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Analysis of Chemical, Microbiological and Sensory Qualities of Soymilk Sold in Gboko Metropolis from Benue State

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ABSTRACT

The microbiological, proximate and sensory evaluation of soymilk produced locally in Gboko, Benue state was carried out to ascertain the safety of consumers of the product. Samples were collected from hawkers in Abagu market, Akaajime market, NKST Central Mkar, Adekaa and J.S Tarka. Proximate chemical analyses carried out shows that the samples had high moisture content ranging from 79.40% to 91.00%, 3.00% to 5.91% for protein while the value range of 3.10% to 7.11%, 0.38% to 0.81% and 0.29% to 0.90% for fat content, ash contents and crude fibre respectively with the carbohydrate value ranging from 1.02% to 7.05%. The total counts of the soymilk samples ranged from $1.0x0^1$ to $3.0x10^1$cfu/ml. with the lowest coming from the samples, collected at Abagu market thus; microbiologically safer than the others. The yeast and mold counts ranged from $1.0x10^2$ to $3.5x10^4$ CFU/ml; with the sample obtained from Adekaa has the highest contamination with faecal microbes such as *Escherichia coli, Salmonella spp* and *Shigella spp* were identified. All samples were gram negative indicating contamination possibly from handlers, processing of raw materials and equipment. *Aspergillus spp* and *Penicillum spp* were also identified. Sample from J.S Tarka score highest with the value of 7.3 for flavor, 7.8 for taste and 8.0 for overall acceptability while sample from NKST Central Mkar had the lowest and sample collected from Abagu market had the highest score of 7.6 in appearance.

Keywords: Soymilk, Quality Analysis, Gboko Metropolis.

INTRODUCTION

Soymilk is a traditional oriental food beverage that is growing in popularity in the United State and in the world (Jimoh and Kolapo, 2007). Soymilk is the white creamy emulsion extracted from soybeans which resembles cow milk

(conventional milk) both in appearance and consistency. According to the ordinance and code recommended by the United State's Public Health Service (USPHS), milk is the lacteal secretion practically free from colostrums obtained by the complete milking of healthy cow. Soymilk falls into the category of milk known as imitation milk. Imitation milk is defined as a product made to resemble cow's milk in appearance, flavor and nutritive value and not produced solely by the mammary gland. Soymilk originated from the Far East of China and several oriental countries. Dated back in antiquity, its consumption is fast gaining ground in Nigeria.

The exorbitant and exceptional scarcity of milk supplies in developing countries perhaps led to the development of alternative milk supplies from vegetable source such as soymilk (Onweluzo and Okafor, 2008). It is a vital substitute to solving malnutrition problem in developing countries like Nigeria and also in countries with adequate supplies of high quality animal protein due to the increase in population and subsequent increase in the cost of animal food proteins (Iwe, 2003). In such areas, there is imposed demand and the advancement of plant protein as an alternative as a result of which there is attendant increases in the rate of soymilk consumption. This has encouraged a low scale production of the milk under household conditions for income generation. Soymilk is packaged in different materials and sold (hawked) in public places in Nigeria to generate income for housewives. The household handling and processes are usually with little or no regard to quality control measures and non compliance with strict hygienic practices (Jimoh and Kolapo, 2007). Therefore, possible increase in microbial contamination as the milk itself is an excellent medium for the growth of microorganism which could be of health hazard to consumers (Jay, 2003). Studies on soymilk samples sold in Uyo, Nsukka and Makurdi have been reported with high rate of contamination in all the studies (Liamgee *et al*., 2013) posing a health risk to the consumers. Therefore, the need to also analyze soymilk products sold in Gboko metropolis is to ascertain its safety for human consumption.

Justification of This Research

New food vehicle of disease transmission has been observed to include street foods one of which is soymilk which is widely consumed in Gboko Metropolis. It is usually affordable and accessible in the environs. Increase in prevalence of food borne diseases has been reported (Jay, 2003). Indiscriminate intake of this street food has led to several food borne diseases such as gastroenteritis, therefore the fitness of these food for consumption has to be ascertained. Research objective was to evaluate the microbiological, chemical and sensory

properties of acceptability of soymilk locally produced and sold in Gboko metropolis which are the basic parameters of the levels of safety and likeness.

MATERIALS AND METHODS

Collection of Samples: The soymilk samples were bought from hawkers in the following area in Gboko metropolis. Abaagu, Akaajime, NKST Ccentral, Adekaa, and J.S Tarka way .The samples were labeled A, B, C, D and E respectively.

Preliminary Handling: All samples were already in plastic bottles, the temperature was determined using a thermometer. The samples were then further stored at 4^0C for further analysis.

Proximate Analysis: Moisture, crude protein, crude fat, crude fibre and ash were determined using the method of AOAC (2012) standard procedures, while carbohydrate was determined by difference (Ihekoronye and Ngoddy 1985).

Microbiological Analysis: One ml of sample was pipette into 9 ml of sterile water; serial dilution was done to 10^{-4}. 1 ml of the sample was pour plated with nutrient agar from the different dilutions. The plates were then inverted and incubated at 37^0C for 24hrs. The plates with countable colonies were chosen and reported (Jay, 2003). Population of bacteria was gotten by multiplying the number of colonies by the dilution factor.

Method of Identification Using MaConkey Agar: MaConkey broth was prepared according to the manufacturer's instruction, sterilized by autoclaving at 121^0C for 15mins.The media were aseptically poured into plates and allowed to solidify. Agar was then plated in duplicates, inverted and incubated at 37^0C for 24hrs. Lactose positive organisms fermented the medium while non lactose positive organisms did not ferment the medium (Jay, 2003).

Method of Identification Using Gram Staining: Gram staining procedure was done by fixing the organism to the slide and staining with crystal violet for 20mins after which it was gently rinsed with water, it was then covered with iodine which served as a mordant and then poured off after which it was decolourized with 95% alcohol. It was then rinsed with water to stop the action of the alcohol. The slide was then covered with safranin for 20secs after which it was gently rinsed off. The slide was blot dry with bibulous paper and observed under the microscope for Gram positive or Gram negative microorganism (Jay, 2003).

Fungi Enumeration: Potato dextrose agar was prepared and incorporated with antibiotics (chloramphenicol) to stop the growth of bacteria. Samples from the different dilution were pour plated in duplicates, inverted and incubated at 28^{o}c for 5 days. The plates with countable colonies was chosen and reported. Population of fungi was calculated by multiplying the number of colonies by the dilution factor. Population was reported to 2 significant figures by Jay (2003).

Fungi Identification: Colony morphology from the plates was compared with an atlas of fungi and reported. Staining with lacto phenol cotton blue dye to observe spores and shape to further confirm the result from cultural morphology was done.

Sensory Evaluation: The soymilk products were served to the panelist in 100ml transparent plastics cup coded with three (3) digit random number. About 25 ml samples were served each to the panelist, colorless transparent spoons were provided for testing the samples and fresh tap water was provided to rinse between evaluations. Descriptive analysis and effective method was used as described by Ihekoronye and Ngoddy (1985). The panelists consist of 15 staff and student of University of Mkar, Gboko.

A 9 point hedonic scale (9 = like extremely, 1 = dislike extremely). Each attribute was evaluated separately and at each session the panelist judge five (5) samples and the order of presentation of the samples was randomized.

Statistical Analysis: Significant ($p<0.05$) difference in chemical composition, microbial counts and sensory attributes were determined by analysis of variance (Ihekoronye and Ngoddy, 1985). Duncan multiple range and Turkey test were used for separating the means.

RESULTS AND DISCUSSION

Proximate Composition

The proximate composition of the various soymilk samples are as presented in Table 1. The crude protein ranged from 3.30% for Sample D to 5.91%, Sample D had the highest protein content. Sample D has the highest moisture content value of 91.0% with the lowest fat content of 3.10 %. Sample A had the highest crude fibre and ash content of 0.90% and 0.81% respectively. The carbohydrate content was highest in Sample B (7.05%) and lowest in Sample E (1.02%). The values of moisture content are comparable to 90.5% and 92.5% for traditional method of soymilk production as reported by Wilkens *et al*., (1967). Lower value of 79.0% in Sample B may be due to loss of water due to evaporation. The fibre

content ranging from 0.90% (Sample A) to 0.29 % (Sample D) recorded is in contrast to 0.00% recorded by Onuorah *et al*., (2007). The ash content of the samples were close to the value reported by Onuorah *et al*., (2007), Omotoye (1984) and slightly lower than the reported value of Liamngee *et al.,* 2013). This may be due to the variation in particle sizes before sieving. The finer the flour the more endosperm is exposed hence more mineral will be extracted in soymilk. Protein values recorded are higher than the values recorded (3.40 - 3.50%) by Ikya *et al.,* (2013), when the effects of cooking temperatures on soymilk was analyzed, but slightly lower to the value (6.78%, 7.76 %and 7.00%) reported by Liamngee *et al.,* (2013) as observed on some locally produced soymilk sample in Makurdi metropolis. This may be attributed to the varying degree of heat treatments which may have resulted in the destruction or inactivation of some amino acids for example cystine. Differences in nutritional values observed in this study may be due to differences in mode of preparation and processing, the variety of soybeans seeds used and the techniques.

Microbiological Quality

The total aerobic, yeast and mold counts of the various soymilk products are as shown in **Table 2.** The total aerobic count ranged from 3.5×10^3 in Sample E to 1.0×10^1 in Sample A. The microorganisms implicated are *Shigella spp, E. coli and Salmonella spp.* The yeast and mold counts are highest in Sample D 3.5×10^4 and lowest in Sample E at 1.0×10^2. *Aspergillus spp* was present in all the samples except Sample B in which *Penicillum spp* was implicated at 3.0×10^2. The entire microorganisms are gram negative. The bacteria count is slightly higher than that reported by Ikya *et al*., (2013), and low to the value reported by Liamngee *et al.,* (2013). The presence *Salmonella* and *E. coli* indicates that the soymilk was not adequately processed and are in agreement with the findings of Liamngee *et al.,* (2013) who reported the presence of *E. coli, Salmonella typhi, Streptococcus faecalis* and *Staph aureus* in soymilk samples obtained from different locations in Benue state.

Also, Agboke *et al.,* (2011) reported the isolation of *E. coli, Staphylococcus aureus, Streptococuss spp* in the analysis of soymilk sold in Uyo, Nigeria. According to Ihekoronye and Ngoddy (1985), the presence of these microorganism are indication of contamination of human faecal discharge and also it may be as a result of poor handling, use of contaminated raw and packaging materials, inadequate processing, unhygienic processing environment and little or no knowledge of good manufacturing practice. These gram negative microorganisms are pathogenic and highly predispose the products to microbial spoilage due to the fact that the soymilk is a good substrate for microorganism

growth, therefore reduced microbial keeping quality. The presence of *Apergillus spp* is in agreement with the findings of Agboke *et al.,* (2011). The large population of yeast and mold may be due to non compliance and variation in good agricultural practices such as inadequate storage and or handling of harvested soybeans seeds, as the seeds may not be of the same varieties. The presence of *Aspergillus spp* and *Penicillum spp* may result in mycotoxicosis which may pose serious health problems to consumers.

Sensory Quality Characteristics

The mean sensory scores for the various soymilk samples are provided for in **Table 3.** Sample E had the highest score for flavor 7.3 (like moderately), taste 7.8 (like very much) and 8.0 (like very much) for overall acceptability while Sample A had the highest score of 7.6 (like very much) in appearance. Sample D and Sample C had the lowest score of 4.3 (dislike slightly) and 5.3 (neither like nor dislike) in flavor and overall acceptability respectively. No significance difference at $p < 0.05$ between the samples A, B and C with respect to flavor, Sample E (JS Tarka) had the highest consumer preference which may be due to reduced objectionable beany flavor, acceptable level of additives and sweetener. The decrease in flavor score in Sample D (4.3) may be due to development of new flavors and possible concentration of the soybeans beany flavor. The overall acceptability was slightly lower than that reported by Ikya *et al*., (2013) but close to the value reported by Liamngee *et al.,* (2013). The variations in acceptability values indicate that the soymilk was not adequately processed under controlled conditions.

CONCLUSIONS

On the basis of proximate composition, Sample E (JS Tarka) had the highest protein content and the most preferred of the soymilk products analyzed in Gboko metropolis. The microbial population estimated by total aerobic count in the samples was lower than the acceptable standard. However, but the yeast and mold value of Sample D exceeded the acceptable value. This study concluded that the soymilk sold in Gboko metropolis are of low microbial and acceptable quality but may pose serious health hazard to consumers if not properly preserved with appropriate anti microbial additives.

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Table 1: Proximate Composition of Soymilk

Nutrients	Samples				
	A	B	C	D	E
Moisture	84.20	79.40	87.60	91.00	87.10
Protein	3.10	5.50	3.45	3.00	5.91
Fat	4.20	7.11	6.60	3.10	4.67
Ash	0.81	0.38	0.44	0.51	0.58
Crude fibre	0.90	0.56	0.46	0.29	0.72
Carbohydrate	6.79	7.05	1.45	2.1	1.02

Sample

A = Abagu Market Gboko
B = Akaajime Market
C = NKST Central Mkar
D = Adeka Gboko
E = JS Tarka

Table 2: Microbiological Analysis of the Various Soymilk Samples

Parameter	Products				
	A	B	C	D	E
Total aerobic	1.0×10^1	3.0×10^3	2.0×10^3	2.5×10^3	3.0×10^1
Gram staining	G-	G-	G-	G-	G-
Identification	(LAC +)	(LAC -)	(LAC +)	(LAC -)	(LAC +)
Organism	*E. coli*	*Salmonella*	*E. coli*	*Shigella*	*E. coli*
Yeast and mold	4.0×10^3	3.0×10^2	5.0×10^2	3.5×10^4	1.0×10^2
Specie	*Aspergillus*	*Penicillum*	*Aspergillus*	*Aspergillus*	*Aspergillus*

(LAC +) = Lactose Fermenters
G- = Gram Negative
(LAC -) = Non Lactose Fermenters (LAC -)
A = Abagu Market Gboko
B = Akaajime Market
C = NKST Central Mkar
D = Adeka Gboko
E = JS Tarka

Table 3: Sensory Scores for the Various Soymilk Samples

Attributes	Products				
	A	B	C	D	E
Flavor	6.4^{b}	5.8^{b}	6.2^{b}	4.3^{c}	7.3^{a}
Taste	6.2^{d}	6.1^{d}	5.5^{d}	6.6^{d}	7.8^{e}
Appearance	7.6^{f}	6.0^{g}	7.0^{f}	7.0^{f}	6.6^{f}
Overall Acceptability	7.2^{h}	6.4^{i}	5.3^{i}	6.3^{i}	8.0^{h}

Mean with common superscript within the row are not significantly ($p<0.05$) different

Based on the scale of 1 to 9 with 1= Dislike extremely and 9= like extremely

A = Abagu Market Gboko
B = Akaajime Market
C = NKST Central Mkar
D = Adeka Gboko
E = JS Tarka

References to this paper should be made as follows: Ikya, J.K. *et al.,* (2013), Analysis of Chemical, Microbiological and Sensory Qualities of Soymilk Sold in Gboko Metropolis from Benue State. *J. of Agriculture and Veterinary Sciences,* Vol. 5, No. 2, Pp. 173 – 181.