Global Scientific JOURNALS

GSJ: Volume 7, Issue 2, February 2019, Online: ISSN 2320-9186
www.globalscientificjournal.com

EFFECTS OF PASTEURIZATION ON THE PHYSICO-CHEMICAL QUALITY OF NUNU SOLD IN AUCHI, EDO, NIGERIA

Ohimai, A[1]., Adegoke, S. A[2]. and Dania, U. J[3].

[1]*Department of Science Laboratory Technology, Auchi Polytechnic, P.M.B. 13, Auchi, Edo State, Nigeria*
[2]*Department of Microbiology, Faculty of Natural Science, Kogi State University, Anyagba, Kogi state, Nigeria*
[3]*Department of Science Laboratory Technology, Auchi Polytechnic, P.M.B. 13, Auchi, Edo State, Nigeria*

Abstract: Nunu is a locally fermented Nigerian milk product used as a staple food amongst the Saharan tribes of West African Sub-region, and is also popular amongst the inhabitants of the Mediterranean region and the Middle East where it is known as dahi or lassi. Samples of fresh Nunu were collected from Zongo farm (a small-scale farm) located in Auchi which is less than 15 minutes distance from the laboratory of Auchi Polytechnic Auchi. The Nunu samples were collected in the early morning to ensure the freshness. All Nunu samples were obtained under aseptic conditions from where the fulani herd women kept them for overnight fermentation and to avoid contamination which can influence the analysis. Nunu samples were divided into 7 portions and treated as follows: sample A, unpasteurized; sample B, C, D, pasteurized at 63°C for 30 min; and sample E, F, and G, pasteurized at 72°C for 15 Seconds. Proximate composition was carried out in triplicate for each sample using standard methods and the mean results were recorded. The result of the physio-chemical analysis reveals the protein, carbohydrate and pH levels of the Nunu samples decreased during the period of storage each day.

Keywords: Nunu, Nigeria, Auchi, Aseptic, Fermentation, Pasteurized, Proximate, Physio-chemical.

1. Introduction

Nunu is yoghurt-like in taste (a sharp acid taste), and is therefore usually taken with sugar and "fura" which is made up of millet flour compressed in balls and cooked for about 20 - 40 min. The cooked "fura" is crumbled in a bowl of nunu (now called "fura de nunu"). Nunu is an excellent source of protein, rich in essential amino acids and a good source of calcium, phosphorous and vitamins A, C, E and the B complex. However, like other milk products, it is poor in ascorbic acid and iron. Nunu, if well prepared and well preserved, could serve as an equally good alternate but cheaper source of dairy product. It is at present being prepared and hawked mostly by the nomadic Hausa/Fulani cattle rearers, who invariably control over 80% of the country's cattle production and only available within walking distance of their settlements. Nunu is thus more available in the Northern part of Nigeria than in the South, and as such only a small percentage of non-Fulanis have acquired the taste for it. It, however, does not appeal to majority of the people because of the apparent unhygienic conditions in which it is prepared, and also its poor shelf life (Wallander and Samson, 1976; Yahuza, 2001).

Elmagli and El Zubier (2006) studied the compositional quality of pasteurized milk in Khartoum State and reported that fat, protein, lactose, ash, titratable acidity and the freezing point ranged between 1 to 2.8%, 2.13 to 3.6%, 2.13 to 4.8%, 0.33 to 0.69%, 0.14 to 0.86% and -0.41 to -0.67, respectively. Elert, (2002) mentioned that the mean density (gm/ml) of various fluid milks was 1.023 at 38.9^0C and 1.035 at 4.4^0C for producer milk, 1.022 at 38.9^0C to 1.033 at 4.4^0C for homogenized milk and for skim milk it was 1.026 at 38.9^0C and 1.036 at 4.4^0C. Elmagli and El Zubeir (2006) reported that the freezing point of pasteurized milk was -0.41 to – 0.67o C and the mean titratable acidity of pasteurized milk was 0.14 to 0.86%. The raw milk distributed for the consumer in Sudan never finds the real quality control measures needed to be of a good quality food (Mohamed and El Zubeir, 2007). In almost all mammals, milk is fed to infants through breastfeeding, either directly or by expressing the milk to be stored and consumed later. The early milk from mammals is called colostrum. Colostrum contains antibodies that provide protection to the newborn baby as well as nutrients and growth factors (Uruakpa, *et al*., 2002). The makeup of the colostrum and the period of secretion vary from species to species.

Milk is a pale liquid produced by the mammary glands of mammals. It is the primary source of nutrition for infant mammals before they are able to digest other types of food. Early-lactation milk contains colostrum, which carries the mother's antibodies to its young and can reduce the risk of many diseases. It contains many other nutrients (Pehrsson *et al*., 2000), including protein and lactose.

In many cultures of the world, especially the West, humans continue to consume milk beyond infancy, using the milk of other animals (especially cattle, goats and sheep) as a food product. Initially, the ability to digest milk was limited to children as adults did not produce lactase, an enzyme necessary for digesting the lactose in milk. Milk was therefore converted to curd, cheese and other products to reduce the levels of lactose. Thousands of years ago, a chance mutation spread in human populations in Europe that enabled the production of lactase in adulthood. This allowed milk to be used as a new source of nutrition which could sustain populations when other food sources failed (Curry, 2013). Milk is processed into a variety of dairy products such as cream, butter, yogurt, kefir, ice cream, and cheese. Modern industrial processes use milk to produce casein, whey protein, lactose, condensed milk, powdered milk, and many other food-additives and industrial products.

2. Methodology

Sample Collection and preparation

Samples of fresh Nunu were collected from Zongo farm (a small-scale farm) located in Auchi which is less than 15 minutes distance from the laboratory of Auchi Polytechnic, Auchi. The Nunu samples were collected in the early morning to ensure the freshness. All Nunu samples were obtained under aseptic conditions from where the fulani herd women kept them for overnight fermentation and to avoid contamination which can influence the analysis (Cheesbrough, 2000). Samples were collected in sterilized 50ml conical flasks and then kept in an ice cooler box. The flasks in the ice were taken to laboratory under 15 minutes for further analysis.

Nunu samples were divided into 7 portions and treated as follows: sample A, unpasteurized; sample B, C, D, pasteurized at 63°C for 30 min; and sample E, F, and G, pasteurized at 72°C for

15 Seconds. Quantitative analysis for physiochemical composition was carried out on sample A and then divided into 2 portions, 1 portion stored at 10°C and the other portion kept at room temperature for 7days. Quantitative analysis for physiochemical composition was also carried out on pasteurized samples: B, C, D, E, F and D and were then divided into 2 portion each, 1 portion stored at 10°C and the other portion kept at room temperature for 7 days.

Determination of Physico-Chemical Analysis

The proximate composition was carried out in triplicate for each sample using standard methods and the mean results were recorded.

Titratable Acidity

This was measured by titrating a mixture of 10ml of sample and 90 ml of distilled water against 0.1 M sodium hydroxide (NaOH) solution using phenolphthalein as indicator AOAC, (2005).

Determination of crude protein

Each sample (2.0 g) was measured into digestion flask. Kjedhal catalyst (0.8 g) was put in each flask with 15 ml of concentrated sulphuric acid added. Each flask was heated on pre heated digester for about 30 min in fume cupboard. This was digested until a clear homogenous mixture was obtained. After digestion, the flask was removed from the heater, cooled and the content was diluted with about 50 ml of distilled water. The flask was then placed in micro-kjedahl analyzer (distillation unit) where 5 ml of 40% NaOH was added. The mixture was subsequently heated up to release ammonia which was distilled into a conical flask containing 25 ml of 2 % boric acid for about 15 min. During the distillation process, the ammonia combined with boric acid to form ammonium borate solution which was titrated against 0.1M HCl until a purplish- grey end point was attained (AOAC, 2000).

Determination of crude fat content

Crude fat content was determined using soxhlet extractor with a reflux condenser and a distillation flask (previously dried and weighed). Each sample (2.0 g) was weighed into fat free extraction thimble plugged with cotton wool and placed in the appropriate chamber of the extractor. The distillation flask was filtered to two-third capacities with n-hexane and boiled on heating mantle, the distillate was collected until the extractor siphoned over for 4 h. Thereafter,

n-hexane was recovered into a clean container and the remaining solvent in the distillation flask was evaporated in oven at 70^0C. The flask was allowed to cool in desiccator after which the final weight of the flask was determined. The difference in the final and the initial weights of the distillation flask represented the oil extracted from the sample (AOAC, 2000).

Determination of Total Solids (Gravimetric method)

Samples of Nunu were transferred to beaker, warm slowly to 35° - 40°C on a water bath with careful mixing to incorporate any cream adhering to the sample. Cool the sample quickly to room temperature. Heat a dish with its lid alongside in the drying oven at least 1 hour. Place the lid on the dish and immediately transfer to a desiccator. Allow cooling to room temperature (at least 30 mins) and weighing to the nearest 0.1 mg. Add 5 ml of prepared sample, place the lid on the dish and weigh again. Place the dish without the lid on the vigorously boiling water bath in such a way that the bottom of the dish is directly heated by the steam. Continue heating till most of the water is removed. Remove the dish from the water bath, wipe the underside and place it in the oven alongside the lid and dry in the oven for 2 hours. Place the lid and transfer to the desiccator. Allow the dish to cool and weigh to the nearest 0.1 mg. Again heat the dish with its lid alongside in the oven for 1 hour. Place the lid on the dish and immediately transfer to the desiccator. Allow to cool and weigh again. Repeat the operation again until the difference in the two consecutive weighing does not exceed 1 mg. Record the lowest mass.

Determination of total ash content

Each sample (5g) was measured accurately into a previously ignited, cooled and weighed crucible. A few drops of glycerol was added, mixed thoroughly and heated until the sample charred. The crucible was transferred into a muffle furnace set at 550^0C until a white grey ash was obtained. The crucible was cooled in desiccator and reweighed (AOAC, 2000). The percentage ash was calculated as:

Determination of crude carbohydrate content

The carbohydrate content of each Nunu sample was calculated by difference. The total of all the previously determined proximate parameters subtracted from total solid represent the carbohydrate content.

pH measurement

The pH was measured using a pH meter, digital model EA 513-055, ELE, England standardized with buffer solution of 4.0 and 7.0 AOAC, (2005). The glass electrode of the pH meter was dipped in 30 mls of the beverage sample measured into a curvette at ambient temperature and was allowed to stabilize for sometimes after which the reading was taken.

Specific Gravity

Specific Gravity was carried out using lactometer method by adjusting the temperature of Nuno sample at 50-80 0 F. Fill clean, dry glass jar about 2/3 rd volume of it with Nuno, pour the Nuno down along the sides of the jar to avoid the incorporation of air. Lower the lactometer gently in the Nuno making sure that the lactometer floats freely without touching the sides of the jar. Add Nunu to brim of the jar. Read the lactometer reading at the top of the meniscus within one minute. Record the temperature of Nunu.

Moisture content

Moisture content was determined by difference that is, by subtracting already determined total solid from 100%.

3. Results

The results of the physiochemical analysis of the fresh, unpasteurized Nunu samples (A) are shown in Table 4A.

Table 1 shows the physio-chemical composition of unpasteurized Nunu, the descriptive statistical analysis using mean and standard deviation shows that titratable acidity for unpasteurized sample A has mean value of 2.14 and standard deviation of 0.02. Protein (3.48, 0.06), Fat (7.03, 0.47), Total solid (38.90, 0.88), Ash content (2.07, 0.15), Carbohydrate (26.32, 1.17), pH (4.55, 0.03), Specific gravity (0.88, 0.03) and moisture content having mean of 61.10 and standard deviation of 0.88.

Table 1: Physio-Chemical Analysis of Unpasteurized (A) Nunu

Parameters	1	2	3	X±SD
Titratable Acidity	2.15	2.14	2.12	2.14±0.02
Protein	3.42	3.54	3.48	3.48±0.06
Fat	6.5	7.2	7.4	7.03±0.47
Total solid	39.75	38	38.95	38.90±0.88
Ash content	2.2	1.9	2.1	2.07±0.15
Carbohydrate	27.63	25.36	25.97	26.32±1.17
pH	4.52	4.58	4.54	4.55±0.03
S. Gravity	0.85	0.9	0.88	0.88±0.03
Moisture	60.25	62	61.05	61.10±0.88

Table 2, shows the results of the physiochemical composition of the Nunu (sample B, C and D) pasteurized at the temperature of 63^0C (LTLT). The results are in triplicate.

Table 2, shows the Physio-chemical composition of pasteurized Nunu, at 63^0C for samples B, C and D, Sample C, Titratable Acidity has mean value of 1.99 and Standard deviation of 0.01. Protein (3.31, 0.02), Fat (2.52, 0.02), Total solid (49.58, 0.02), Ash content (1.95, 0.05), Carbohydrate (41.68, 0.12), pH (5.28, 0.26), Specific gravity (0.98, 0.26) and moisture content having mean of 50.42 and standard deviation of 0.02.

Sample C, Titratable acidity has mean value of 1.99 and Standard deviation of 0.01. Protein (3.31, 0.02), Fat (2.52, 0.02), Total solid (49.58, 0.02), Ash content (1.95, 0.05), Carbohydrate (41.68, 0.12), pH (5.28, 0.26), Specific gravity (0.98, 0.26) and moisture content having mean of 50.42 and standard deviation of 0.02.

Sample D, Titratable acidity has mean value of 1.99 and Standard deviation of 0.01. Protein (3.31, 0.02), Fat (2.52, 0.02), Total solid (49.58, 0.02), Ash content (1.95, 0.05), Carbohydrate (41.68, 0.12), pH (5.28, 0.26), Specific gravity (0.98, 0.26) and moisture content having mean of 50.42 and standard deviation of 0.02.

Table 2: Physio-Chemical Analysis of (LTLT) Pasteurized Nunu

Parameters	B				C				D			
	1	2	3	X±SD	1	2	3	X±SD	1	2	3	X±SD
Titrable acidity	1.99	2.00	1.98	1.99±0.01	1.97	1.98	1.99	1.99±0.01	2.01	1.95	1.98	1.99±0.01
Protein	3.30	3.32	3.33	3.31±0.02	3.35	3.33	3.30	3.31±0.02	3.32	3.31	3.34	3.31±0.02
Fat	2.50	2.54	2.52	2.52±0.02	2.51	2.53	2.52	2.52±0.02	2.51	2.50	2.53	2.52±0.02
Total solid	49.59	49.56	49.60	49.58±0.02	49.57	49.58	49.55	49.58±0.02	49.60	49.62	49.58	49.58±0.02
Ash content	1.90	1.95	2.00	1.95±0.05	1.98	1.97	2.10	1.95±0.05	2.00	2.10	1.90	1.95±0.05
Carbohydrate	41.55	41.75	41.75	41.68±0.12	41.73	41.75	41.63	41.68±0.12	41.77	41.71	41.81	41.68±0.12
pH	5.25	5.29	5.30	5.28±0.26	5.25	5.24	5.22	5.28±0.26	5.27	5.24	5.29	5.28±0.26
S. Gravity	1.00	0.95	0.99	0.98±0.26	0.92	0.98	0.94	0.98±0.26	0.99	0.96	1.01	0.98±0.26
Moisture	50.41	50.44	50.40	50.42±0.02	50.43	50.42	50.45	50.42±0.02	50.40	50.38	50.42	50.42±0.02

Table 3, reveals the triplicate results of the physiochemical composition of the Nunu (sample E, F and G) pasteurized at the temperature of 72^0C (HTST).

The table 4C shows the Physio-chemical composition of pasteurized Nunu, at 72^0C for samples E, F and G.

Sample E, Titratable acidity has mean value of 1.90 and Standard deviation of 0.02. Protein (2.57, 0.15), Fat (2.09, 0.04), Total solid (44.03, 0.07), Ash content (1.82, 0.03), Carbohydrate (37.55, 0.11), pH (6.60, 0.03), Specific gravity (1.03, 0.02) and moisture content having mean of 55.94 and standard deviation of 0.12.

Sample F, Titratable acidity has mean value of 1.90 and Standard deviation of 0.03, Protein (2.52, 0.08), Fat (2.02, 0.03), Total solid (44.01, 0.01), Ash content (1.89, 0.04), Carbohydrate (37.58, 0.11), pH (6.70, 0.02), Specific gravity (1.08, 0.03) and moisture content having mean of 55.97 and standard deviation of 0.06.

Sample G, Titratable acidity has mean value of 1.87and Standard deviation of 0.03, Protein (2.53, 0.12), Fat (2.04, 0.02), Total solid (44.00, 0.48), Ash content (1.88, 0.03), Carbohydrate (37.55, 0.36), pH (6.98, 0.08), Specific gravity (1.09, 0.11) and moisture content having mean value of 55.97 and standard deviation of 0.50.

Table 3: Physio-Chemical Analysis of (HTST) Pasteurized Nunu

Parameters	**E**				**F**				**G**			
	1	**2**	**3**	**X±SD**	**1**	**2**	**3**	**X±SD**	**1**	**2**	**3**	**X±SD**
Titrable Acidity	1.90	1.88	1.92	1.90±0.02	1.93	1.88	1.89	1.90±0.03	1.91	1.89	1.86	1.87±0.03
Protein	2.60	2.40	2.70	2.57±0.15	2.45	2.60	2.50	2.52±0.08	2.55	2.65	2.40	2.53±0.12
Fat	2.10	2.12	2.05	2.09±0.04	2.03	2.05	2.00	2.02±0.03	2.05	2.04	2.02	2.04±0.02
Total solid	43.99	44.00	44.11	44.03±0.07	44.00	44.02	44.0	44.01±0.01	44.45	44.05	43.50	44.00±0.48
Ash content	1.81	1.80	1.86	1.82±0.03	1.84	1.90	1.92	1.89±0.04	1.91	1.88	1.85	1.88±0.03
Carbohydrate	37.48	37.68	37.50	37.55±0.11	37.68	37.47	37.58	37.58±0.11	37.94	37.48	37.23	37.55±0.36
pH	6.63	6.56	6.61	6.60±0.03	6.70	6.72	6.68	6.70±0.02	6.90	7.00	7.05	6.98±0.08
S. Gravity	1.03	1.01	1.05	1.03±0.02	1.10	1.05	1.08	1.08±0.03	1.05	1.22	1.00	1.09±0.11
Moisture	56.01	56.00	55.89	55.94±0.12	56.00	55.98	56.00	55.97±0.06	55.55	55.95	56.50	55.97±0.50

The mean values of the physiochemical analysis of Nunu sample B, C and D with subscript “b” are significantly different from the mean value of Nunu sample A. While the mean values of Nunu sample E, F and G with subscript “ab” are significantly different from sample A, B, C and D ($P<0.05$) as shown in table 5 below.

Table 4: Mean and Standard Deviation of the Physio-Chemical Analysis of Nunu before Storage

Parameters	A	B	C	D	E	F	G
	X±SD	**X±SD**	**X±SD**	**X±SD**	**X±SD**	**X±SD**	**X±SD**
Titrable Acidity	2.14^{a}±0.02	1.99^{b}±0.01	1.98^{b}±0.01	1.98^{b} ±0.03	1.90^{ab}±0.02	1.90^{ab}±0.02	1.89^{ab}±0.02
Protein	3.48^{a}±0.06	3.31^{b}±0.02	3.31^{b}±0.02	3.31^{b}±0.02	2.57^{ab}±0.15	2.52^{ab}±0.08	2.53^{ab}±0.12
Fat	7.03^{a}±0.47	2.52^{b}±0.02	2.52^{b}±0.02	2.52^{b}±0.02	2.09^{ab}±0.04	2.02^{ab}±0.03	2.04^{ab}±0.02
Total solid	38.90^{a}±0.88	49.58^{b}±0.02	49.58^{b}±0.02	49.58^{b}±0.02	44.03^{ab}±0.07	44.01^{ab}±0.01	44.00^{ab}±0.48
Ash content	2.07^{a}±0.15	1.95^{b}±0.05	1.95^{b}±0.05	1.95^{b}±0.05	1.82^{b}±0.03	1.89^{ab}±0.04	1.88^{ab}±0.03
Carbohydrate	26.32^{a}±1.17	41.68^{b}±0.12	41.68^{b}±0.12	41.68^{b}±0.12	37.55^{ab}±0.11	37.58^{ab}±0.11	37.55^{ab}±0.36
pH	4.55^{a}±0.03	5.28^{b}±0.26	5.28^{b}±0.26	5.28^{b}±0.26	6.60^{ab}±0.03	6.70^{ab}±0.02	6.98^{ab}±0.08
S. Gravity	0.88^{a}±0.03	0.98^{b}±0.26	0.98^{b}±0.26	0.98^{b}±0.26	1.03^{ab}±0.02	1.08^{ab}±0.03	1.09^{ab}±0.11
Moisture	61.10^{a}±0.88	50.42^{b}±0.02	50.42^{b}±0.02	50.42^{b}±0.02	55.94^{ab}±0.12	55.97^{ab}±0.06	55.97^{ab}±0.50

Table 5, shows the mean values of protein content of Nunu during the period of storage from first day to the seventh day at temperature of 10^{0}C and 28^{0}C.

Table 5: Mean Protein analysis during Storage

Sample	Day 1		Day 3		Day 5		Day 7	
	10^{0}C	28^{0}C	10^{0}C	28^{0}C	10^{0}C	28^{0}C	10^{0}C	28^{0}C
A	3.30	3.20	3.25	3.40	3.20	2.50	3.10	2.30
B	3.32	3.30	3.30	3.25	3.28	3.20	3.26	3.00
C	3.33	3.28	3.32	3.23	3.30	3.18	3.28	3.08
D	3.32	3.28	3.31	3.24	3.29	3.2	3.27	2.99
E	2.70	2.66	2.68	2.63	2.66	2.61	2.64	2.58
F	2.69	2.65	2.67	2.62	2.65	2.60	2.63	2.57
G	2.69	2.67	2.67	2.63	2.66	2.60	2.64	2.57

The mean values of carbohydrate content of Nunu during the period of storage from first day to the seventh day at temperature of 10^{0}C and 28^{0}C are revealed in Table 6 below.

Table 6: Mean Carbohydrate Analysis during Storage

Sample	Day 1		Day 3		Day 5		Day 7	
	10^0C	28^0C	10^0C	28^0C	10^0C	28^0C	10^0C	28^0C
A	26.53	25.70	26.45	25.58	26.38	25.52	26.28	25.49
B	40.50	39.55	40.20	39.30	39.80	38.95	39.36	38.70
C	40.52	39.56	40.22	39.32	39.82	38.96	39.38	38.72
D	40.55	39.60	40.24	39.33	39.83	38.96	39.38	38.73
E	36.81	36.20	36.50	35.70	36.45	35.10	35.40	34.80
F	36.80	36.18	36.48	35.68	36.44	35.07	35.40	34.78
G	36.82	36.15	36.52	35.46	36.46	35.05	35.41	34.75

Table 7 below reveals the mean values of pH of Nunu during the period of storage from first day to the seventh day at temperature of 10^0C and 28^0C.

Table 7: Mean pH Analysis during Storage

Sample	Day 1		Day 3		Day 5		Day 7	
	10^0C	28^0C	10^0C	28^0C	10^0C	28^0C	10^0C	28^0C
A	4.40	4.20	4.35	4.10	4.30	3.90	4.20	3.70
B	5.05	4.35	4.98	4.20	4.93	4.00	4.88	3.80
C	5.08	4.33	4.95	4.15	4.92	3.97	4.86	3.70
D	5.00	4.40	4.93	4.10	4.90	4.05	4.85	3.80
E	6.40	6.00	6.22	5.85	6.05	5.70	6.00	5.58
F	6.42	5.90	6.25	5.75	6.10	5.62	6.05	5.50
G	6.45	5.95	6.27	5.82	6.12	5.70	6.08	5.56

4. Discussion

Quantitative analysis on the physio-chemical composition of unpasteurized Nunu and Nunu pasteurized at low temperature of 63^0C and by time exposure of 30minutes and high temperature of 72^0C short time exposure of 15seconds were done prior to storage and during storage at different temperature.

The titratable acidity of the unpasteurized Nunu (2.14) mean value was the highest of the three (3) samples. The heat applied in the pasteurization of the other two (2) samples may be responsible for the low value of 1.98 and 1.90 recorded for LTLT and HTST, respectively. The titratable acids present could probably be very volatile hence the titratable acid value for HTST (1.90) was less probably due to heat more heat applied in pasteurization, making more of the volatile acid to reduce. The result shows that the more heat applied, the more the titratable acid would vaporize from the sample.

The descriptive statistical analysis of the physio-chemical composition of unpasteurized Nunu, using mean shows that Protein for unpasteurized sample A has mean value of 3.48 before storage and was 3.30 and 3.20 during the first day of storage at temperature of 10^0C and 28^0C, respectively. This decrease continues till the seventh day of storage where the protein content was 3.10 and 2.30 at temperature of 10^0C and 28^0C, respectively.

The Protein for pasteurized sample B has mean value of 3.31 before storage and was 3.32 and 3.30 during the first day of storage at temperature of 10^0C and 28^0C respectively. This decrease continues till the seventh day of storage where the protein content was 3.26 and 3.00 at temperature of 10^0C and 28^0C respectively.

The Protein for pasteurized sample C has mean value of 3.31 before storage and was 3.33 and 3.28 during the first day of storage at temperature of 10^0C and 28^0C respectively. This decrease continues till the seventh day of storage where the protein content was 3.28 and 2.98 at temperature of 10^0C and 28^0C respectively.

The Protein for pasteurized sample D has mean value of 3.31 before storage and was 3.32 and 3.28 during the first day of storage at temperature of 4^0C and 28^0C respectively. This decrease

continues till the seventh day of storage where the protein content was 3.27 and 2.99 at temperature of 10^0C and 28^0C respectively.

The Protein for pasteurized sample E has mean value of 2.57 before storage and was 2.70 and 2.66 during the first day of storage at temperature of 10^0C and 28^0C respectively. This decrease continues till the seventh day of storage where the protein content was 2.64 and 2.58 at temperature of 10^0C and 28^0C respectively.

The Protein for pasteurized sample F has mean value of 2.52 before storage and was 2.69 and 2.65 during the first day of storage at temperature of 10^0C and 28^0C respectively. This decrease continues till the seventh day of storage where the protein content was 2.63 and 2.57 at temperature of 10^0C and 28^0C respectively.

The Protein for pasteurized sample G has mean value of 2.53 before storage and was 2.69 and 2.67 during the first day of storage at temperature of 10^0C and 28^0C respectively. This decrease continues till the seventh day of storage where the protein content was 2.64 and 2.57 at temperature of 10^0C and 28^0C respectively.

The physio-chemical composition of unpasteurized Nunu, the descriptive statistical analysis using mean shows that Carbohydrate for unpasteurized sample A has mean value of 26.32 before storage and was 26.53 and 25.70 during the first day of storage at temperature of 10^0C and 28^0C respectively. This decrease continues till the seventh day of storage where the protein content was 26.28 and 25.49 at temperature of 10^0C and 28^0C respectively.

The protein content of HTST mean value (2.54) was the least compared to that of LTLT and unpasteurized Nunu with mean value (3.31) and (3.48) respectively. The result shows that heat is a major factor affecting the protein content of Nunu. The more of the heat applied the more of the protein that is destroyed with duration of exposure not having a prominent effect.

The fat content of the Nunu displayed some level of heat volatility. The unpasteurized having highest fat content of 7.02 (mean value) than that of LTLT with 2.52 (mean value) recorded. However, the HTST had less fat content mean value compared to LTLT. This may be due to oil of the fat becoming more volatile at high temperature of 73^0C used for HTST.

The Carbohydrate for pasteurized sample B has mean value of 41.68 before storage and was 40.50 and 39.55 during the first day of storage at temperature of 10^0C and 28^0C respectively. This decrease continues till the seventh day of storage where the protein content was 39.36 and 38.70 at temperature of 10^0C and 28^0C respectively.

The Carbohydrate for pasteurized sample C has mean value of 41.68 before storage and was 40.52 and 39.56 during the first day of storage at temperature of 10^0C and 28^0C respectively. This decrease continues till the seventh day of storage where the protein content was 39.38 and 38.72 at temperature of 10^0C and 28^0C respectively.

The Carbohydrate for pasteurized sample D has mean value of 41.68 before storage and was 40.55 and 39.60 during the first day of storage at temperature of 10^0C and 28^0C respectively. This decrease continues till the seventh day of storage where the protein content was 39.38 and 38.73 at temperature of 10^0C and 28^0C respectively.

The Carbohydrate for pasteurized sample E has mean value of 37.55 before storage and was 36.81 and 36.20 during the first day of storage at temperature of 10^0C and 28^0C respectively. This decrease continues till the seventh day of storage where the protein content was 35.40 and 34.80 at temperature of 10^0C and 28^0C respectively.

The Carbohydrate for pasteurized sample F has mean value of 37.58 before storage and was 36.81 and 36.20 during the first day of storage at temperature of 10^0C and 28^0C respectively. This decrease continues till the seventh day of storage where the protein content was 35.40 and 34.78 at temperature of 10^0C and 28^0C respectively.

The Carbohydrate for pasteurized sample G has mean value of 37.55 before storage and was 36.82 and 36.15 during the first day of storage at temperature of 10^0C and 28^0C respectively. This decrease continues till the seventh day of storage where the protein content was 35.41 and 34.75 at temperature of 10^0C and 28^0C respectively.

The physio-chemical composition of unpasteurized Nunu, the descriptive statistical analysis using mean shows that pH for unpasteurized sample A has mean value of 4.55 before storage and was 4.40 and 4.20 during the first day of storage at temperature of 10^0C and 28^0C respectively.

This decrease continues till the seventh day of storage where the protein content was 4.20 and 3.70 at temperature of 10^0C and 28^0C respectively.

The pH for pasteurized sample B has mean value of 5.28 before storage and was 5.05 and 4.35 during the first day of storage at temperature of 10^0C and 28^0C respectively. This decrease continues till the seventh day of storage where the protein content was 4.88 and 3.80 at temperature of 10^0C and 28^0C respectively.

The pH for pasteurized sample C has mean value of 5.28 before storage and was 5.08 and 4.33 during the first day of storage at temperature of 10^0C and 28^0C respectively. This decrease continues till the seventh day of storage where the protein content was 4.86 and 3.70 at temperature of 10^0C and 28^0C respectively.

The pH for pasteurized sample D has mean value of 5.28 before storage and was 5.00 and 4.40 during the first day of storage at temperature of 10^0C and 28^0C respectively. This decrease continues till the seventh day of storage where the protein content was 4.85 and 3.80 at temperature of 10^0C and 28^0C respectively.

The pH for pasteurized sample E has mean value of 6.60 before storage and was 6.40 and 6.00 during the first day of storage at temperature of 10^0C and 28^0C respectively. This decrease continues till the seventh day of storage where the protein content was 6.00 and 5.58 at temperature of 10^0C and 28^0C respectively.

The pH for pasteurized sample F has mean value of 6.70 before storage and was 6.42 and 5.90 during the first day of storage at temperature of 10^0C and 28^0C respectively. This decrease continues till the seventh day of storage where the protein content was 6.05 and 5.50 at temperature of 10^0C and 28^0C respectively.

The pH for pasteurized sample G has mean value of 6.98 before storage and was 6.45 and 5.95 during the first day of storage at temperature of 10^0C and 28^0C respectively. This decrease continues till the seventh day of storage where the protein content was 6.08 and 5.56 at temperature of 10^0C and 28^0C respectively.

The result of the physio-chemical analysis reveals the protein, carbohydrate and pH levels of the Nunu samples decreased during the period of storage each day. This decrease was more noticed

in the unpasteurized samples and the samples stored at 28^0C. This is in line with the work of Nebedum and Obiakor, (2007) that Protein levels decreased in both the preserved and unpreserved nunu, indicating proteolysis. This was highest in the unpreserved sample, ranging from 3.26 - 2.20 mg/ml by the 7th day. Changes were least in the sample preserved with sodium benzoate. Adesokan, *et al*., (2011) opined that pH of Nunu samples decreased as fermentation progressed which is in agreement with Oyewole (1990) who stated that the acidity of fermented milk is normally noticeable when the pH falls to about 5.5.

5. Conclusion

Nunu is an excellent refreshing and nourishing drink that is used by nomadic cattle rearers. The lactic acid content determines the sensory and rheological properties of the milk and also makes it more easily digestible. Nunu, which is very much like yoghurt, is being produced in limited daily consumable quantities due to its poor keeping quality. Knowledge of the biochemical and microbial changes that are associated with its spoilage and the various methods of preservation will obviously enhance the production and proper utilization on a larger scale. An attempt was made to assess the impact of pasteurization temperature and storage temperature on Nunu milk. The results indicated that pasteurization at 72^0C for 15 seconds has a positive impact on Nunu milk shelf life and sensory analysis. Nunu milk pasteurized at 72^0C for 15 seconds showed better sensory characteristics and higher pH compared to the Nunu milk pasteurization at 63^0C for 30 minutes. Therefore, Nunu milk pasteurized at 72^0C for 15 seconds could be an interesting way to produce on an industrial scale, a uniform product of constant quality with improved sensory characteristics.

Reference

Adesokan, I.A., Odetoyinbo, B. B., Ekanola, Y. A., Avanrenren, R. E. and Fakorede, S. (2011): Production of Nigeria Nono using Lactic starter cultures. *Pakistan Journal of Nutrition*. 10(3): 203-207.

AOAC (2000): Official Methods of Analysis, 13th Ed., Washington DC: Association of Official Analytical Chemist.

AOAC (2005): Official method of Analysis. 18th Edition, Association of Officiating Analytical Chemists, Washington DC, Method 935.14 and 992.24.

Cheesbrough, M. (2000): District laboratory practice in Tropical countries. Cambridge University press, United Kingdom. 416pp.

Curry, A. (2013): Archaeology: The milk revolution. *Nature*. 500 (7460): 20–22.

Elert, G, (2002): Density of milk. http://hypertextbook.com/facts/2002/ Alicia Noelle Jones. Shtml.

Elmagli, A. A. O. and El Zubeir, I. E. M. (2006): Study on the compositional quality of pasteurized milk in Khartoum State (Sudan). *International Journal of Dairy Sciences*. 1 (1): 12– 20.

Mohamed, N.N.I. and El Zubeir, I.E.M. (2007): Evaluation of the hygienic quality of market milk of Khartoum State (Sudan). *International Journal of Dairy Sciences*. 2 (1): 33-41.

Nebedum, J. O. and Obiakor, T. (2007): The effects of different preservation methods on the quality of nunu, a locally fermented Nigerian dairy product. *African Journal of Biotechnology*. 6 (4): 454-458.

Oyewole, O. B. (1990): Optimization of cassava fermentation for fufu production. Effects of single stater culture. *J. Applied Bacteriol.* 68: 49-54

Pehrsson, P. R., Haytowitz, D. B., Holden, J. M., Perry, C. R. and Beckler, D. G. (2000): USDA's National Food and Nutrient Analysis Program: Food Sampling. *Journal of Food Composition and Analysis*. 13 (4): 379–389.

Uruakpa, F. O., Ismond, M. A. H. and Akobundu, E. N. T. (2002): "Colostrum and its benefits: A review". Nutrition Research. 22 (6): 755–767.

Wallander, J. F. and Samson, A. M. (1976): Effect of certain heat treatments on the milk lipase system. J. Dairy Sci. 50: 949.

Yahuza, M. L. (2001): Small - holder dairy production and marketing constrains in Nigeria. In: Rangnekegr, D. and Thorpe, W. (Eds). Proceedings of a South – South workshop held at National Dairy Development Board (NDDB). Anand, India and ILRI (International Livestock Research Institute), Nairobi, Kenya.