MICROBIOLOGICAL AND PHYSIOCHEMICAL ASSESSMENT OF STREET VENDED SOYABEAN CHEESE SOLD IN MINNA, NIGERIA

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Abstract

Objective: To evaluate microbial quality assessment of street vended soyabean cheese products (Tofu) sold in Minna metropolis

Method: Standard microbiological pour plate technique was used to examine the microbial content of ready to eat soybean cheese and also to isolate, characterize and identify the microorganisms.

Result: The results revealed the viable bacterial counts ranged from 1.40 x 10^5 cfu/ml - 8.40 x 10^5 cfu/ml, enteric bacterial counts ranged from 1.10 x 10^5 cfu/ml – 7.60 x 10^5 cfu/ml and fungal counts ranged from 3.0 10^3 cfu/ml – 36.0 x 10^3 cfu/ml. The bacteria isolated from the samples were *Staphylococcus aureus, Enterobacter aerogenes, Escherichia coli, Pseudomonas aeruginosa* and species *of Klebsiella* and *Bacillus* while fungi isolated include *Microsporum canis, Trichophyton rubrum, Aspergillus niger* and species of *Candida* and *Mucor*. The most frequently occurring bacteria was *S. aureus* while the most frequently occurring fungal was species of *Mucor*.

Conclusion: The results suggested that the soybean cheese samples were contaminated with pathogenic microorganisms and could cause health hazard to the consumers. There is need to improve personal hygiene and environmental sanitation as a good hygienic practice in the production and preparation of the soybean cheese since it serves as a good source of protein, carbohydrate and fat being of great nutritional value to the consumers

Keywords: Ready to eat, Soyabean cheese.

Introduction

Food can be described as a chemical mixture in a form that is regarded by an organism or suitable for ingestion Microorganisms are tiny organisms which cannot be seen with the naked eye. Food and microorganisms have developed long before the beginning of recorded history. Foods (such as soyabean cheese in this context) are not only of nutritional value to those who consume them but are often ideal culture medium for microbial growth. Since food is capable of supplying man with nutrients. It is equally capable of supporting the growth of contaminating microorganisms[1]

Soil and water microbes may also find their way into “ready to eat food” through contamination of raw material and water used to prepare food[2]. Food utensils are also source of microorganisms. The type of microorganisms found on food

utensils depend on the type of food being handled, the care of these utensils, their storage and other factors. If foods are handled in a given set of utensils, one would expect to find some or all of the organisms associated with the food. Utensils that are kept in the open and exposed to dust might lead to collection of air borne microorganisms[1]. There are several genera of bacteria that are found in the digestive tracts of man and animals which may find their way directly into the soil and water e.g. *Eshericha coli*, *Shigella* etc. the most notable of the genera is the genus *Escherichia*. Molds however are not thought to be transmittable by faecal sources. Lack of personal hygiene can also facilitate ingestion of intestinal microorganisms[2].

The micro flora on the other hand and other garments of food handlers generally reflects the environment and habitat of the individual. In addition, there are several genera of bacteria that are associated specifically with the hands and nasal cavity. e.g *Staphylococcus* and *Micrococcus*.

The most notable of which are *Staphylococcus*. The deposition of microorganisms into food occurs if sanitary practice is not followed by the food handler[1].

Many microorganisms found in the air contaminate foods, if the food or utensils for preparation are not well kept. Food can be viewed as a type of ecosystem in which microorganisms metabolize the nutrients in the food to make products such as acids, alcohols and gas.

Growth of microorganism on food can lead to its decomposition and spoilage. Foods may also carry pathogenic microorganisms and results in transmission of diseases. Other microorganisms if allowed to grow in certain food products such as soya beans cheese produce toxic substances that result in food poisoning when the food is ingested. Also appearance, flavour, colour and other properties of food may change as a result of degradative action of microorganisms[2].

The change that microorganisms cause in foods are not limited to the results of dehydration, they may also be used by products of microbial synthesis. Some microorganisms discolour foods as result of pigment produced.

Microorganisms capable of synthesizing certain polysaccharides may develop in or on foods as slimes. Other microorganisms also cause food spoilage e.g. moulds. The sign are off odours sometimes like rotten egg produced when bacteria breakdown the protein in food (putrefaction).

Discolouration, which occurs as a result of microbial growth e.g. moulds that have coloured spores. The greatest health risk today is food contamination from bacteria and also to a lesser extent various forms of viruses and parasites. These microbes can also cause food borne illness or food-borne diseases.

Some people who suffer food-borne illnesses more than others include the following: infants and children, those with liver disease, diabetes, HIV infection, cancer patients, pregnant women, people taking immunosuppressant agents. Some bouts of food borne illness coupled with the previous conditions can lead to food allergies, blood poisons (from toxin of microbes in blood stream) or other illness are recognized i.e. infections and intoxication[1].

Food borne infection requires the ingestion of the pathogen followed by

growth in the host, including tissue invasion before the release of toxins. Examples of microorganisms that cause food borne infection include *E.coli*, species of *Salmonella* and *Campylobacter jejuni*. The symptoms of the disease, which usually do not appear for at least one day after ingestion of contaminated food, usually include diarrhea but vary according to the type of organism ingested. Through cooking of food immediately before consumption will kill the organism there by preventing food borne infection[3].

Food borne intoxication is an illness that results from the consumption of toxins produced by microorganisms growth in a food product when such food is ingested, the toxins are what cause the illness not the living organisms. Toxins produced can be associated with microbial cells which can be released from the cells. Examples of organisms that cause food intoxication are *S. aureus and Clostridium botulinum*. The risk of illness from food borne microbes increase, as more of our foods are prepared in centralized Kitchen, outside the home.

"Ready to eat food" is defined as the status of food being ready for immediate consumption at the point of sale. It could be raw or cooked, hot or chilled can be consumed without further heat treatment including-reheating. The food and Agricultural organization defined street foods as ready-to-eat foods prepared and/or sold by vendors and hawkers, especially in streets and other similar public places[4]. Street food vending is an age-old tradition which predates urbanization in Nigeria, however rapid urbanization, high unemployment, low salaries, and limited work opportunities have resulted in the proliferation of street food and its vending as well as increased patronage by consumers[4]. While street foods provide a source of readily available inexpressive, nutritional meals to urban population and a source of income to the vendors, it also poses risks to health[5].

In several developing countries including Nigeria, consumers demand for freshness and convenience which has led to the increased production of street vending of several minimally processed food products such as soya beans cheese. The digestibility of soya bean cheese is 92.7%[7]. The objective of this study is to assess the microbial quality of ready to eat soyabean cheese sold on the street of Minna metropolis, and to also isolate, characterize and identify these micro organisms.

Materials and Methods

Sterilization of Materials

Glass wares such as Petri-dishes conical flask, beakers, testubes, pipettes, and Mc Cartney bottles were washed with detergents, rinsed with water and dried. They were sterilized in hot air oven at 160^0c for 1 hour. Media and sugar solutions used were sterilized by autoclaving at 121^0c for 15 minutes. Inoculating needles and loops were sterilized by heating them to red hotness in the Bunsen burner flame.

Preparation of Culture Media

The culture media used for bacterial count, enteric bacteria count and Fungi counts were Nutrient agar, MacConkey agar and Sabouraud dextrose agar respectively. They were all prepared according to the specification of the manufacturer.

Collection of Samples

Four different locations in Minna metropolis were selected and sampled. Different samples of soya beans cheese were collected from each location. They include Boiled samples, fried samples and stewed samples. Each sample was collected in sterile containers.

Determination of the pH of the food samples

Ten grams of each of the food samples was weighed with an aluminum foil. The samples were crushed completely using a sterile laboratory mortar and pestle, after which they were transferred into a beaker. Ninety millimeter of distilled water was added into each beaker. The resulting solution was left for ten minutes. The pH meter was dipped into the solution without allowing it to touch the settled particles beneath after which the pH was read on the pH scale and recorded for each sample.

Determination of Moisture Content

Ten grams of each of the food samples was weighed into piece of aluminum foil of known weight and then dried in an oven at 80^0c to constant weight. After which it was cooled in the desiccator removed and weighed.

The weight of the aluminum foil was subtracted from the total weight of each of the dried samples, leaving only the weight of each of the dried food. The moisture content was determined by the difference between the weights of the samples before and after drying to a constant weight. This was expressed as a percentage of the total weight.

Moisture content (%) = x – y/x X 100%

Where x = Initial weight of cooked food.

y = Final weight of cooked food.

Isolation of Bacteria

The pour plate technique was used for bacteria isolation. One gram was weighed from each sample and transferred into sterile test tubes containing 10 ml each of sterile distilled water. After shaking, six fold of serial dilution of the suspension was prepared. 1 ml from the required dilution of each sample was plated. Nutrient agar and MacConkey agar were used for the primary isolation of bacteria which were inoculated at 37^0C for 24 hours, for fungi Potato Dextrose was used at room temperature for 48 hours. The total bacterial count was enumerated using the standard plate count method.

Characterization of Isolates

Bacteria isolates were identified on the basis of the colonial and cellular morphology. Gram staining, capsule and spore staining, motility, catalase, oxygen relationship, methyl red, indole and sugar fermentation tests were also carried out in order to identify the organisms.

Result

Physiochemical characteristics

Table 1 shows the pH and moisture content of the various samples. Boiled sample 1 had the highest pH of 6.14 while stew sample 1 had the lowest pH of 5.58. Stew sample 2 had the highest moisture content which is 76% while fried sample 3 had the lowest moisture content which is 62%.

Microbial count

The total bacterial counts of the samples varied widely. stew sample 3 had the highest bacterial count of 7.60 x 10^5 cfu/ml while fried sample 3 had the lowest bacterial count of 1.40 x 10^5 cfu/ml.

Enteric bacteria were found in all food samples analyzed. stew sample 1 had the highest enteric bacterial count of 8.30 x 10^5 cfu/ml while boiled sample 1 had the lowest enteric bacterial count of 1.90 x 10^5 cfu/ml **(Table 2)**.

The Total fungal counts of the samples also varied. stew sample 3 had the highest fungal count of 36.0 x 10^3 cfu/ml while fired sample 2 had the lowest fungal count of 3.0 x 10^3 **(Table 2).**

The total bacterial counts varied widely. Fried sample had the lowest bacterial count ranging from 1.40 x 10^5 to 7.0 x 10^5.cfu/ml While stew sample had the highest bacterial count ranging from 4.20 x 10^5 to 8.30 x 10^5 cfu/ml.

The most frequently occurring bacteria was *S. aureus.* While the most frequently occurring fungi was species of *Mucor*.

Discussion

Four locations were randomly selected. Most of the street vendors kept the soya beans cheese in transparent plastic buckets and the cheese were sold to consumers by using fork to put it into transparent nylons. The low microbial count associated with some of the soya beans cheese could be as a result of the hygienic condition of preparation and handling by the hawkers.

pH is an important factor in the survival of microorganisms. The pH range of the food samples were between 5.58 to 6.82 for all the food samples. The lowest bacteria count of all the food samples was found in C-fried and this could be associated with the low pH i.e. high acidity of the food, as this does not favour the proper growth of bacteria except those that can adapt to such pH [8].

Organisms majorly found in C-fried where *Staph. aureus and Pseudomonas aeruginosa*. In other food samples, the pH ranged from 5.63-6.38 which allowed the growth of a number of species of bacteria which includes. *Staph. aureus, Escherichia coli, Enterobacter aerogenes, Pseudomonas aerugenosa.* species of *Bacillus and Klebsiella. Staph. aureus* is found in nose, throat, hair and skin of more than 50% of healthy individuals, hence the presence of these organisms indicates contamination from food handlers. *S. aureus* is the pathogentic specie of the genus and it produces toxin, which causes staphylococcal food poisoning[9].

The presence of organisms such as *E. coli.* and species of *Klebsiella* which are indicators of faecal contamination could be attributed to the method used in the preparation of the food and it could also be as a result of the unhygienic activities of the handlers. Species of *Pseudomonas* are motile organisms and are widely distributed in water, soil and sewage. *P. auruginesa* inhabits the intestinal tract of humans and animal. The presence of this organism indicates contamination from any of the mentioned source[4]

The presence of species of *Bacillus* is an indicator of contamination from the soil as their spores are found in the soil. Species of *Bacillus* is a major cause of contamination[4]

Generally, the moisture content of the food samples affects the growth of these organisms. The moisture content on all food samples ranged from 62%-76% which permited effective growth of bacteria. The major cause of bacteria on food sample is as a result of unhygienic practices in the process of preparation. The fungi isolated were *Aspergillus niger, Microsporium canis, Trichophyton*

rubrum, and species of *Candida*. and *Mucor*. Generally, the fungal population on the food samples was lower than the bacterial population. This was associated with the relatively high moisture content, which the fungi do not need[10].

Trichophyton rubrum is from the hand and nails of the individual during preparation. Contamination by species of *Candida* could also be a source of faecal or urine contamination from water.

Presence of *Microsporium canis* is contamination from the body (i.e. hands) of the individual during preparation[10]. Presence of other species of fungi also stated is as a result of contamination from the air. Food contamination by micro-organisms can be prevented if necessary precautions are taken especially by the handlers.

Conclusion

A good knowledge of soyabean handling practice is essential for all those involved in its processing, preparation and sale. Good food improves the health and well being of the consumer as health is wealth.

RECOMMENDATIONS

It is recommended that:

- If unwell, food should be not be handled.
- The hair, nose and mouth should be not touched during food preparation
- Suitable light coloured protective clothing should be worn.
- Cuts and abrasions should be covered with water proof bandages and if on the hands suitable gloves should be worn.
- Ring and other jewlry especially those worn on the wrist and fingers should not be worn during food preparation as they can harbour dirt and bacteria.
- Utensils used for cooking should be washed well after each use to prevent cross contamination from air.
- Soya beans prepared should not be exposed to contamination from air and flies while hawking.

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Table 1: Physiochemical characteristics of the sample

Sample code	pH	Moisture content %
AS	6.00	75%
AB	6.14	74%
AF	6.00	68%
BS	6.15	76%
BB	6.38	75%
BF	6.34	70%
CS	5.82	70%
CB	5.68	67%
CF	5.79	62%
DS	5.63	67%
DB	6.36	71%
DF	6.03	64%

KEY:
AS = stew sample 1, AB = boiled sample 1, AF = fried sample 1, BS = stew sample 2, BB = boiled sample 2, BF = fried sample 2, CS = stew sample 3, CB = boiled sample 3, CF = Fried sample 3, DS = stew sample 4, DB = D boiled sample 4, DF = fried sample 4

Table 2. Microbial counts

Sample code	Bacterial count (cfu/ml)	Enteric bacterial count (cfu/ml)	Fungal count (cfu/ml)
AS	5.10×10^5	6.30×10^5	4.0×10^3
AB	3.90×10^5	1.90×10^5	5.0×10^3
AF	1.80×10^5	7.50×10^5	22.0×10^3
BS	8.30×10^5	6.50×10^5	3.50×10^3
BB	4.20×10^5	1.10×10^5	8.0×10^3
BF	2.30×10^5	2.10×10^5	3.0×10^3
CS	8.40×10^5	7.60×10^5	36.0×10^3
CB	6.40×10^5	1.70×10^5	15.0×10^3
CF	1.40×10^5	3.10×10^5	27.0×10^3
DS	4.20×10^5	6.40×10^5	27.0×10^3
DB	3.80×10^5	5.20×10^5	8.0×10^3
DF	2.10×10^5	2.30×10^5	16.2×10^3

KEY:
AS = stew sample 1, AB = boiled sample 1, AF = fried sample 1, BS = stew sample 2, BB = boiled sample 2, BF = fried sample 2, CS = stew sample 3, CB = boiled sample 3, CF = Fried sample 3, DS = stew sample 4, DB = D boiled sample 4, DF = fried sample 4, CFU= colony forming unit.