

The Health Belief Model as a Tool for Food Safety Governance for Milk and Cheese Produced by Settled Fulani Pastoralists in Southwest Nigeria.

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Abstract: This study analysed consumers' perception on safety of milk and cheese produced by settled Fulani pastoralists (SFP) in Ogun and Oyo States, Nigeria in terms of microbial and organic contaminations using the Health Belief Model (HBM). Data were collected from 55 pastoralists and 222 consumers of pastoralists' milk and cheese from 13 communities in the two States. Two hundred and twenty (220) milk and cheese samples were collected for heavy metals and bacteriological analyses. Descriptive statistics were used to analyse social data while the heavy metals were investigated using an Atomic Absorption Spectrometer. Furthermore, the study investigated bacteria present in the milk and cheese samples using standard micro-bacteriological methods. The result of chemical analysis shows contaminations in Zinc, Copper, Chromium, Lead, Nickel and Cadmium. All the heavy metal analysed were higher than the European Union (EU) of 5.0 ppm permit on intake of Heavy metals in Food. Result of bacteria analysis shows the presence of *Escherichia coli*, Coliform bacteria and *Staphylococcus aureus*. These contaminations have grievous implications on public health although the HBM analysis shows that respondents' perceived a low risk of susceptibility to disease through the consumption of contaminated SFP milk and cheese. They also have insufficient orientation on possible health threats that could result from consuming unsafe food products. In conclusion, the perceived benefit of the respondents was higher than the perceived barriers, which implies that they have confidence in SFP milk and cheese. As a tool for food safety governance, HBM analysis will help in safeguarding public health through consumers' orientation. Enforcement of food safety practices by environmental sanitation officers during milking and processing will help to improve quality of milk and cheese produced by SFP households in Nigeria.

Keywords: Health Belief Model, Food contamination, susceptibility to disease, milk and cheese, Fulani Pastoralists, Nigeria

Introduction

Fulani pastoralists are often described as the largest pastoral group in the world and are found in most parts of West Africa in search of pasture for their herds. There are three major Fulani sets in Nigeria and this includes Bororo (they are the set of Fulanis that migrated from Kaduna, Kastina and Kano), Hausaji (Sokoto and Kebbi) and Baku (Kwara state). The SFP found in the South Western Nigeria are majorly Baku. According to Sodiya *et al.* (2006), the men are specialised in herding and cattle business, while women are specialised in the processing of raw milk to cheese.

Consumers' perception of food safety is determined by interplay of scientific, legal/regulatory, social and economic forces, and goes beyond the avoidance of food borne biological pathogens, chemical toxicant and other hazards (Bektas *et al.*, 2011). The increasing complexity and length of food chain has led to an increase in opportunity of contamination by chemical or biological agents. In particular, chemical and microbial contaminants in food represent an important food safety issue. The physical contaminants which could be a result of methods

of food production and /or eating habits of consumers has given rise to emerging and reoccurring food safety problems (Sirieix *et al.*, 2007; Mohammad *et al.*, 2014). Consumers' perception of choice of food is influenced by their psychological interpretation of the benefit that is attached to the food and this could be related to the Health Belief Model (HBM). The HBM principles include; perceived susceptibility, perceived severity of the disease, perceived benefits of treatment, perceived barriers to treatment, barriers to behavioural change, self-efficacy, cues to action and likelihood of engaging in health- promoting behaviour.

The principle 'Perceived susceptibility' combines with 'perceived severity' to form a perceived threat, which may influence how consumers of SFP products will process health information and how motivated they are to engage in food safety practice. It also refers to the way consumers view the consequences of a serious health event or outcome of consuming SFP product without considering food safety practice. 'Perceived benefits' could be the extent to which consumers' believe that, responding to a recommended health action will effectively alleviate a health threat associated with the consumption of raw milk and cheese produced by SFP. 'Barriers to behavioural change' refers to consumers' feelings towards performing a recommended health action such as engaging in food safety practice. Self-efficacy is the extent to which consumers' of SFP products believe they are capable of performing specific behaviours in order to attain certain goals. 'Cues of actions' refer to the stimulus needed to trigger the decision-making process to accept a recommended health action such as food safety practice. These cues can be internal (e.g. chest pains, wheezing, etc.) or external (e.g. advice from friends, illness of family member, newspaper article, etc.). The above principles determine the likelihood of engaging in Health-Promoting Behaviour of consumers.

2. Methodology

2.1 Study Location

Ogun and Oyo State are two of the states in Southwest Nigeria. These States are occupied mainly by Yoruba people who are primarily sedentary arable crop growers and small business entrepreneurs. History has it that the movement of Fulani's into the southwest Nigeria dated back to the late 19th century during the Dahomey war (Fabusoro *et al*, 2008). The affected Fulani's migrated from the Republic of Benin and settled around the southern guinea of southwest Nigeria.

2.2 Sampling

The population of the study involved consumers and processors of milk produced by SFP in Ogun and Oyo State, Nigeria. A multi-stage sampling approach was used to select the pastoralists and consumers of milk and cheese produced in the two states. Local governments areas (LGAs) where pastoralists reside were selected purposively based on high population of SFP. Households involved in production of raw milk and processing of cheese were selected purposively for Focus Group Discussion (FGD) in each pastoral settlement. The FGD involved formal meetings with groups of 5-10 respondents in Ogun State (Yewa North and Odeda LGA) and Oyo State (Atiba, Atigbo, Itesiwaju and Saki West LGA). The focus was to discuss on their reasons for continuous consumption of milk and cheese produced by SFP. Furthermore, a total of 55 processors were selected from each State. From each of the 55 processors, 10 ml of milk sample and 12 gram of cheese sample were collected making a total 1100 ml of milk samples and 1320 gram of cheese samples collected from the two states. Also from each state, 111 consumers of milk and cheese were selected purposively to have a total of 222 respondents in the two states.

2.3 Data Analysis

Two types of analyses were carried out. These were statistical and Laboratory analyses. The statistical analyses were used to analyse social data; while the laboratory analyses were used for the isolation of bacteria and detection of heavy metals in milk and cheese samples collected. The statistical analysis includes frequency counts and percentages. Laboratory analyses such as Atomic Absorption Spectrometer were used for investigating heavy metals while Standard bacteriological methods were employed for the isolation of bacteria as recommended by Cheesebrough (2006).

3 Results and Discussion

3.1 Consumers' Perception on Safety of Milk and Cheese Produced by SFP

Consumers' perception on safety of milk and cheese produced by SFP was analysed by adopting the Health Belief Model. The importance of this model is that it attempts to explain and predict health behaviours by focusing on the attitudes and beliefs of individuals. From all the dimensions of HBM, 30 statements were developed and subjected to 5 point Likert scale (Table 1). The 30 perception statements were scored along Likert scale of 5 to 1.

For 'perceived susceptibility' of disease, Witte (1992) asserts that susceptibility is measured as a person's perception of the likelihood of developing an illness. The result in table 1 show that, 41 % of the respondents agreed that their health is at risk when they consume SFP milk and cheese while about 49 % disagreed with the statement. Many (62 %) of the respondents agreed that they could be exposed to health problems by what they consume while 28 % disagreed with the statement and 9 % were indifferent. The implication of this is that majority of the respondents perceived the risk of susceptibility to disease through the consumption of SFP milk and cheese.

Table 1: Consumers' perception on safety of milk and cheese produced by SFP (n=222)

| | Perception Statement | SA | A | U | D | SD | Average |
|----|--|-----------|----------|----------|----------|-----------|----------------|
| | Perceived susceptibility | % | % | % | % | % | of scale |
| 1. | My health is at risk when I consume / drink Fulani milk and cheese | 25.7 | 15.3 | 9.9 | 26.6 | 22.5 | 2.95 |
| 2. | I know I can be exposed to health problems by what I consumed | 33.3 | 28.8 | 9.0 | 14.4 | 14.4 | 3.53 |
| | Perceived threat of the diseases | | | | | | |
| 3. | Sour milk and cheese have major consequences on my health | 28.4 | 22.0 | 18.0 | 21.2 | 10.4 | 3.37 |
| | Perceived benefits versus Barriers to behavioural change | | | | | | |
| 4. | Fulani milk and cheese are very nutritious and tasty | 34.2 | 35.6 | 16.2 | 5.9 | 8.1 | 3.82 |
| 5. | Fulani milk is natural and therefore very nutritious | 32.9 | 35.2 | 18.9 | 6.7 | 6.3 | 3.82 |
| 6. | Anything that is natural will be pure, so no problem | 26.1 | 25.7 | 16.2 | 18.0 | 14.0 | 3.32 |
| 7. | Milk and cheese produced by Fulani are affordable | 38.7 | 39.6 | 12.6) | 5.0 | 4.1 | 4.04 |

| | | | | | | | |
|-----|--|------|------|------|------|------|------|
| 8. | Pastoral milk and cheese are readily available | 27.5 | 41.0 | 18.0 | 8.7 | 5.0 | 3.78 |
| 9. | My religion does not stop me from taking pastoral milk and cheese | 53.2 | 30.2 | 7.2 | 3.5 | 5.9 | 4.21 |
| 10. | Irrespective of pasteurized milk available, I will continue to consume milk and cheese produced by settled Fulani pastoralists | 16.7 | 21.2 | 22.5 | 18.0 | 21.6 | 2.93 |
| 11. | Milk and cheese from pastoralist does not contain any contaminations | 11.7 | 12.6 | 27.0 | 24.8 | 23.9 | 2.64 |
| 12. | Hygiene status of the pastoralists does not affect the quality of their milk and cheese produced | 12.2 | 17.6 | 20.3 | 22.0 | 27.9 | 2.64 |
| 13. | I can recommend pastoral milk and cheese because it contains the essential nutrient required in the body | 20.3 | 35.1 | 17.6 | 13.0 | 14.0 | 3.35 |

Source: Field Survey 2015. SA= Strongly Agree, A= Agree, U= Undecided, D= Disagree, SD= Strongly Disagree

For 'perceived threat', 50 % of the respondents believed that milk and cheese have major consequence on their health while 31 % disagreed with the statement (Table 1). This implies that consumers have sufficient orientation on possible health threat that could result from consuming unsafe products. According to Sturges and Rogers (1996) and Witte (1992), perceived threat of a disease can influence how people process health information and how motivated they may be to engage in a particular behaviour. With this, there is the likelihood that consumers will be willing to receive information that can reveal the safety of the milk and cheese.

Findings under 'perceived benefits' versus 'Barriers to behavioural change' reveal that 69 % of the consumers agreed that Fulani milk and cheese are very nutritious and tasty. Only 14 % of the respondents disagreed with the statement. Most (68 %) of the consumer agreed that Fulani milk is natural and therefore very nutritious; 18 % were indifferent about the statement and 13 % disagreed (Table 1). This implies that consumers' perceived milk and cheese from SFP as natural, tasty and nutritious and that it contains the essential nutrients required for growth and development. This result support Rosenstock (1974) that if an individual believes that a particular action will reduce susceptibility to a health problem or decrease its seriousness, then he or she is likely to engage in that behaviour regardless of objective facts regarding the effectiveness of the action. In addition, this may influence consumers' continuous consumption unless they perceive any form of health threat. Therefore for safe public health, food safety practice has to be encouraged by educating the pastoralists to improve on their method of production. This result support Janz *et al.* (1984) and Glanz and Bishop (2010) that even if an individual perceives a health condition as threatening and believes that a particular action will effectively reduce the threat, barriers may prevent engagement in the health-promoting behaviour. In other words, the perceived benefits must outweigh the perceived barriers in order for behaviour change to occur and to effectively reduce the threat.

Results for 'self-efficacy' reveal that 69 % of the consumers were actively working to improve their health status while 16 % of the consumers disagreed; 14 % were indifferent as shown in Table 2. Majority (77 %) of the consumers agreed that they were in control of how and what they learnt about their health; 12 % of the consumers disagreed. This implies that consumers' perception about their health status was positive. This

orientation may stem from individual health conditions, which may be generally good. Rosenstock *et al.* (1988) posit that interventions may also aim to boost self-efficacy by providing training in specific health-promoting behaviours, particularly for complex lifestyle changes. For instance, changing diet or engaging in physical activity, adhering to a complicated medication regime among others.

For 'cues to action', 34 % of the consumers revealed the information obtained from news articles about SFP products is not friendly. The news articles inform that SFP are life threatening, 27 % were unable to decide whether they have heard any information about milk and cheese contamination while 38 % disagreed with the statement. About 36 % of the respondents revealed that they do not pay attention to health information unless it is related to a problem they have; 14 % were indifferent about the statement and 50 % believed that they pay attention to health information apart from the ones related to them (Table 2). Half of the respondents reveal that they have been consuming the Fulani milk and cheese for years and have never been sick; 9 % were unable to decide while 41 % disclosed that they were sick after consuming milk and cheese. The implication of this is that majority of the respondents do not perceive that their health is at risk and they do not need any medical check-up. Glanz *et al.* (2008) posits that interventions based on the health belief model may provide cues to action to remind and encourage individuals to engage in health-promoting behaviours. That intervention may be news from articles or sickness from close relation. Two issues are evident here: response of the consumers to health information and the non- expression of ill health after consuming SFP milk and cheese. This indicates that consumers will take action when they experience ill health after consuming unsafe products and if health information about the product is alarming.

Table 2: Consumers' perception on safety of milk and cheese produced SFP continued

| | Perception Statement | SA | A | U | D | SD | Average |
|----|---|-----------|----------|----------|----------|-----------|----------------|
| | Self-efficacy | % | % | % | % | % | |
| 14 | I have set some definite goals to improve my health status | 33.3 | 28.4 | 14.4 | 11.7 | 12.2 | 3.59 |
| 15 | I have been able to meet the goals I set for myself to improve my health | 20.7 | 33.8 | 17.6 | 15.8 | 12.1 | 3.35 |
| 16 | I am actively working to improve my health status | 31.5 | 37.4 | 14.4 | 8.1 | 8.6 | 3.75 |
| 17 | I feel that I am in control of how and what I learnt about my health | 41.4 | 35.1 | 11.3 | 8.6 | 3.6 | 4.02 |
| 18 | The contamination in milk and other products from Fulani pastoralists can still be tolerated | 12.2 | 19.4 | 26.1 | 20.7 | 21.6 | 2.8 |
| 19 | I am fine, I don't need any medical check up | 21.2 | 14.4 | 10.4 | 27.0 | 27.0 | 2.77 |
| 20 | Even if milk and cheese of Fulani are contaminated it cannot be life threatening | 14.9 | 15.3 | 20.3 | 27.0 | 22.5 | 2.73 |
| 21 | Fulani women are beautiful so I believe they will be neat | 9.9 | 13.1 | 19.8 | 22.1 | 35.1 | 2.41 |
| | Cues of actions | | | | | | |
| 22 | My doctor has certified my consumption of Fulani milk and cheese | 5.0 | 10.8 | 12.2 | 27.5 | 44.5 | 2.04 |
| 23 | Information obtained from news articles shows a serious health threat from consuming Fulani milk and cheese | 18.0 | 16.2 | 27.0 | 23.4 | 15.3 | 2.98 |
| 24 | I don't pay attention to health information unless it's about a | 17.6 | 18.5 | 14.0 | 24.8 | 25.1 | 2.78 |

| | problem I have | | | | | | |
|---|---|------|------|------|------|------|------|
| 25 | I have been consuming the Fulani milk and cheese for years and I have never been sick | 24.3 | 25.7 | 9.0 | 19.8 | 21.2 | 3.12 |
| 26 | The milk and the cheese is a major source of income to Fulani women so I consume it to help them generate income | 15.3 | 18.5 | 14.4 | 24.8 | 27.0 | 2.7 |
| Likelihood of engaging in health-promoting behaviour | | | | | | | |
| 27 | I will be more healthier if I take pasteurize milk and cheese and not the pastoral milk and cheese | 26.1 | 15.8 | 26.6 | 18.5 | 13.0 | 3.23 |
| 28 | I have had frequent cases of dysentery in recent weeks from milk and cheese produced by settled Fulani pastoralists | 4.1 | 6.3 | 17.1 | 31.5 | 41.0 | 2.01 |
| 29 | I will try and fry the cheese before I consume | 11.7 | 14.9 | 29.7 | 18.0 | 25.7 | 2.69 |
| 30 | I will investigate the hygiene level of the Fulani and decide if I should stop or not | 16.2 | 14.4 | 29.7 | 15.8 | 23.9 | 2.83 |

Source: Field Survey 2015, SA= Strongly Agree, A= Agree, U= Undecided, D= Disagree, SD= Strongly Disagree Likert scale...

In the area of Likelihood of engaging in health-promoting behaviour, 10 % of the respondents disclosed that they have had frequent cases of dysentery in recent weeks from milk and cheese produced by SFP while 17 % were indifferent about the statement and 73 % of the consumers disagreed with the statement. Some (31 %) of the consumers disclosed that they will investigate the hygiene level and food safety practice of the Fulani and decide if they should stop consuming milk and cheese or not as shown on Table 2. About 30 % of the consumers were unable to decide and 40 % of the consumers disclosed that they will not investigate the hygiene level of the Fulani and would continue to consume SFP products. This support the work of Committee on Communication for Behaviour Change in the 21st Century (2002), that “a person's perceived likelihood or subjective probability that he or she will engage in a given behaviour is based on his/her intension”. Ajzen (1991) also asserted that behavioural intension reflects how hard a person is willing to try, and how motivated he or she is, to perform the behaviour.

In summary, the aggregated value was used to categorize perception of the respondents on safety of milk and cheese into two (favourable and unfavourable perception) (Table 3). The findings show that 62 % of the respondents had favourable perception on the safety of milk and cheese produced by SFP. Using the health belief model indicators, the perceived benefit of the respondents is higher than the perceived barriers which implies that they are confident in SFP milk and cheese and that it cannot be life threatening. For cues to action, consumers won't stop consuming SFP products until they experience ill- health or sickness from a family member and newspaper article. The perceived benefit versus perceived barriers, self- efficacy and cues to action will in-turn affects the respondent likelihood of engaging in health-promoting behaviour. Although, they have experienced some physical symptoms of health condition through consumption of milk and cheese from pastoralists' but they cannot stop patronizing the pastoralists' women because they believed that there are nutritional benefits attached to pastoralists' milk and cheese. This calls for the need to build the level of confidence in consumers' ability to undertake some preventive measure before consuming milk and cheese from SFP.

Table 3: Summarized result of consumers' perception (n=222)

| Category | Percentage of Consumers |
|--|-------------------------|
| Unfavourable consumers' perception (score of < 90) | 37.8 |
| Favourable consumers' perception (score 91- 180) | 62.2 |

Source: Field Survey, 2015

3.2 Contaminations in Milk and Cheese

3.2.1 Mean and Standard Deviation of Heavy Metals in Milk and Cheese

The concentration of heavy metals in the samples of milk and cheese analysed are reported in Table 4. All the heavy metal analysed were higher than the European Union (EU) of 5.0 ppm permit on intake of Heavy metals in Food. The mean concentration of Zinc was found to be the highest 8.52 ppm for milk sample and 9.33 ppm for cheese sample in Ogun state. When compared to the mean concentration of Zn in milk and cheese in Oyo state (milk= 6.90 ppm and cheese = 18.50 ppm), that of Oyo state cheese is higher. This high concentration has negative implication on human health particularly when consumed regularly and these include abdominal pain, nausea, vomiting, diarrhoea, irritation, headache, irritability, lethargy, anaemia and dizziness (Le Mone, 1999). The Zinc concentration in the cheese sample analysed in Oyo state was also higher than the zinc concentration in the milk samples in the two states and several folds higher than other metals analysed. The high concentration observed in Zinc level may be attributed to uncontrolled administration of mineral supplements by the pastoralists to meet the Zn requirement of the animals. It could also be attributed to the environment where the animal grazed or browsed or the sites where the *Sodom apple* plant used as coagulant in cheese grow or is found. The environmental factors can be related to improper disposal of rubber materials. This conforms to the findings of Ogundiran *et al.* (2012) that residues from burnt tires site are known to contain high level of zinc.

The metal with the lowest mean concentration on Table 4 and 5 was Cadmium with a mean concentration of 0.23 ppm in milk sample and a mean concentration of 0.14 ppm in cheese sample in Ogun state and a mean concentration of 0.23 ppm in milk and 0.20 ppm in cheese in Oyo state. This could be ascribed to the coagulant used during cheese processing and the low heat treatment. However, these values are far higher than EU standard (0.05). The presence of cadmium may be due to contamination of the soil, fodder that grow with the soil and the water consumed by the animals. Previous work in support of this finding includes those of Faust and Aly (1981), Peter (1993) and Mansour (1999) that accumulation of cadmium in human body will lead to hypertension, gastroenteritis, pulmonary oedema, severe pain, softy bones and finally death.

Table 4: Mean and Standard Deviation of Heavy Metals in Milk against Standards

| State | Cd | Cr | Cu | Ni | Pb | Zn |
|------------------|-------|-------|-------|-------|-------|-------|
| Ogun Milk | 0.23± | 8.18± | 8.36± | 1.82± | 2.98± | 8.52± |
| Mean± SD | 0.14 | 2.57 | 4.12 | 0.92 | 2.43 | 2.94 |
| Min | 0.51 | 0.01 | 4.94 | 0.72 | 1.98 | 5.42 |
| Max | 3.11 | 0.49 | 10.91 | 7.7 | 13.04 | 13.33 |

| | | | | | | |
|-----------------|-------|-------|-------|-------|-------|-------|
| Standard | 0.05 | 0.1 | 0.4b | ≤0.1 | 0.2 | 5.0b |
| Oyo Milk | 0.23± | 6.76± | 6.75± | 2.29± | 2.77± | 6.90± |
| Mean± SD | 0.11 | 2.20 | 3.37 | 0.29 | 2.34 | 2.39 |
| Min | 1.92 | 0.14 | 3.42 | 0.83 | 1.86 | 5.1 |
| Max | 2.66 | 0.4 | 8.8 | 6.66 | 10.03 | 10.92 |

Source: Field Survey, 2015

The result of the finding shows that the mean concentration of Cadmium in the milk samples in the two states were the same (0.23 ppm) due to the fact that Ogun state has a mean concentration of 0.23 ppm and Oyo state with a mean concentration of 0.23 ppm (Figure 1 and 2). The concentration of chromium, copper and Zinc in the milk sample were several folds higher than cadmium, lead and nickel. This could be attributed to the difference in geographical location. This conforms to the findings of Ogundiran *et al.* (2012) that researchers have recorded high level of lead in milk samples produced in animals raised around contaminated sites.

For the cheese sample analysed, there was a difference in the level of Zinc content in the two states. The residual content of zinc in Oyo state was higher (18.50 ppm) than that of Ogun state (9.33 ppm) with a mean concentration of approximately 9.0ppm as shown in Figure 3 and 4. There was a significant variation in the level of heavy metals detected in the cheese samples analysed in the study area.

Table 5: Mean and Standard Deviation of Heavy Metals in Cheese against Standards

| State | Cd | Cr | Cu | Ni | Pb | Zn |
|--------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Ogun Cheese | 0.14± | 6.04± | 9.94± | 2.96± | 3.08± | 9.33± |
| Mean± SD | 0.07 | 3.31 | 2.42 | 2.37 | 2.32 | 3.39 |
| Min | 0.69 | 0.05 | 0.82 | 0.81 | 5.83 | 3.21 |
| Max | 7.63 | 0.25 | 9.63 | 8.33 | 12.58 | 13.05 |
| Standard | 0.05 | 0.1 | 0.4b | ≤0.1 | 0.2 | 5.0b |
| Oyo Cheese | 0.20± | 6.37± | 9.32± | 2.93± | 2.92± | 18.50± |
| Mean± SD | 0.15 | 1.82 | 3.01 | 0.68 | 1.38 | 8.37 |
| Min | 2.1 | 0.04 | 3.42 | 1.65 | 4.56 | 12.66 |
| Max | 3.88 | 0.44 | 8.19 | 4.74 | 12.08 | 32.9 |

Source: Field Survey, 2015

The residual concentrations of the heavy metals (Cd, Cr, Cu, Ni, Pb and Zn) in raw cow milk and cheese sample are presented in Figure 3 and 4. Detectable residue concentration of Cd, Cr, Cu, Ni, Pb and Zn were observed in 54 of the 55 milk sampled and 54 of the 55 cheese sampled in Ogun and Oyo state. In Ogun state, the minimum and maximum heavy metal values in milk samples are Cd (0.51 to 3.11), Cr (0.06 to 0.49), Cu (4.94 to 10.91), Ni (0.72 to 7.7), Pb (1.98 to 13.04), and Zn (5.42 to 13.328) while that of cheese sample are Cd (0.69 to 7.63), Cr (0.05 to 0.25), Cu (0.82 to 9.63), Ni (0.81 to 8.33), Pb (5.83 to 12.58), and Zn (3.21 to 13.05). The presence of lead content in the sample analysed could be attributed to its high affinity to casein which is one of the

contents found in milk. It can also be attributed to contamination from pastoralists and their environment. This result is supported by Aniello *et al.* (2006) that lead in milk can be a consequence of contamination during milking and processing of cheese. The result shows that all the heavy metals detected in the milk samples analysed were above the European Union heavy metal intake permissible limit.

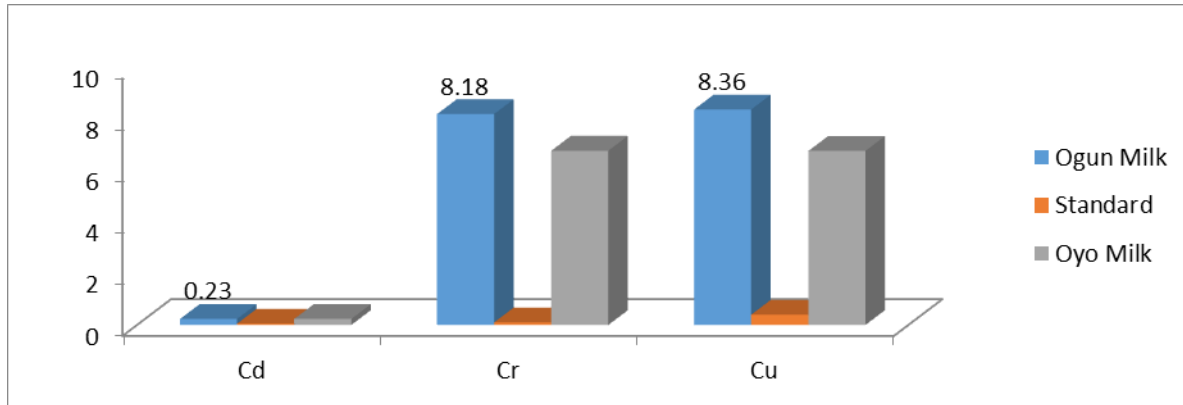


Figure 1: Result of Cadmium, Chromium and Copper present in Milk Samples against EU Standard

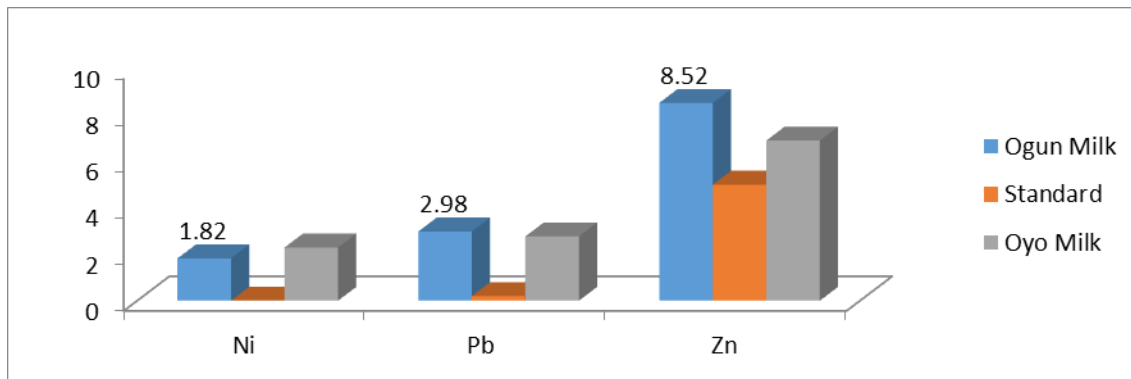


Figure 2: Result of Nickel, Lead and Zinc present in Milk Samples against EU Standard

In Oyo state, the heavy metal content in the milk sample analysed were as follows; Cd (1.92 to 2.66), Cr (0.14 to 0.4), Cu (3.42 to 8.8), Ni (0.83 to 6.66), Pb (1.86 to 10.03), and Zn (5.1 to 10.92). The mean value for cheese ranges from Cd (2.10 to 3.88), Cr (0.04 to 0.44), Cu (3.42 to 8.188), Ni (1.65 to 4.74), Pb (4.56 to 12.08), and Zn (12.7 to 32.9). The results of the cheese samples analysed in this study were beyond the European Union standard for heavy metals permissible limit in food for human consumption. Furthermore, the higher value of Zinc (Zn=18.5ppm>E.U=5.0) detected in all the milk and cheese samples analysed in this study is in line with previous work by Tripathi *et al.* (1999); Martino *et al.* (2001) and Licata *et al.* (2004).

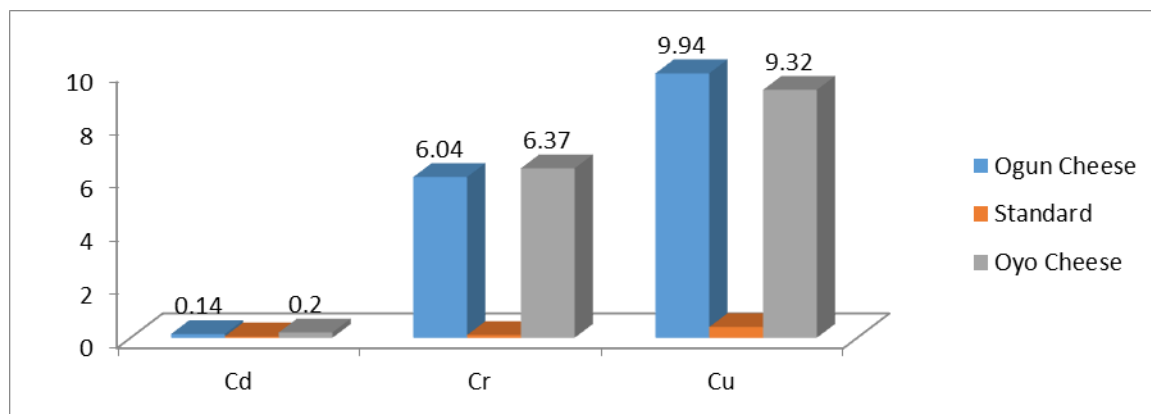


Figure 3: Result of Cadmium, Chromium and Copper present in Cheese Samples against EU Standard

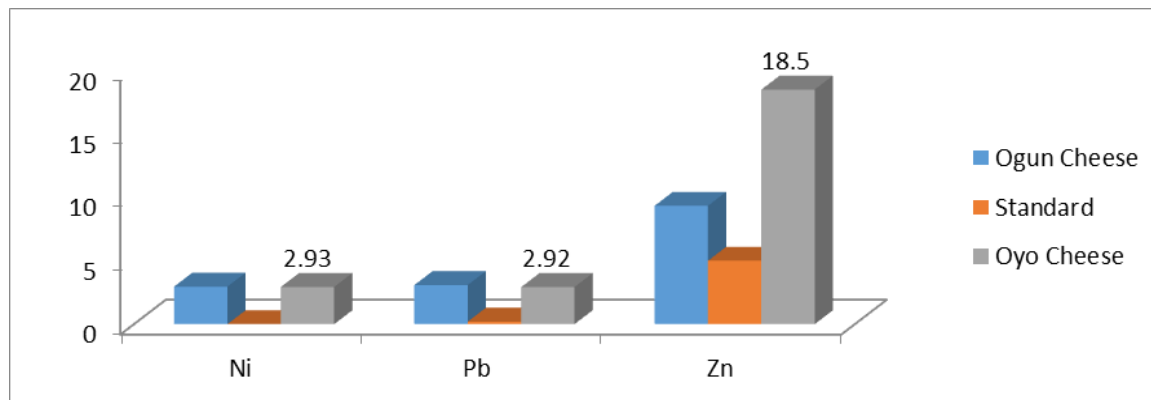


Figure 4: Result of Nickel, Lead and Zinc present in Cheese Samples against EU Standard

3.2.2 Bacteriological Analysis of Milk and Cheese

Raw milk and cheese are good sources of microbial growth that causes infection in consumers. Microorganisms gain access into raw milk through some external factors such as water, bedding materials, infection of the udder, storage materials and human. Observation during this study reveals that raw milk is consumed directly by a large number of pastoralists every day and by some rural people living close to the pastoralists. Also, a large number of both rural and urban people consume raw milk indirectly through consumption of cheese because it is usually produced under a very low heat or temperature.

The results of this study are summarized in Figure 5 and 6. According to these results, the highest number of occurrence of *Staphylococcus aureus* was found in milk sample (27 %) while 25 % was recorded for the cheese sample. This implies that 27 % of the milk samples and 25 % of the cheese samples collected in the two states were infected with *Staphylococcus aureus* which could be attributed to poor handling of milk during collection and processing of milk and cheese in an unhygienic manner. Figure 5 and 6 also shows that 26 % of the cheese samples and 17 % of the milk samples analysed were contaminated with *Bacillus spp.* In this research, the occurrence of *Bacillus spp.* in the milk and cheese produced by settled Fulani pastoralist was high and may be due to improper handling of milk and milk products, use of dirty cooking utensils and unhygienic processing technique used by the Fulani women. The presence of *Bacillus spp.* (*B. cereus*, *B. subtilis*, *B. megaterium*) in the samples of milk and cheese is of public health concern and it can be associated to pastoralists' source of water and soil around them. This result is similar to the findings of Omotayo *et al.* (2013) who disclosed that almost all the cheese samples analysed in Ogun and Oyo states were positive for bacteria contamination.

Furthermore, 19 % of cheese samples and 16 % of milk samples were tested positive for *Escherichia coli* in the two states. The presence of these potentially pathogenic organisms in milk could be as a result of poor hygiene or contamination from poor handling of the milk samples by workers, particularly carriers of these organisms. Figure 5 and 6 also shows that 13 % and 12 % of the milk and cheese samples respectively were contaminated with *Proteus mirabilis*.

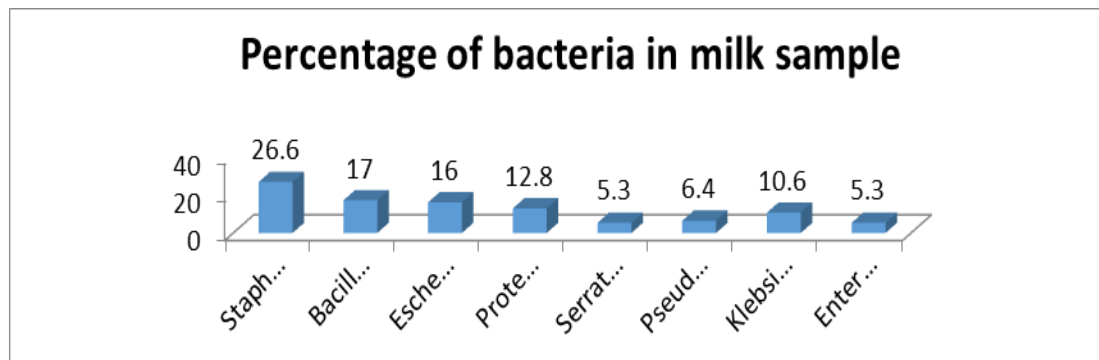


Figure 5: Different Types of Bacteria present in Milk Samples from Oyo and Ogun State

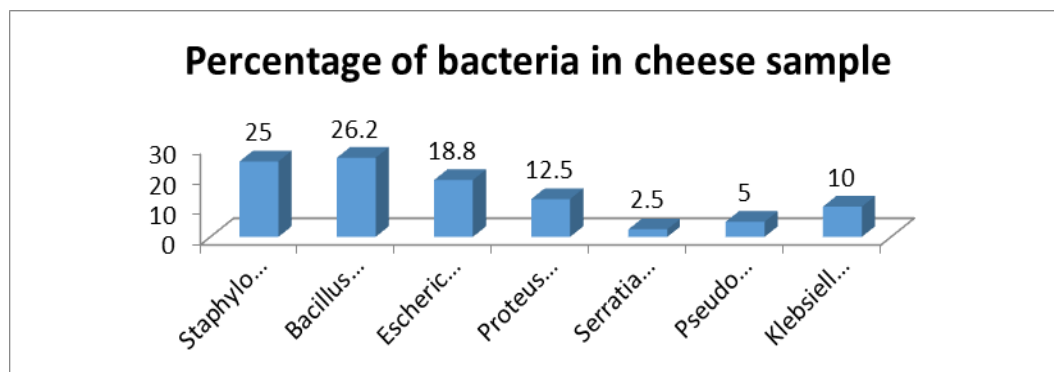


Figure 6: Different Types of Bacteria present in Cheese Samples from Oyo and Ogun State.

Source: Field Survey, 2015

4 Conclusion and Recommendations

Arising from the findings of the study, the quality of milk and cheese produced by Fulani pastoralists is of food safety concern, having high level of contaminations of heavy metals and bacteria. These contaminations have grievous implications on public health. Although, perception of the consumers is favourable to continued consumption of the products. The implication of this is that, there is low knowledge of food safety issues among consumers. They also do not feel threatened by the possible health challenges that could result from consuming unsafe food products. The analysis of the health beliefs further implies low cues to action except in emergency situation or widespread health hazards. Based on the foregoing, the study recommends the following:

1. Government agencies such extension organisations, research institutes and development partners would need to invest efforts in trainings, seminars and workshops for the general public on food safety awareness and attitudinal change towards contaminated food substances. This will increase awareness of consumers of milk and cheese and the risk associated with the continuous consumption of contaminated foods.

2. Efforts should be geared up by government agencies such as extension organizations and development partners in training and capacity building for Fulani pastoralists on hygiene and safe procedures in processing of milk and cheese.
3. Appropriate government agencies in charge of environmental sanitation and food safety procedures should conduct regular monitoring of milk and cheese production sites to monitor compliance with safe procedures. The capacity of Fulanis should be developed to enhance their adherence to food safety practices during milking and processing.

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