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Research Article

Bacteriological Profile of Ready-To-Serve "Achu" and "Yellow Soup" Sold Within Bamenda Municipality, Cameroon

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Abstract

Introduction: Street-sold food may form an important source of food poisoning if not properly handled during the preparatory phase or while serving to consumers. In this study, we aimed at screening for bacteria in ready - to - serve achu and yellow soup vended in the streets within Bamenda municipality. This was a cross-sectional study carried out within a month; involving 60 vendors of achu and yellow soup within Bamenda municipality.

Materials and Methods: The samples collected were aseptically transported to the microbiology department of the Bamenda Regional Hospital laboratory. 2 µL of the yellow soup and a swap of each of the achu samples were separately inoculated on Blood Agar, Mannitol Salt Agar, Sabouraud Dextrose Agar, *Salmonella-Shigella* Agar and MacConkey Agar using the streak plate technique. Isolates obtained were identified by their morphology, gram stain and biochemical tests. Additional information regarding food preparation, storage and handling practices by vendors were noted using a questionnaire to correlate with the extent of bacterial contamination.

Results: All achu samples (100%) and majority (83.3%) of the yellow soup samples were contaminated with pathogens.The microorganisms isolated from achu and yellow soup in this study included *Eschericha coli* (33.3%, 31.7%), *Enterobacter* spp (28.3%, 21.7%), *Klebsiella* (20.0%, 5.0%), *Pseudomonas* (13.3%, 1.7%), *Proteus* (3.3%, 1.7%), *Alpha haemolytic streptococci* (3.3%, 18.3%), *Beta haemolytic streptococci* (3.3%, 0), *Salmonella* spp (63.3%, 53.3%), *Shigella* spp (20.0%, 21.7%), *Candida* spp (41.7%, 0), *Staphylococcus aureus* (40.0%, 31.7%) and other *Staphylococcus* spp (30.0%, 21.7%) respectively. The most prevalent bacterial isolate was *Salmonella* spp and the least prevalent were *Proteus, Alpha and Beta haemolytic Streptococci* for the achu; *Pseudomonas* and *Proteus* for the yellow soup respectively.

Conclusion: All samples of the ready-to-serve achu and more than 80 percent of the yellow soup samples in this study were contaminated with food-poisoning pathogens; a potential danger to consumers. Access to good drinking water and health education programs for food vendors on personal hygiene, food safety and proper disposal of waste would greatly improve on food quality; thereby reducing food-borne diseases amongst the inhabitants of Bamenda municipality.

Keywords: Bacteria Profile; Food-Borne Pathogens; Street-sold; Achu; Yellow Soup; Bamenda Municipality

Introduction

Achu and yellow soup is a traditional meal affiliated to some villages of the North West Region of Cameroon; but it is also well eaten and enjoyed in the Western Region and some other parts of Cameroon. Food borne diseases are diseases caused by pathogenic microorganisms (bacteria, viruses, fungi or protozoan), or their toxins when ingested with food. Many aspects of our everyday lives are influenced in some way by microorganisms; they play a role in our environment in food production as well as their ability to cause or cure infectious diseases [1]. Evident statistics have shown that food poisoning caused by Catering Services is 70% higher than that caused by any other sector [2]. It is suggested that about 15-70% of all diarrhoea episodes may be associated with practices of food handling, storage and feeding methods [3]. Little or no data is available on the investigation of pathogens in cooked "achu" and "yellow soup" albeit the method of preparation and storage practices involved. About 10 – 20% of food borne disease outbreaks are due to contamination by food handlers [3]. Food vendors often use stands and carts that are of crude and inefficient construction; running water is rarely accessible for washing of hands, with hand and dish washings usually performed in the same bucket and sometimes without soap [3]. It is common practice for waste water to be discarded in streets, and garbage bins are usually just nearby, providing an attraction site and food for insects and rodents. In many cases, toilets are not available, forcing most vendors to eliminate their body wastes in nearby areas and to return to their vending sites without washing their hands [4]. Such conditions and practices are likely to lead to contamination of cooked food [4]. Improper food practices contribute to about 97% of food borne diseases in food service establishments and homes [5]. Foodborne diseases could also result from poor personal hygiene of food vendors. Hand washing is a vital measure in the fight against the spread of food borne diseases and is one of the main practices to reduce the transfer of microbes between individuals and from individuals to food surfaces [6]. Assessed hand contamination among food handlers revealed that both *Staphylococcus epidermidis, Escherichia coli* (41.7%), followed by *Staphylococcus aureus* (29.2%) were the prevalent organisms isolated [6]. The researchers reported that ignoring hand washing after toilet or touching dirty materials and having long fingernails were the significant risk factors for food contamination and in extension, the food being served [6]. Improper handling of food and disregard of personal hygienic practices enable pathogens to come into contact with food and in some cases to survive and replicates in sufficient number to cause disease to the consumers [3]. A study conducted at Amaravati city located in south Indian state of Maharashtra [7] revealed a high degree of bacterial contamination in street foods (92 bacterial isolates obtained from 55 food samples analysed). The bacterial pathogens identified were *Pseudomonas aeruginosa* (39%), *Escherichia coli* (21%), *Staphylococcus aureus* (16%), *Salmonella* sp. (12%) and *Proteus* sp. (12%). Another study from Pune city found 88% of street foods contaminated with several bacteria including *P. aeruginosa*, *E. coli*, *S. aureus*, *Enterobacter* and *Klebsiella* sp. Out of 60 street food samples tested from another study in South Indian city Mangalore, 56 (93%) were contaminated with bacteria. Significant Coliform count was detected in 21 samples. High bacterial counts were recorded from samples prepared and served in places where the washing of hands, utensils and dishes were done in buckets [8]. No study to the best of our knowledge has been carried out on ready-to-eat achu and yellow soup; a traditional dish very much sold, eaten and enjoyed within Bamenda municipality. Therefore, the present study was carried out to assess the bacteriological profile of ready-to-eat achu and yellow soup sold within Bamenda municipality.

Materials and Methods

This study was carried out within Bamenda II municipality between May and June 2020. It was a community-based cross-sectional study which included 60 achu and 60 yellow soups sampled from well-utilized street-food vending sites within the given area. These samples were collected aseptically in sterile containers, placed in a flask and transported immediately to the Microbiology Laboratory of the Bamenda Regional Hospital for further processing.

Sample collection procedure

A Questionnaire was administered to acquire demographic information and the habits/lifestyle of the food vendors. Food samples were collected using the dishing spoons used by the food vendors and packaged into sterile plastic containers. Care was taken by investigators not to contaminate the samples by having a face mask on and not hand- touching the samples during the temporal storage period before transportation (within 2 hours) to the Microbiology laboratory of the Bamenda Regional Hospital.

Culture procedure

Upon arrival at the Microbiology unit; personal protective equipment (PPEs) were put on, and hair confined. Culture plates were removed from the fridge and allowed to obtain room temperature. The work surface was decontaminated using 10 percent sodium hypochlorite. Samples were numerically coded and arranged on the work surface according to the order of inoculation. The culture plates were labelled with the sample codes and the date of inoculation. Close to a lighted Bunsen burner flame, a swab was used to obtain the achu specimen which was inoculated on Blood agar, MacConkey agar, Sabouraud Dextrose agar, Salmonella-Shigella agar and Mannitol salt agar using the streak plate technique. In the same way, the yellow soup samples were mixed by moderately shaking the sample container, and while close to the flame, an inoculating wire loop was used to transfer 2 µl of the samples unto the culture media for inoculation using the streak plate technique. The inoculated plates were then incubated at 37°C for 24 hrs and examined for possible growth. Morphology of the isolates were examined both macroscopically and microscopically by means of post culture gram staining. Isolates from these media were used for biochemical testing such as; the Catalase, Oxidase, Motility, and Coagulase tests for proper identification.

Media preparation and Quality control of culture plates

The different culture media used were prepared according to the manufacturer's instructions and stored in the fridge. Before use, the culture plates were brought to room temperature after removal from the refrigerator, and examined to exclude for bacterial growth/colonies due to contamination. Any plate that showed growth without prior inoculation with the sample of interest was discarded.

Data management and analysis

Quantitative data was presented using tables and graphs. Results were recorded into a log book. Filled questionnaires were coded and data obtained were keyed into Microsoft Office Excel and later imported to Statistical Software Package for Social Science (SPSS) version 22.0 for statistical analysis, with tables and charts used to display results. $p < 0.05$ was considered statistically significant.

Ethical considerations

An attestation (Ethical Clearance) of authorization was obtained from the Ethical Review Board of the Faculty of Health Sciences- University of Bamenda, and the General Supervisor of the Bamenda Regional Hospital.

Results

Hygienic knowledge of vendors on food safety in relation to significant bacterial growth

Out of the 60 vendors sampled, 45(75.0%) said they had knowledge on food safety and hygiene while 15(25.0%) said otherwise. Among the 45, 11(24.4%) got the knowledge from friends, 18(40.0%) got it from school and 16(35.6) got it from parents. 35 of these vendors (58.3%), have been selling this meal for more than 5years, 22(36.7%) of them for 2-5years and only 3(5.0%) have been selling for less than a year. Also, most of the vendors 31(51.7%) had knowledge about food poisoning, 19(31.7%) had never heard about it and 10(16.7) claimed to have heard but knew nothing about it. Among the vendors that had heard about food poisoning, 7(17.1%) got it from the internet, 12(29.3%) from school, 16(39.0%) from family and friends and 6(14.6%) from both internet and school. Furthermore, out of the 60 vendors, only 4(6.7%) had any formal training on basic food hygiene while 56(93.3%) had never received training. Among those who had never received training on food hygiene, 40(66.7%) ensured food is well cooked before serving and 20(33.3%) followed proper hygienic measures before and after cooking. Also, 38(63.3%) used pipe borne water, 16(26.7%) used water from streams and 6(10.0%) used well water for cooking and washing of kitchen utensils. All 60 vendors claimed washing their hands frequently when handling the meal. Overall, with respect to food quality or the number of bacterial isolates, we found no significant differences between those who indicated having knowledge on food safety and hygienic and those who did not.

Bacteria isolated

From this study, out of the 60 achu samples analysed, all showed growth (100%) whereas out of the 60 yellow soup samples analysed, 50(83.3%) showed growth and 10(16.7%) had insignificant growth. Twelve different microorganisms were isolated from the achu samples which included *E.coli* from 20 cultures (33.3%), *Enterobacter* spp from 17 cultures (28.3%), *Klebsiella* from 12 cultures (20.0%), *Pseudomonas* from 8 cultures (13.3%), *Proteus* from 2 cultures (3.3%), *Alpha haemolytic streptococci* from 2 cultures (3.3%), *Beta haemolytic streptococci* from 2 cultures (3.3%), *Salmonella* spp from 38 cultures (63.3%),

Shigella spp from 12 cultures (20.0%),*Candida* spp from 25 cultures (41.7%), *Staphylococcus aureus* from 24 cultures (40.0%) and other *Staphylococcus* spp from 18 cultures (30.0%). 10 different bacteria were isolated from the soup which included *E.coli* from 19 cultures (31.7%), *Enterobacter* spp from 13 cultures (21.7%), *Klebsiella* from 3 cultures (5.0%), *Pseudomonas* from 1 culture (1.7%), *Proteus* from 1 culture (1.7%), *Alpha haemolytic streptococci* from 11 cultures (18.3%), *Salmonella* from 32 cultures (53.3%), *Shigella* spp from 13 cultures (21.7%), *Staphylococcus aureus* from 19 cultures (31.7%) and other *Staphylococcus* spp from 13 cultures (21.7%). *Beta haemolytic strep* and *Candida* spp were not isolated in the soup. Amongst all the bacteria isolated, the most prevalent bacteria from both achu and yellow soup was *Salmonella* spp with a prevalence of 63.3% of the achu samples and 53.3% of the yellow soup samples as shown on figures 1 and 2 respectively.

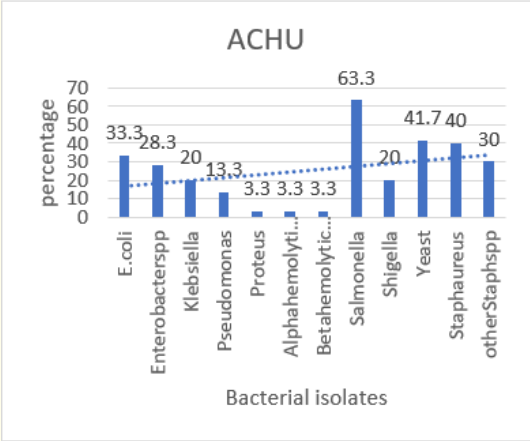

Figure 1: Bacterial isolates in achu.

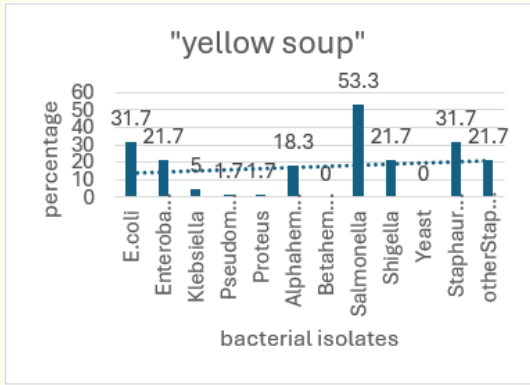

Figure 2: Bacterial isolates in yellow soup.

Discussion

In this study, a random sampling of 60 achu and yellow soup samples were analysed separately; there was 100% bacterial contamination of achu and 83.3% bacterial contamination of the soup. In the 100% that yielded significant bacterial growth with achu, twelve microorganisms were identified: 38(63.3%) *salmonella* spp, 25(41.7%) *Candida* spp, 24(40.0%) *Staph aureus*, 20 (33.3%) *Escherichia coli*, 18(30.0%) other *Staph* spp, 17(28.3%) *Enterobacter* spp, 12(20.0%) *Shigella* spp, 12(20.0%) *Klebsiella* spp, 8(13.3%) *Pseudomonas,* 2(3.3%) *Alpha haemolytic streptococci*, 2(3.3%) *Proteus* spp and 2(3.3%) *Beta haemolytic streptococci*.

In the 83.3% that yielded significant bacterial growth with yellow soup, ten bacteria genus were identified: 32(53.3%) *salmonella* spp, 19(31.7%) *Staph aureus*, 19(31.7%) *Escherichia coli*, 13(21.7%) other *Staph* spp, 13(21.7%) *Enterobacter* spp, 13(21.7%) *Shigella* spp, 11(18.3%) *Alpha haemolytic streptococci*, 3(5.0%) *Klebsiella* spp, 1(1.7%) *Pseudomonas,* and 1(1.7%) *Proteus spp. Beta haemolytic Streptococci* and *Candida* spp were not isolated in the soup. The microorganisms isolated were similar with the results obtained by [9] on other food samples carried out at Eastern Cape Province, South Africa in 2012 from which *Staph aureus, Pseudomonas* spp, *Klebsiella* spp, *Enterobacter spp and Proteus spp* were isolated showing high microial contamination. Also similar results of high microbial contamination was obtained in a study carried out by [9] in Kuali Lumpur of foods sold by street vendors.

The most prevalent bacteria isolated were *Salmonella* spp with a prevalence of 63.3% and 53.3% from achu and yellow soup respectively, followed by 41.7% *Candida* spp in achu. These results are different from those obtained by [10] on other food samples in South India in 2019, with *E. coli* (44%) and *Staphylococcus aureus* (29%) being the most prevalent bacteria isolated. These differences and the higher prevalence with current study could be attributed to dirty water supply, or poor hygiene in the preparation or handling of this meal while serving. Identification of *Candida* spp in the achu may be due to the fact that some vendors sell overnight achu that has been fermented to their customers. E. *coli* and other *Enterobacter* spp are indicative of possible faecal contamination and thus, the risk of transporting such pathogenic bacteria upon consumption of the said food sample [10].

The rate of contamination of ready-to-serve achu and yellow soup within Bamenda municipality is a call for concern. This may be due to the method of preparation given that the final processing of this traditional meal is done without heat and it is served cold. The wooden mortar and pestle used in pounding the cocoyam to make achu if not properly cleaned from previous use, and before use, may be a good source of food-poisoning pathogens. In the preparatory process, water is sometimes added to the cocoyam paste in the mortar to make it softer and easier to swallow; but this step may introduce pathogens in the food in the absence of good pipe-borne water. In addition, the traditional meal can only be properly eaten with fingers, necessitating the availability of clean and running tap water with soap in these vending sites for the proper washing of hands.

Assessing the hygienic knowledge of the vendors on food hygiene and safety with respect to the presence of pathogenic bacteria isolated from their food, no factor was statistically significant among those tested. This is contrary to the work done by [9] in which there was a statistically significant correlation ($p < 0.05$) of food-borne pathogens with hygienic knowledge on food safety and hygiene. This could be due to our small sample size or the possibility of respondents not being sincere with their responses.

Conclusion

From this study, we realized that street-sold achu was more contaminated than the yellow soup. The most prevalent bacterial isolate was *Salmonella* spp (causative agent of typhoid fever) and the least prevalent were Proteus, Alpha and Beta haemolytic *Streptococci* for the achu; *Pseudomonas* and *Proteus* for the soup. Food vendors play a very vital role in the society. Access to good drinking water and health education programs for food vendors on personal hygiene, food safety and proper disposal of waste would greatly improve on food quality; thereby reducing food-borne diseases amongst the inhabitants of Bamenda municipality.Thus, it is suggested that regular monitoring of the quality of street foods must be practiced to avoid any food bone illness in future.

Limitation of the Study

- This study was limited only to ready to eat "achu" and "yellow soup" sold within Bamenda municipality. Taking into consideration the environmental condition, the site of vending and hygienic practices carried out by food vendors within Bamenda might differ from those of other areas, the results obtained from this study will only be generalized with caution.
- Due to the fact that achu and yellow soup is mostly consumed here in Cameroon, little information was available on it.

Recommendation

To food vendors

All food vendors should endeavor to practice personal and good food hygiene: washing of hands after visiting the toilet, wash hands regularly when serving food, avoid talking over food, wash raw and cook food properly, put on clean clothing and finally go for regular medical checkup.

To the Government

- Put in place regulatory bodies to effectively monitor the hygienic conditions and practices of food vendors.
- Establish training seminars to sensitized food vendors on food safety and food hygiene.
- Put in place good toilet facilities at commercial eateries and measures put in place to ensure that they are always kept clean.
- And finally make available a constant water supply at commercial eateries

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Authors' Contributions

MOA conceived the study, designed the method, did the laboratory work, collected and transported samples, analysed data and drafted the manuscript. MCG provided nutritional expert advice, drafted and edited the manuscript. AM approved the study, supervised and monitored the experimental design and laboratory work, reviewed the data analysis, edited and finalized the manuscript for publication. All authors read and approved the final manuscript.

Conflict of Interest

None of the authors have a conflict of interest to disclose.

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