Direct Research Journal of Agriculture and Food Science
Vol. 11(4) Pp. 97-104, April 2023
ISSN 2354-4147
DOI: https://doi.org/10.26765/DRJAFS49495705
Article Number DRJAFS49495705

https://directresearchpublisher.org/drjafs/

Original Research

Quality Evaluation, Mineral Composition and General Acceptability of *Mordom*, a Traditional Millet Gruel Produced from Different Millet Varieties

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Received 6 January 2023; Accepted 28 March 2023

ABSTRACT: The goals of this study are to make mordom from several millet grain varieties and to evaluate the functional characteristics, proximate composition, mineral, microbiological, and sensory qualities of the produced mordom. A total of eight (8) samples were employed in the investigation, including six millet types (Ex- Borno, Soss at C88, Super Soss at, PEO5834, Farmer's local, and LCIC9702) and two localities mordom as controls (Shehuri North mordom N, Shehuri South mordom S). The functional properties of the flour samples ranges were bulk density;0.41 g/ml to 0.58 g/ml, dispersibility;72.29% to 76.50%, solubility; 25.62% -32.05%, swelling power; 0.50 g/g -0.73 g/g, water absorption capacity;1.48% to 1.65% and viscosity;1891 m/s^2 to 1401 m/s^2). The proximate composition of the *mordom* samples ranges were moisture; 63.96% to 68.39 %, protein;10.05% to 11.39%, fat ;3.41 % to 4.74%, ash; 1.36% to 1.76% and carbohydrate;14.97% to 20.61%. The mineral contents ranges were zinc; 24.20 mg to 35.92 mg, calcium; 171.92 mg to 374.92 mg, iron ;19.17mg to 33.86 mg, potassium; 350.33mg to 461.30mg and magnesium; 268.40 mg to 529.52 mg. The total bacteria count ranges from 1.4×10^3cfu/g to 2.1×10^3cfu/g and total fungal count ranges from 0.8×10^2cfu/g to 1.5×10^2cfu/g. The overall acceptability mean score ranges from 8.17 to 8.78. Mordom made from different millet kinds was widely accepted. The addition of kindirmo (cow milk) considerably boosted the nutritious content of the mordom by boosting the protein and fat content.

Keywords: *Mordom*, millet, kindirmo, nutrient composition, minerals

Citation: Barde, A., Abubakar,F., Adamu, U. T., & Dawud, Maryam, A. (2023). Quality Evaluation, Mineral Composition and General Acceptability of Mordom, a Traditional Millet Gruel Produced from Different Millet Varieties. Direct Res. J. Agric. Food Sci. Vol. 11(4) Pp. 97-104. https://doi.org/10.26765/DRJAFS49495705

INTRODUCTION

Millet is a prominent and staple food crop in Nigeria's northwestern region, and it is used for human consumption due to its drought resistance. Pearl millet is the sixth most important cereal crop grown as a rain-fed crop in Africa and the Indian subcontinent each year (FAO, 2007; Khairawal *et. al*, 1999). It is farmed in over 40 countries, primarily in Africa and Asia, as a major food grain, feed and fodder, fuel, and building material (FAO, 2007. Millions of tonnes of pearl millet are consumed as a staple grain in many Nigerian households, particularly among the poor, who live primarily in Northern Nigeria (FAO, 2007). It is also used to make "masa," a popular fried cake. Its flour is also used to make "tuwo," a thick binding paste known as "toh" in Northern Africa. It includes 18% protein and is high in vitamin B, particularly niacin, B6, and folic acid. Numerous popular traditional millet cuisines include 'yaryau,''masa,' 'kunun tsamiya,' 'fura,' 'dambu,' and mordom (Nkama, 1990; Nkama *et al.,* 2001). Mordom can be described as a thin, non-alcoholic porridge. It is made with millet flour, fermented cow milk (kindirmo or tsala), spices (ginger, clove, pepper, and so on), and sugar, and is popular in northern Nigeria, notably Borno state. Hence, in Sub-Saharan Africa, it serves as a vital breakfast, refreshment drink for adults, and complementary food for children (Kikafunda *et al.,* 2006; Oi and Kitabake, 2003;Onyango, 2003), as well as a source of nourishment for the sick and invalid (Wanjala *et al*., 2016). Tropical cereal and root crops such as maize (Zea mays), finger millet (Eleusine coracana), pearl millet (Pennisetum glaucum), sorghum (Sorghum bicolor), and cassava (Manihot esculenta) are also used to make it (Taylor and Emmambux, 2008; Wanjala *et al*., 2016).

'Kindirmo' is a popular traditional yoghurt made from fermented whole cow milk by lactic acid bacteria such as Lactobacillus, Lactococcus, and Leuconostoc; it can be partially skimmed and fermented or whole fermented milk that has been partially skimmed (Sudi *et al*., 2011). The addition of 'Kindirmo' to mordon improves the taste of the porridge. The study aim to produce *mordom* from different millet varieties, and to determine the proximate content, functional properties of the millet flour, mineral content, microbiological counts and sensory acceptability of the *mordom*.

MATERIALS AND METHODS

Sample preparation

Mordom is usually produced from millet flour and a total of eight (8) samples were used in study. Six millet varieties (Ex- Borno, Sossat C88, Super Sossat, PEO5834, Farmer's local and LCIC9702) which were obtained from Lake Chad Research Institute, Maiduguri, Borno State and Two local controls (Shehuri North *mordom* N, Shehuri South *mordom* S)that were obtained from Maiduguri metropolitan. The *mordom* samples from Shehuri North (*mordom* N) and Shehuri South (*mordom* S) were immediately collected after preparation from two homes in these two locations and kept in an air tight plastic container, covered, labeled and transported immediately to the laboratory for analysis along with the *mordom* samples produced from the six millet varieties. All the samples were freshly prepared for each of the analysis.

Production of mordom

The mordoms were made using the traditional procedure, which includes cleaning, pounding, winnowing, washing, sun drying, pounding, sifting, and millet flour. Spices such as ginger and clove were added to the dry millet and pressed until it became flour. To eliminate the coarse particles, the flour was sieved through smaller aperture sieves. The coarse particles were pounded again until it came soft and fine flour was formed. Pounding and sieving were repeated until the necessary amount of flour was obtained. Slurry was formed with flour and water and set aside. A small amount of slurry was boiled in a pot. Cooking has already been cleaned. Two portions of the slurry were gradually added to the saucepan while stirring for five to ten minutes, depending on the amount. The mixture was covered and left for around 15 to 20 minutes. To the remaining fraction of the slurry, fresh 'kindirmo' was sieved to eliminate particles and clumps and to make the milk smoother. This provided the appropriate flavour, taste, and colour while also transforming the mordom into a thin gruel. This was then stirred into the slightly cooled millet in the pot, with the addition of sugar to taste, and served (Figure 1).

Millet grains
↓
Cleaning
↓
Pounding (to remove the outer testa)
↓
Winnowing to remove the bran
↓
Washing
↓
Sun drying
↓
Pounding of millet and spices into flour
↓
Sieving with very fine sieve → coarse flour
↓
Millet flour

Figure 1: Flow chart for *mordom* flour production

Proximate composition of the mordom

Moisture, protein, fat, ash, and carbohydrate were determined using standard wet analysis procedures (AOAC, 2000). The moisture content of mordom was determined in a hot air oven at 105°C for 3 hours, and the total ash content of mordom was determined in a muffle furnace at 550°C for 5 hours. The crude fibre content was determined by digesting the filtered residue with a trichloroacetic acid reagent, drying it in an oven, and finally ashing it in a boiler. The crude fibre content is the difference between the dried residue and the ash percentage. Fat contents were determined using Soxhlet extraction method using petroleum ether for 5hr, oven drying the extract at 70ºC for 10 min. and crude protein contents by micro-Kjeldahl method involving 200 mg sample. Carbohydrate contents by difference. Carbohydrate (%) = 100 -[% moisture + % protein + % fat + % ash + % crude-fiber]. Energy in kcal/100g of *mordom* by multiplying gross nutrients with Atwaters conversion factors.

Functional properties

Bulk density determination of the *mordom*

Onwuka (2005) described method was used. A graduated measuring cylinder with a capacity of ten (10ml) was pre-weighted. The sample was carefully poured into the cylinder. After filling to the 10ml mark, the cylinder was gently tapped several times on the laboratory bench until there was no further decline in the sample level. It was weighed and the following calculations were made:

$$\text{Bulk Density (g/ml)} = \frac{weight\ of\ sample\ (g)}{volume\ of\ samples}$$

Water absorption capacity (WAC) of the *mordom*

The AOAC (2000) was used to determine water absorption capacity. A centrifuge tube was filled with around 2 g of gruel. Five millilitres of water were added and thoroughly mixed. After standing for 30 minutes, the mixture was centrifuged at 600 rpm for 15 minutes. The supernatant was decanted, and the sample's new weight was taken as water absorbed, and the result was expressed as weight (g) of water per 100 g dry samples.

$$\%WAC = \frac{weight\ of\ sample\ after\ centrifuge}{weight\ of\ the\ original\ sample} \quad x \quad \frac{100}{1}$$

Swelling power and solubility index determination of the *mordom*

Hirsch and Kokini (2002) approach was utilized to calculate swelling power and solubility index. One gramme of the gruel was placed into a pre-weighed graduated centrifuge tube that had been labelled correctly. The solution was agitated and placed in a water bath heated at varying temperatures of 85°C for one hour while shaking the sample gently to ensure that the starch granules stayed in suspension until gelatinization occurred. The samples were cooled to room temperature under running water before being centrifuged at 3000 rpm for 15 minutes. The supernatant was decanted from the sediment into a pre-weighed petri-dish after centrifugation; the supernatant in the petri-dish was weighed and dried at 105 °C for 1 hour. The weight of the sediment in the tube was recorded. The swelling power and solubility of starch were calculated using the formulae below,

$$\text{Swelling power} = \frac{weight\ of\ swollen\ sediment}{weight\ of\ starch\ sample}$$

$$\text{Solubility} = \frac{\text{weight of dry supernatant}}{\text{weight of starch sample}} \times 100$$

Measurement of dispersibility of the *mordom*

The method described by Balami *et al.* (2004) was adopted. Fifty milliliters (50 ml) of distilled water were added to 3g of the sample and the mixture stirred for a minute at room temperature. The mixtures were filtered through dried cheese cloth of known weight then rinse in a beaker with 50 ml of distilled water and pour through the cheese cloth. The sieve and residue were dried in a hot air oven at 1000ºC for 10minutes. The dispersibility was expressed as the percentage of the solids dissolved.

Determination of viscosity of the *mordom*

Viscosity was determined using Haake Roto Visco RVI equipped with concentric cylinders and viscosity measurement made at 300ºC. The apparent viscosity of the feed was measured over a range of shear rates (s-1) and the relative viscosity of the solution at a given shear rate was calculated as shown below (Attia *et al.,* 1979).

$$\text{Relative viscosity } (\eta r) = \frac{\eta g}{\eta s}$$

Where, ŋg = apparent viscosity of solution, Ŋs = apparent viscosity of solvent

Microbiological Count of the *Mordom*

Ten grams of each of the processed *mordom* blends was suspended in 90 ml sterile nutrient broth and serially diluted. Using the pour plate method, the serial dilution was plated out on duplicate plates for bacterial counts using nutrient agar (Harrigan and McCance, 1976). Mould count was determined using potato dextrose agar. Representative colonies of mold were isolated and, purified by culturing on potato dextrose agar. A bacterial colony was isolated, purified using nutrient agar and inoculated into biochemical media, before identification using methods described by Harrigan and McCance (1976).Staphylococcal count was determined using Baired- Parker agar. Procedure (a) a 10^{-1} food homogenate was prepared and, serial decimal dilution was carried out. (b) A table surface counting method was selected and enumerated on Baird—Parker agar. (c)The plate was incubated at 37°C for 48±4h. Examination for the presence of typical colonies, which appear grey black, shiny and convex, of diameter 1— 1.5mm (24h incubation) or up to 3mm (48h incubation), surrounded by a zone of clearing was appeared. After at least 24h an opalescent ring immediately in contact with the colony may appear within the zone of clearing (Roberts and Greenwood, 2003).

Mineral determination

The mineral content of *mordom* produced was determined according to the method described by AOAC (2000). Five grams each of the gruel were weighed into a crucible dish and placed in a muffle furnace and Ashed for 2 hours at a temperature of 500°C. To the Ashed sample 10cm^3 of 6M Nitric acid (HNO_3) was added and agitated until a uniform solution is obtained. It was filtered into a 50cm^3 sample bottle. To the filtrate, distilled water was added until it was filled up to the 50cm^3 level. A blank sample was prepared involving 10cm^3 6M Nitric acid. Solutions were analyzed with Atomic Absorption Spectrophotometer (AAS). A blank and the standard were first aspirated and the absorbance reading was recorded. Average absorbance reading of both standard and samples were corrected using blank reading, and a similar procedure was repeated for different lamps and samples. A calibration curve was plotted for the standard of each metal with the absorbance versus concentration. By interpolation, the concentration of metals in part per million (ppm) was determined in the calibration graphs.

Statistical analysis

All experimental data obtained were subjected to analysis of variance (ANOVA) procedure of SPSS version 15.0(SPSS, 2006) at 5% level of significant.

RESULTS AND DISCUSSION

Proximate composition of *mordom* produced from different millet varieties

The results of proximate composition for the *mordom* samples used in the study is shown in (Table 1). The results indicate increased in protein, fat, ash contents which was due to the addition of the fresh '*kindirmo*' to the *mordom*, the moisture content of the *mordom* samples showed significant differences (p<0.05) among the samples. Udeozor, (2012) have shown similar results to the proximate values for the thin gruels. The moisture content ranged between 63.96% and 68.39%. The *mordom* sample produced from PEO5984 had the lowest moisture content of 63.96% while *mordom* sample produced from Super Sossat had the highest moisture content of 68.39%. This high moisture content indicates that the *mordom*was a thin porridge that was attributed to the addition of the *kindirmo* (cow milk). The protein content of the *mordom* sample produced indicates significant differences (p<0.05), the protein ranged from 10.05% to 11.39%. This shows that *mordom* sample produced from LCIC9702 had the lowest protein content of 10.37% while *mordom* sample produced from Farmers local had the highest protein content of 11.39%. The protein content of the *mordom* produced in this study was higher than the protein content of tiger nut drink with (1.2 – 2.3%) (Ukwuru and Ogbodo, 2011) and soymilk protein (2.19 – 2.99) (Jiang, *et. al.,* (2013). The increment in the protein content of the *mordom* is an indication that *mordom* has a great potential to increase the protein intake in the diet of its consumers. The increase in protein content in the *mordom* samples was due to the addition of the '*kindirmo*' (cow milk) which improved the nutritive value of the *mordom*. Fat content indicate that, there were significant differences (p<0.05) within the column. The fat content ranged from 3.41 % to 4.74%. The *mordom* sample produced from PEO5984 had the lowest fat content of 3.41% while the *mordom* sample produced fromLCIC9702 had the highest fat content of 4.74%. Although, Cereals generally are low in fats (1–2%) contents (McDonald *et al.,* 1997), the increase in fat content in the *mordom* samples was due to the addition of the '*kindirmo*'obtainable from cow milk which has fat content of about 27.6 – 34.6%, (Ajai *et. al.,* 2013). Other thin gruels have fat content of (2.0 – 2.8%) for soymilk kunnu blends produced by Sowonola *et al.,* (2005), and higher fat content of (7.57 – 9.17%) for the fortified kunnu produced by Bolarinwa, *et.al.,* (2017). The relatively high fat content of the fortified *mordom* indicates that *mordom* will be creamy and palatable to taste.The ash content showed a significant difference at (p<0.05) among the samples. Ash ranged from 1.36% to 1.76% and this indicate that the *mordom* sample produced from Ex-Borno and LCIC9702 had the least ash contents of 1.36% while the *mordom* sample produced from Shehuri North had the highest ash content. Carbohydrate showed significant differences(p<0.05).The carbohydrate content ranged from 14.97% to 20.61% where of the *mordom* sample produced from Super Sossat had the lowest carbohydrate while the *mordom* sample produced from PEO5984 had the highest carbohydrate content. This is in lined with Ukwuru and Ogbodo (2011), that reported carbohydrate content of 5.1 to 11% for thin gruel tiger nut milk and 25.6 – 28.2% for thin gruel kunnu-zaki was also reported by Bolarinwa *et al.,* (2017). The carbohydrate content of the *mordom* samples indicated

Table 1: Proximate composition of *mordom* produced from different millet varieties.

Sample	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Carbohydrate (%)	Energy(Kcal)
Ex- Borno,	64.41±0.14^{d}	10.72±0.11^{c}	4.49±0.09^{b}	1.36±0.01^{e}	19.02±0.10^{b}	159.37
Sossat C88,	67.30±0.20^{b}	10.68±0.15^{d}	4.58±0.06^{b}	1.51±0.03^{c}	15.93±0.12^{e}	147.66
Super Sossat,	68.39±0.10^{a}	11.30±0.09^{a}	3.75±0.05^{d}	1.59±0.02^{b}	14.97±0.15^{e}	138.83
PEO5984,	63.97±0.16^{e}	10.53±0.10^{d}	3.41±0.08^{e}	1.48±0.01^{d}	20.61±0.13^{a}	155.25
Farmers"local	65.52±0.22^{c}	11.40±0.12^{a}	4.56 ±0.06^{b}	1.59±0.05^{b}	16.93±0.12^{d}	154.36
LCIC9702	65.99±0.40^{c}	10.50±0.08^{e}	4.74±0.08^{a}	1.36±0.03^{e}	17.41±0.13^{c}	154.30
Mordom (N)	64.69±0.10^{d}	10.64±0.13^{d}	3.96±0.07^{c}	1.50±0.01^{c}	19.21±0.14^{b}	155.04
Mordom (S)	65.74±0.30^{c}	10.81±0.10^{b}	3.81±0.05^{d}	1.76±0.08^{a}	17.88±0.11^{c}	149.05

Values are means of three replicate± standard deviation, number in the same column followed by the same letters are not significant different at (p<0.05) level. Key: *Mordom* (N) = *mordom* from Shehuri North; *Mordom* (S) = *mordom* from Shehuri South

Table 2: Functional properties of the millet flour varieties.

Sample	Bulk density (g/ml)	Dispersibility (%)	Solubility (%)	Swelling Power (%)	Water Absorption (%)	Viscosity (m/s^{2})
Ex- Borno,	0.51±0.01^{c}	76.50±0.52^{a}	32.05±2.10^{a}	0.69±0.01^{c}	1.64±0.21^{b}	1891±10.4^{a}
Sossat C88	0.42±0.03^{e}	75.61±0.32^{b}	29.01±1.40^{c}	0.50±0.06^{h}	1.52±0.30^{e}	1820±8.90^{b}
Super Sossat,	0.58±0.01^{a}	72.30±0.36^{e}	29.68±1.35^{c}	0.62±0.01^{e}	1.64±0.34^{b}	1640±6.89^{d}
PEO5984,	0.47±0.05^{d}	74.15±0.40^{c}	30.04±2.52^{b}	0.73±0.02^{a}	1.50±0.15^{f}	1701±8.48^{c}
Farmer's local	0.41±0.02^{g}	74.40±0.42^{c}	28.01±1.90^{d}	0.52±0.40^{g}	1.48±0.10^{g}	1501±3.45^{f}
LCIC9702	0.39±0.01^{h}	72.90±0.29^{e}	28.91±1.47^{d}	0.71±0.03^{b}	1.65±0.21^{a}	1420±9.50^{g}
Mordom (N)	0.44±0.03^{f}	73.21±0.25^{d}	25.62±2.43^{e}	0.64±0.02^{d}	1.55±0.35^{d}	1550±4.30^{e}
Mordom (S)	0.52±0.06^{b}	72.29±0.10^{e}	25.82±1.20^{e}	0.59±0.01^{f}	1.62±0.50^{c}	1401±4.36^{h}

Values are means of three replicate± standard deviation, number in the same column followed by the same letters are not significant different at (p<0.05) level. Key: *Mordom* (N) = *mordom* from Shehuri North; *Mordom* (S) = *mordom* from Shehuri South

that the thin gruel *mordom* is a nutritious product that would provide adequate energy for both children and adults.

Functional properties of the millet flour varieties

Table 2 shows the results of a functional properties of the flour samples and the bulk density ranges from 0.41 g/ml to 0.58g/ml, dispersibility 72 .29% to 76.50%, solubility 25.62% to 32.05%, swelling power (0.73-0.50 g/g), water absorption capacity 1.48% to 1.65% and viscosity 1401 m/s^{2}to 1891 m/s^{2}. The properties indicated the quality of the flour in the preparation of *mordom* samples for consumption. The bulk density showed a significant difference (p<0.05). The bulk density of Ex- Borno was 0.51g/ml and Super Sosat 0.58g/ml was greater than the control flour N 0.44g/ml and S 0.52g/ml. Variations exit in the rate of dispersibility, showing that there was significant different within the column, The higher the dispersibility the better and more preferred flour. Significant difference existed in the swelling capacity and solubility index, with variations within the columns, Solubility 25.62% to 32.05%, Swelling Power 0.50g/g to 0.73g/g. The swelling capacities of flours depend on the variety and particle size of the flour (Suresh, 2013). Significant difference (p<0.05) existed in the mean solubility of the flours. Water absorption capacity ranged from 1.48% to 1.65%. The higher WAC of flour could be attributed to the presence of higher amount of carbohydrates (starch) and fibre in the flour. Water absorption capacity is a critical function of protein in various food products like dough and baked products (Adeyeye and Aye, 1998).

Microbiological count of the *mordom* produced from different millet varieties

The *mordom* food was analyzed microbiologically to determine microbial load. **Table 3** shows the total bacterial count, *Staphylococcus* aureus count, *Salmonella* count, yeast and mould count and *Escherichia* count, of the produced *mordom*. The total bacteria counts of the *mordom* samples ranges from 1.4×10^{3}cfu/g to 2.1×10^{3}cfu/g, *Staphylococcal aureus* from 1.4×10^{2}cfu/g to 1.8×10^{2}cfu/g, *Salmonella* ND (not detected), Yeast and Mould ranged from 0.8×10^{2}cfu/g to 1.5×10^{2}cfu/g and *E.coli* ND (not detected) respectively. It shows that from the table of result that *salmonella* and *E.coli* were not detected. The load varies from one sample to the other which could either be due to handling and processing methods. Yeast and mould growth had also been seen on all the *mordom* samples produced. Lower microbial count was observed. The safe limit of 10^{4} was accepted by ICMSF (International Commission on Microbiological Specification for Foods, 1996), this implies that, the population of the microorganisms does not produce an effective dose that would render the food unfit for consumption. Yeast and mould seems to be lowered among all the organisms tested in the study this could be as a result of high moisture content present in the samples. The presence of microorganisms in *mordom*

Table 3: Microbiological count of the *mordom* produced from different millet varieties.

Sample	TBC(cfu/g)	S. Aureus (cfu/g)	Salmonella (cfu/g)	Yeast/moulds(cfu/g)	E.coli (cfu/g)
Ex- Borno,	$2.0X10^3$	$1.5X10^2$	ND	$0.9X10^2$	ND
Sossat C88	$1.6x10^3$	$1.8x10^2$	ND	$0.8x10^2$	ND
Super Sossat,	$1.5x10^3$	$1.7x10^2$	ND	$1.4x10^2$	ND
PEO5984,	$2.1x10^3$	$1.5x10^2$	ND	$1.5x10^2$	ND
Farmer's local	$1.8x10^3$	$1.6x10^2$	ND	$1.4x10^2$	ND
LCIC9702	$1.7x10^3$	$1.4x10^2$	ND	$1.3x10^2$	ND
Mordom (N)	$1.6x10^3$	$1.6X10^2$	ND	$1.4x10^2$	ND
Mordom (S)	$1.4x10^3$	$1.4x10^2$	ND	$1.5x10^2$	ND

Values are means of three replicate± standard deviation, number in the same column followed by the same letters are not significant different at (p<0.05) level.Key: *Mordom* (N) = *mordom* from Shehuri North; *Mordom* (S) = *mordom* from Shehuri South, BDL= below detective.

Table 4: Mineral composition of the *mordom* produced from different millet varieties.

Sample	Zn	Ca	Fe	K	Mg
Ex- Borno,	$24.20±0.01^h$	$233.60±1.00^f$	$29.25±0.00^c$	BDL	$310.04±1.00^d$
Sossat C88	$26.96±0.10^f$	$304.63±0.20^b$	$21.65±0.01^g$	BDL	$268.40±0.00^g$
Super Sossat,	$32.87±0.33^c$	$171.88±0.22^h$	$19.17±1.00^h$	BDL	BDL
PEO5984,	$33.52±2.01^b$	$249.12±1.01^d$	$31.20±0.20^b$	$461.30±0.00^a$	$529.52±0.01^a$
Farmer's local	$27.83±0.00^d$	$374.92±3.00^a$	$33.86±0.00^a$	BDL	$300.00±0.00^e$
LCIC9702	$35.92±0.30^a$	$190.40±2.00^g$	$25.60±1.01^f$	$350.33±1.01^b$	$356.68±2.22^b$
Mordom (N)	$25.44±0.03^g$	$243.21±0.25^e$	$25.62±2.43^e$	BDL	$320.55±0.35^c$
Mordom (S)	$27.52±0.06^e$	$300.29±0.10^c$	$25.82±1.20^d$	BDL	$280.62±0.50^f$

Values are means of three replicate± standard deviation, number in the same column followed by the same letters are not significant different at (p<0.05) level. Key: *Mordom* (N) = *mordom* from Shehuri North; *Mordom* (S) = *mordom* from Shehuri South, BDL= below detective.

food is not desirable because they can cause diarrhea and vomiting in children, leading to complications such as dehydration.

Mineral composition of the *mordom* produced from different millet varieties

The mineral contents of the *mordom*are shown on (**Table 4)**. Zinc ranged from 24.20mg to 35.92mg, Calcium from 171.92 mg to 374.92mg, Iron from 19.17mg to 33.86 mg, Potassium from 350.33 mg to 461.30mg in samples POE5984 and LCIC9702, while Ex-Borno, Sosat C88, Super Sosat are below detective (BDL) and Magnesium ranged from 268.40 mg to 529.52mg. The range of zinc, calcium, iron, potassium and magnesium and in samples showed a significance difference at (p<0.05) within the samples. The results in (**Table 4)** show, the level of zinc, calcium, iron, magnesium and potassium reported with higher contents with variations within the columns. The magnesium and iron varied significantly at (P<0.05) from one another. Similar results have also been reported by Abulude *et al.*(2006).Magnesium and potassium which are essential for good health, by maintaining muscle and nerve function, keeps heart steady and supports a healthy immune system, calcium to build strong bones and teeth, iron a major component of hemoglobin, Helps to boost immune system and for cognitive function and zinc also helps in maintaining a healthy immune system and for healthy skin.

Sensory evaluation of *mordom* produced from different millet varieties

The results for sensory evaluation of the *mordom* samples produced is shown in (Table 5). The result indicated that the *mordom*samples produced were generally accepted by the panels and were in line with the results obtained from Ukom *et al*. (2018). The result for colour ranges from 7.76 to 8.85, which indicate that there were significant differences (p<0.05) among the *mordom* sample produced. The colour of the *mordom* sample produced from Super Soss at had the least score for color with 7.76 while of the *mordom* sample produced from LCIC9702had the highest score for color of 8.85. Texture ranges from 7.80 to 8.53 and indicated that there were significant differences among all the *mordom* sample produced except that,*mordom* (N) and Sossat C88 significant differences (p<0.05)between these two samples. The texture of the *mordom* sample produced from *mordom* (N) had the least score for texture while the *mordom* sample produced from PEO9702had the highest score for color of 8.53. Taste indicates that there was no significant difference (p<0.05) among the *mordom* sample produced from Ex-Borno, Super Sossat, Farmer's local, and LCIC9702 while there was also no significant difference between PEO9702, Super Sossat, *mordom*(S) and *mordom*(N). The taste score ranged between 7.49 and 8.75. The taste of the *mordom* sample produced from *mordom* (N) had the least score for taste with 7.49

Table 5: Sensory Evaluation of *Mordom* Produced from Different Millet Varieties.

Samples	Colour	Texture	Taste	Aroma	Consistency	Overall acceptability
Ex- Borno,	8.38±0.11[c]	8.53±0.14[a]	8.73±0.12[a]	8.78±0.11[a]	7.56±0.12[d]	8.78±0.14[a]
Sossat C88,	8.46±0.10[b]	8.19±0.11[d]	8.58±0.13[b]	8.48±0.12[c]	7.58±0.13[d]	8.59±0.11[b]
Super Sossat,	7.76±0.15[e]	8.28±0.10[c]	7.85±0.12[c]	8.70±0.10[a]	7.70±0.12[c]	8.36±0.10[d]
PEO5984,	7.68±0.12[e]	8.50±0.15[a]	7.74±0.14[d]	8.55±0.12[c]	7.24±0.11[e]	8.47±0.11[c]
Farmer's local	8.48±0.11[b]	8.35±0.14[c]	8.75±0.12[a]	8.78±0.15[a]	8.08±0.12[b]	8.41±0.13c
LCIC9702	8.85±0.13[a]	8.44±0.13[b]	8.43±0.13[b]	8.64±0.13[b]	8.47±0.13[a]	8.29±0.14[d]
Mordom (N)	8.20±0.10[d]	7.80±0.11[e]	7.49±0.16[e]	8.19±0.10[e]	7.27±0.14[e]	8.17±0.15[e]
Mordom (S)	8.44±0.13[b]	8.32±0.15[c]	7.88±0.10[c]	8.28±0.12[d]	7.20±0.11[e]	8.30±0.13[d]

Values are means of three replicate± standard deviation, number in the same column followed by the same letters are not significant different at ($p<0.05$) level. Key: *Mordom* (N) = *mordom* from Shehuri North; *Mordom* (S) = *mordom* from Shehuri South

while the of the *mordom* sample produced from farmer's local had the highest score for taste of 8.75. The score for aroma ranged between 8.19 and 8.78. The aroma of the *mordom* sample produced *mordom* (N) had the least score for aroma with 8.19 while the *mordom* samples produced from Ex-Borno and farmers local had the highest score for aroma with 8.78. Overall acceptability showed that there were significant differences at $p<0.05$ among the *mordom* samples produced from all the millet grains, the result indicated that all the *mordom* samples produced were highly rated. The score for overall acceptability ranged between 8.17 and 8.78. The overall acceptability of the *mordom* sample produced from *mordom* (N) had the least score for overall acceptability while the *mordom* sample produced from Ex-Borno wheat had the highest score for overall acceptability of 8.78. However, all the produced *mordom* samples were generally accepted. Wanjala *et al.* (2016) also reported similar results for the acceptability of gruels.

Conclusion

Mordom produced from different millet varieties is generally accepted. Addition of kindirmo (cow milk), increased the nutritional contents of the *mordom* by increasing the protein and the fat contents of the *mordom*. *Mordom* is a nutritious and a valued thin gruel commonly produced among the kanuri tribe of Borno state. It is produced from cleaned millet grain flour, cleaned millet grains with fermented cow milk (*kindirmo*, or *stala*), spices and sugar added without any preservative used. *Mordom* is prepared especially during the fasting period of Ramadan, during gathering and ceremonies like weddings, naming ceremonies and even during funerals or hosting of special guests. In this study, *mordom* was produced from different millet varieties to carry out the production method, determine the proximate, nutritional and acceptability of the *mordom* and the results indicated that the samples were of adequate nutrition and were generally accepted. Addition of kindirmo (cow milk) increased the nutritional contents of the *mordom* by increasing the protein and the fat contents of the *mordom*. The microbial quality of *mordom* indicated low microbial count or contamination which indicates that it is safe and suitable for human consumption.

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