Iseyin ranged from (8.30-9.70%) and for total solid

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275 fat from (11.53-13.11%).

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276 277 278 279 280 281 *Mineral composition*

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283 The results of mineral compositions of raw cow milk in different locations (Ogbomoso, Arolu,

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285 Ife Odan, Oyo and Iseyin) in derived savanna zone of Nigeria are presented in table 2. The

286
287 potassium (k) concentration for all the milk samples collected from different locations ranged

288
289 between 0.46 to 0.64%. The milk sample collected from Oyo, Arolu and Ogbomoso (0.64, 0.63

294 and 0.62%) were significantly higher in value than that value recorded for Iseyin and Ife-Odan
 295
 296 (0.49 and 0.46%). Calcium (Ca) and Phosphorus (P), there were no significant ($P>0.05$)
 297
 298 difference in both calcium (%Ca) and phosphorus (% P) content. The value of Ca ranged from |
 299
 300 0.21 to 0.23% and P from 0.21 to 0.22%. The milk collected from different locations
 301
 302 had good quality of Ca and P contents. |
 303
 304 The magnesium content of raw cow milk collected from different locations ~~(Ogbomoso, Arolu,~~
 305
 306 ~~Ife odan, Oyo and Iseyin zone)~~ ranged between 0.16 to 0.19%. Higher value of Mg
 307
 308 contents were observed from milk samples collected from Ogbomoso, Arolu and Oyo (0.17,
 309
 310 0.18 and 0.19%). The trace mineral content in the studies milk samples compared favorably
 311
 312 with those reported by other workers. The value of Zn ranged from 2.34 to 2.83% and Fe from |
 313
 314 0.32 to 0.56%. The milk sample collected from Ogbomoso, Arolu and Oyo had the higher
 315
 316 values for Zn and Fe. The concentration of copper (Cu) in the milk sample collected from
 317
 318 Ogbomoso, Arolu, Ifeodan, Oyo and Iseyin were 1.53, 1.56, 1.36, 1.61 and 1.31%. |
 319
 320 respectively. |
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 322 The milk sample collected from Oyo, Arolu and Ogbomoso had the higher levels for Cu and the
 323
 324 least concentration for Cu were found in
 325
 326 the milk sample collected from Iseyin and Ifeodan.
 327
 328 Selenium (Se) content of raw milk collected from different locations (Ogbomoso, Arolu,
 329
 330 Ifeodan, Oyo and Iseyin zone ranged between 0.04 to 0.06%. Higher significantly value of Se
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 332 content were observed from milk sample collected from Oyo, Ogbomoso and Arolu (0.06, 0.05

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345 and 0.05%). The lower values were observed for milk collected from Iseyin and Ife odan.
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348 The trace mineral content in the studied milk samples compared favourably with those
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350 reported by others workers. The value of Pb ranged from 0.00-0.14% and Co from 0.10 –
351
352 0.26%.

353
354 The milk samples collected from Iseyin and Oyo locations had highest Co and Pb contents
355

356 *Bacterial Count*

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358 Effect of locations on the bacterial counts of fresh cow milk in derived savanna zone
359
360 is presented in Table 3. The samples of fresh cow milk collected from Ogbomoso, Arolu and
361
362 Ife-Odan had no traces of *Salmonella* and *E coli* but lower values when compared with
363
364 microbial count from Ogbomoso (1.21×10^3), Arolu (1.02×10^3) and Ife-Odan (1.09×10^3). Milk
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366 collected from Oyo and Iseyin were highly contaminated with heavy microbial count, of
367
368 *Salmonella* and *E Coli* respectively.

369 **Discussion**

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371
372 The values recorded for moisture content for fresh cow milk from different location fell within
373
374 the value of 88.27% reported by Alemede and Sodiq (2008b). The significant of
375
376 ~~moisture contents in milk is that, high moisture content implies high water activities~~
377
378 ~~which support microbial growth consequently reduces the shelf life of the milk sample. Low~~
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380 ~~moisture content on the other hand, implies low water activities causing reduction in~~
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382 ~~microbial growth and the predominantly microbial culture consequently increasing the shelf~~
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384 ~~life of the milk samples as a result of low availability of water for microbial growth~~ (Ajai *et al* |
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386 ., 2012).

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388 The crude protein content recorded for milk samples collected at different locations were higher
389
390 than that value (3.61%) reported by Tona *et al.*, 2013. Higher ash content was observed for cow
391
392 milk samples collected from Oyo Arolu and Ogbomoso (0.75, 0.73 and 0.71%) This could be
393
394 due to the provision of salt lick after grazing in the zones. The value recorded
395
396 was significantly lower than the value (4-13%) reported by Ajai *et al.*, (2012) also lower than
397
398 the value (0.78%) reported by Tona *et al.*, 2013. The fat contents of the entire milk sample |

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400 Were lower than the values (27.55-34.59%) reported by Ajai *et al.*, 2012. Also lower than the
401
402 values (4.02%) reported by Tona *et al.*, 2013. Fat is widely known as a source of energy but
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404 excess fat contents in food constitute health risk (Henry *et al.*, 2003) for this reason, the milk |
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406 sample collected from different location was safer for consumption. The values recorded for
407
408 lactose was higher than (5.00%) reported by Enb *et al.*, (2009). The milk samples collected
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410 from Ogbomoso, Arolu and Oyo had higher value than their counterpart for solid nonfat. The
411
412 total solid fat was higher for Iseyin (13.11%) followed by Ife odan (12.83%), while least values
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414 were obtained for fresh cow milk sample from (Ogbomoso, Oyo and Arolu). Thus, the cow
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416 milk in Ogbomoso, Oyo and Arolu were considered safe for human consumption.

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419 *Minerals composition*
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423 The implication of lower potassium intake can lead to lethargic condition with high incidence of
424 comas and death; can also lead to diarrhea, distended abdomen and
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426 untidy appearance (Adesina, 2012). Potassium deficiency affects the collecting tubules of the
427
428 kidney, resulting in the inability to concentrate urine, and also causes alterations of gastric
429
430 secretions and intestinal motility (Soetan, *et al.*, 2010). The rapidly growing animals apparently
431
432 have a higher requirement for potassium, and increasing the protein level increases the
433
434 requirement. One of the most vital contribution of milk to human nutrition is the Calcium and
435
436 Phosphorus it supplies (Adesina, 2012). Calcium plays an important role in bones formation
437
438 and metabolism, muscle contraction, nerve transmission and blood clotting. Calcium and
439
440 phosphorous are required in large amount and for promotion of rapid growth of neonate. It also
441
442 ensures bone growth and development of soft tissues. Phosphorous is involved in maintaining
443
444 body pH, in storage and transfer of energy (Adesina, 2012). Both elements are needed for
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446 tissue and bone development while deficiency result in slow growth, depraved appetite,
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448 unthrifty appearance and rickets (N R C, 1978). Higher value of Mg contents were observed
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450 from milk samples collected from Ogbomoso, Arolu and Oyo (0.17, 0.18 and 0.19%). The
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452 implication of the lower Mg content from milk will lead to hyper irritability with
453
454 convulsions, loss of equilibrium And trembling tetany (Adesina, 2012). Zn is essential for
455
456 physiological processes including development, lipid metabolism, brain and immune function
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458 and deficiency of Zn allow body to more susceptible to disease caused by viral, bacteria and
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460 fungi infection (Adesina, 2012). Iron on the other hand is an integral part of many proteins
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468 and enzymes that maintain good health.
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470 It is an essential component of proteins and is involved in oxygen transport. However, excess
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472 Fe may result in poisoning even death (Chandra, 1990).
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474 The milk sample collected from Oyo, Arolu and Ogbomoso had higher levels of Cu and
475
476 the least concentration for Cu were found in the milk sample collected from Iseyin and Ifeodan.
477
478 Cu is an important element in nutrition because it is an essential element for human health.
479
480 However, excess in the body is undesirable. It may lead to liver and kidney damage among
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482 other effects.
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484 Higher value of Se content were observed from milk sample collected from Oyo,
485
486 Ogbomoso and Arolu (0.06, 0.05 and 0.05%). The lower values were observed for milk
487
488 Collected from Iseyin and Ife odan. The selenium concentration observed in this study is lower
489
490 than value reported by Tona *et al.*, (2013). Selenium is an essential element in nutrition. It
491
492 function as an antioxidant as well as co-factor of enzymes which protects cell membranes from
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494 damage caused by peroxidation of lipids, thereby decreasing the risk of cancer, heart and blood
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496 vessels disease. Selenium is a crucial nutrition for an HIV infection person (Rayman, 2000)
497
498 The milk samples collected from Iseyin and Oyo zone had highest Co and Pb. The mean values
499
500 for Pb was below the general statutory limit of 1smg/kg set by for the lead in food regulations
501
502 (TLFR, 1979). High levels of heavy metal in Iseyin and Oyo zones may be attributed to the high
503
504 contamination of animal feed and water by pollutants and could be excreted into milk at
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506 various levels (Abou – Arab *et al.*, 1994) and also through poor handling procedures.

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Bacterial count

The samples of fresh cow milk collected from Ogbomoso, Arolu and Ife-Odan had no traces of *Salmonella* and *E coli* but lower values were observed for microbial count on Ogbomoso (1.21×10^3), Arolu (1.02×10^3) and Ife-Odan (1.09×10^3). Milk collected from Oyo and Iseyin were highly contaminated with Microbial count, *Salmonella* and *E coli* respectively.

Conclusion and Recommendation

This work, investigated the on- farm nutritive content and the bacteria contents of milk from extensively managed cattle by Fulani in the derived Savanna Zone, of Nigeria. It could be concluded that fresh cow milk collected from Ogbomoso, Arolu and Ife-Odan had higher values of proximate and mineral contents. High sanitary practices should be encouraged before, during and after collection of milk samples from respective animals. Handling and processing including pasteurization, packaging and even storage of raw milk, especially those collected or purchased directly from Fulani settlements called rugas or those being hawked by Fulani women in town, villages and road sides is recommended to eliminate or reduce to a tolerable level, the presence of these microbes before consumption by humans. However, consumption of milk procured from Iseyin and Arolu areas should if possible be completely discountenance as traces of lead in the milk make it consumption worst.

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 629 **GraceTona, Oyebamiji Oyegoke, Sadiq Ademola and Jelili Akinlade.**
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Table 1: Effects of locations on Proximate Composition of Cow Milk in Derived Savanna

PARAMETER	OGBOMOSHO	AROLU	IFE-ODAN	OYO	ISEYIN	SED
%M	87.46	88.03	87.77	87.52	88.62	0.39
%CP	3.65	3.56	3.45	3.85	3.26	0.33
%CF	3.49	3.54	3.55	3.52	3.55	0.25
%TS	11.53	11.92	12.83	11.82	13.11	0.23
%SNF	8.88	9.70	8.43	8.95	8.30	0.35
%LAC	5.82	5.88	5.91	4.73	5.93	0.40
%ASH	0.71	0.73	0.67	0.75	0.65	0.04

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M- Moisture , CP- Crude protein, CF- Crude oil, TS- Total Solid Fat, SNF- Solid Non Fat

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Table 2: Effect of Locations on Mineral Composition of Cow Milk in Derived Savanna Zone.

PARAMETERS	OGBOMOSHO	AROLU	IFE-ODAN	OYO	ISEYIN	SED
%K	0.62	0.63	0.49	0.64	0.46	0.03
%Ca	0.22	0.22	0.21	0.23	0.21	0.01
%P	0.21	0.22	0.21	0.22	0.21	0.01
%Mg	0.17	0.18	0.16	0.19	0.16	0.01
%Zn	2.81	2.73	2.40	2.83	2.34	0.40
%Fe	0.55	0.56	0.37	0.56	0.32	0.02
%Cu	1.56	1.56	1.36	1.61	1.31	0.41
%Se	0.05	0.05	0.04	0.06	0.04	0.01
%Pb	0.00	0.00	0.00	0.14	0.13	0.01
%Co	0.10	0.10	0.10	0.26	0.21	0.01

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808 Means along the same row with differences superscripts differ significant (P >0.05) differences
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849 **Table 3: Effects of Locations on the Bacterial Count of Milk in Derived Savanna Zone**

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851	PARAMETER	OGBOMOSO	AROLU	IFE-ODAN	OYO	ISEYIN	SED

852	Microbial Count	1.21x10 ³	1.02x10 ³	1.09x10 ³	9.3x10 ³	5.4x10	21.29x10 ³
853	Salmonella	0.00	0.00	0.00	1.7x10 ³	1.9x10 ³	0.129x10
854	<i>E.coli</i>	0.00	0.00	0.00	2.8x10 ³	1.3x10 ³	0.19x10

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858 Cfu/g in forming unit per gram of milk sample SED in the standard error of difference
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