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Evaluation of Bacteriological Quality of Dried Crayfish (*Procambarius clarkil*) Sold at Selected Markets in Federal Capital Territory (FCT), Abuja, Nigeria.

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ABSTRACT

Dried crayfish are known to be important for human nutrition. Four hundred samples of dried `crayfish were purchased from six different markets and taken to bacterial zonooses laboratory for evaluation of microbial quality. Samples were analysed for bacterial load counts using standard microbiological methods. Total aerobic plate counts ranged from 6.74 ± 0.53 log10cfu/g for Bwari and 8.23 ± 0.36 log10cfu/g for Garki respectively, while total coliform counts ranged from 7.73 ± 0.48 logcfu/g for Gwagwalada to 8.31± 0.22 log10cfu/g for kubwa respectively. The common genera of bacterial isolated were Staphylococcus species (298;74.5%) and Streptococcus species (242;60.5%), Escherichia coli (230; 57%) Bacillus species (212;53%), Salmonella spcies (196; 49%) and Pseudomonas species (188; 47%). Overall, the highest value 8. 31 ± 0.22logcfu/g was obtained for both aerobic plate count and coliform counts which is much higher than the reference value of 5.7log10cfu/g for International commission on microbiological specification for food. This therefore highlights the need to improve the processing, handling, distribution, storage and transportation of dried crayfish in other to enhance consumer safety.

Keywords: Evaluation, bacteriological, quality, dried crayfish, markets

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INTRODUCTION

Crayfish (*Procambarius clarkil*) is one of the foods used as a source of protein for both the high and low income earners. It is a freshwater crustacean resembling small lobsters. Some species are found in brooks and streams where there is running fresh water, while others thrive in swamps, ditches and paddy fields. [1. Crayfish is known as a low fat, high protein food and usually contains useful fatty acids such as Omega-3 fatty acids which are important for optimal brain and nervous system development [2].

Crayfish contains a good amount of vitamin A, C, B6, thiamine, riboflavin [3]. It is also rich in sodium, potassium and phosphorous with good amount of iron, zinc, copper and manganese [4, 5, 2, 6]. Crayfish is preserved from bacterial deterioration by drying, smoking, freezing, chilling and banning, but drying is the commonest way used to prolong the shell life of the products by reducing the water content thereby protecting the products [2].

Crayfish is abundant in the fresh waters of the Delta region of Nigeria. The production level is conservatively estimated at about 12,000 metric tons per annum [1]. Crayfish is economically valuable in many riverine countries particularly in countries where fish production accounts for more than 75% of the total value of their commodity trade [1, 7]. Crayfish is used to a large extent in local food preparation in Nigeria. It is a common delicacy in the diet, among the people of the Southern and Western parts of the country [1]. Moreover, it may also be available at all the seasons, relatively cheap, affordable and suitable to supply adequate nutrients to cater for infant's estimated daily nutrient requirements to eradicate protein energy malnutrition (PEM), especially in the developing countries [8]. [1] reported that crayfish has found use in complementary food formulations. It is an important flavour ingredient in many Nigerian local preparations.

The pathogenic bacteria that are normally associated with the contamination of processed seafood are *Escherichia coli* [9] *Staphylococcus aureus* [10], and human pathogens such as *Salmonella* species [11] *Vibrio cholera* [12] and *Listeria monocytogenes* [13].

Poor hygienic practices during handling, processing and preservation of seafood are very common in developing countries including Nigeria. Consequently, such practices pose threats to public health and socio-economic services [14, 15].

Like most marine products, crayfish is susceptible to microbial damage which may create quality and safety problems. One-fourth of the world's food supply and 30% of landed fish are lost through microbial activity alone [16]. In open markets, crayfish are often displayed unpackaged which likely enhance microbial contamination via dust-laden air [2]. Crayfish in open markets are constantly touched by prospective buyers with bare hands, an unhygienic practice which could contribute significantly to increased contamination by micro-orgnisms [8]. This hazardous practice can lead to outbreak of diseases caused by these organisms. It can also be a reasonable source for the transmission of antibiotic resistance genes to the clinical species and vice versa.

The aim of this study was to evaluate dried crayfish sold at selected markets in FCT, Abuja, Nigeria, with the view of highlighting the implications of consuming dried crayfish direct from the sellers table.

MATERIALS AND METHODS

Sample Collection and Sample Preparation

A total of 400 dried crayfish samples were purchased from six (6) different markets namely, Gwagwalada, Bwari and Abuja municipal area council. All samples were collected aseptically in labeled sterile sample bags (polythene bag). Samples were transported to the Bacterial Zoonoses Laboratory, Department of Veterinary Public Health and Preventive Medicine, Ahmadu Bello University, Zaria for laboratory analyses.

Ten (10) grams each of dried crayfish sample was weighed using electronic weighing balance and placed in a sterile sample bag and a total of 90ml sterile peptone water added to the sample and homogenized in a stomacher for 2 minutes. Tenfold Serial dilution up to 10^{-6} were used for both total aerobic plate and coliform counts. A volume of 0.1ml from the final dilution was spread on nutrient agar for total aerobic plate counts and on MacConkey agar for coliform counts and incubated at 37^{0}C for 24hr. [17].

Bacteria Colony Count, Characterization and Identification of the Isolates

Enumeration of the colonies was carried out after incubation using a colony counter and plates with the dilution factor that gave between 30-300cfu were counted and expressed as colony forming unit per gram (cfu/g) of the samples. Discreet colonies on MacConkey agar were subcultured into fresh agar plates aseptically to obtain pure culture of the isolates. [18]. The isolates were characterized and identified based on their cultural characteristics, microscopic appearance, and biochemical reactions.

RESULTS

The results obtained from this present study shows cultural and microscopic characteristics of bacteria isolates from dried crayfish samples as shown in (table 3.1). The total aerobic plate count and coliform counts ranged from 6.74 ± 0.53 to 7.23 ± 0.36 log10cfu/g while total coliform counts ranged from 7.73 ± 0.48 logcfu/g to 8.31± 0.22 log10cfu/g. (Table 3.2). Six (6) different organisms were isolated as follows: *Staphylococcus* spp 298 (74.5%) and *Streptococcus* spp, *Escherichia coli* 230 (57%) *Bacillus* spp 212 (53%), *Salmonella* spp 196 (49%) and *Pseudomonas* species 188 (47%) respectively (Table 3.3).

Table 3.1 Cultural and Microscopic characteristics of bacteria isolates from dried crayfish samples

Pigmentation	Colony morphology	Motility	Gram reaction	Spore formation	Organism identified
Orange, yellow pink, creamy	Convex, Smooth Cocci in clusters	-	+	-	*Staphylococcus* spp
yellow, creamy pink	Entire, Convex, Smooth Short rods.	-	+	+	*Bacillus* spp
Green, creamy	Flat, Smooth Shiny surface Short rods	-	-	-	*Pseudomonas* spp
Pink, Creamy	Entire, Convex, Smooth	+	-	-	*E coli*
Orange, yellow Creamy	Entire, Convex cocci in chains	-	+	-	*Streptococcus* spp
Red with black center	Rod	+	-	-	*Salmonella* spp

+ = positive and - = negative

Table 3.2 Mean ± standard deviation (Log10 cfu/g) of total aerobic plate and coliform counts

Location	APC	TCC
GWA	7.04 ± 0.38	7.73 ± 0.48
ZUB	7.13 ± 0.36	8.03 ± 0.33
BWA	6.74 ± 0.53	8.0 ± 0.45
KUB	7.88 ± 0.59	8. 31 ± 0.22
WUS	8.11 ± 0.38	8.23 ± 0.36
GRK	8.23 ± 0.36	8.17 ± 0.34

Key: GWA (Gwagwalada), ZUB (Zuba), BWA (Bwari), KUB (Kubwa), WUS (Wuse) GRK (Garki).

Table 3.3 Frequency and percentage of occurrence of bacterial isolates

Bacterial isolated	Number of occurrence	Percentage
Staphylococcus spp	289	74.5%
Streptococcus spp	242	60.5%
E coli	230	57%
Bacillus spp	212	53%
Salmonella spp	196	49%
Pseudomonas spp	188	47%

Table 3:4 Biochemical Characteristics of Bacteria Isolates from dries crayfish samples

CAT	COA	CIT	IND	OX	MR	VP	SER	EMBA	Organism identified
+	+	-	-	-	-	-	+		*Staphylococcus* spp
+	-	-	-	-	+	-	-		*Bacillius* spp
+	+	-	-	+	-	-	+		*Pseudomas* spp
+	-	-	-	+	+	-	+	+	*E coli*
-	-	-	-	+	-	-	+		*Streptococcus* spp
+	-	+	-	-	+	+	+		*Salmonella* spp

CAT= Catalase, COA= Coagulase, CIT= Citrate, IND= Indole, OXI= Oxidase, MR= Methyl red, VP= VoguesProkuaer, SFT= Sugar Fermentation Test and EMBA= Eosin Methylene Blue Agar.

+= Positive, - = negative, Colony Count in CFUs on various parts of the crayfish samples.

DISCUSSION

There are various factors that pose risks to seafood safety and they range from contamination within the environment from the point of harvesting to consumption [19, 20]. This study revealed that crayfish which are cheap source of protein, mighty harbor a lot of pathogenic microorganisms that constitute health hazard to man.

The bacterial load of the dried crayfish samples in this study showed values ranging from 6.74 ± 0.53 to 7.23 ± 0.36 log10cfu/g for aerobic plate counts and 7.73 ± 0.48 logcfu/g to 8.31± 0.22 log10cfu/g for coliform counts. (Table 3. 2). This disagrees with the reports of [7] who reported low total bacterial counts in the range of 4.2×10^2 with coliform counts ranging from 2.0×10^2 to 2.8×10^2 cfu/g from dried crayfish in Uyo urban market, Akwa Ibom Nigeria: [21] reported 4.0×10^4 cfu/g to 7.2×10^4 cfu/g from heterotrophic count of dried crayfish in Ozoro market in Delta state Nigeria. [22] also reported $2.1x\ 10^4$ cfu/ml to $2.5x\ 10^4$ cfu/ml from evaluation of bacteriological quality of dried crayfish sold at Ogbete main market in Enugu metropolis, Nigeria.

The high microbial load recorded in this study, when compared with 5.7log10cfu/g for international commission on microbiological specification for food [23] showed that uncooked dried crayfish are not safe for human consumption.

The high population of bacteria in dried crayfish from this study indicates poor postharvest quality and high degree of exposure to environmental contamination during processing, handling, packaging, transportation, storage and at the point of sales.

Presence of food borne pathogens in fish and shellfish products is due to the environment it was harvested, sanitary and hygienic condition and practices associated with equipment and personnel in the processing environment [24]. The pathogen Staphylococcal species mighty have been introduced into the production process by human healthy carriers through handling as reported by [25], and their presence could predispose consumers to food poisoning [26].

The 74.5% of *Staphylococcus* species isolated from this study correlates with reports of [7, 22], who found the presence of Bacteria like *Staphylococcus* species, *E coli* species, *Bacllius* species from Mycoflora and bacteriological evaluation of dried crayfish from Uyo Urban market and Ogbete Main Market in Enugu respectively. In the same vain [27] found *Escherichia coli* and *salmonella* spp from farmed fish and retailed ones. The presence of *Staphylococcus* species on crayfish may be as a result of improper handling, cross contamination and poor temperature control [28]. *Staphylococcus* species are pathogenic as well as normal flora of human and animals and their presence in food are indications of excessive human handling [29]. Fish and shellfish vendors use their bare hands during measuring and constantly dip their fingers into basins containing fresh and dried seafood's which could lead to cross contamination of dried crayfish.

The presence of *Bacillus* species in crayfish might be associated with the habitat in which it was caught. [30, 31]. *Bacillus* is known to cause a number of infectious diseases such as septicemia, wound and foodborne infections, meningitis, respiratory and urinary tract infections. [32, 33, 31, 34]. *Bacillus* was present in dried crayfish samples tested in this study which is in agreement with the findings of [31]. The organism is of public health importance particularly *B. anthracis* which causes anthrax and *B. coagulase* which causes food spoilage. [34] *Pseudomonas* is a soil bacterium that requires a high water activity for growth. It is known to cause food spoilage (meat, fish) by secreting lipases and proteases that causes off-odors and formation of slime; [31]. *Salmonella* is reported to be a very high pathogenic bacterium, [35] it had been reported to cause enteritis and systemic disease [31]. The detection of these pathogenic microorganisms in the dried crayfish samples analyzed may be from the source in which it was harvested and the environment where the crayfish are sold. [13] stated that the potential source of *salmonella* in seafood is likely due to poor water quality, farm runoff and fecal contamination from wild animals or livestock. The isolation of *Pseudomonas* and *Salmonella* species from this study agrees with [36] who isolated the presence of similar organisms from catfish in cross river state. The high percentage recorded from this present study could be due to high number of samples. Worthy of note in this study is the presence of both spoilage and pathogenic bacteria species that were isolated from the dried crayfish samples analyzed.

The presence of *Staphylococcus* species, *Streptococcus* species, *E. coli*, and *Bacillus* species in fish may result from indiscriminate disposal of human and animal excreta as well as other environmental wastes into ponds and rivers that harbor seafoods or through washing of land surfaces into water bodies during the rainy season [37].

In conclusion this study showed that dried crayfish harbors a lot of bacterial species leading to increases bacterial counts that exceeded the recommended level for human consumption in the study area. Therefore, precautionary measures such as improved hygiene, during production, packaging, storage, transportation and distribution and also at the point of sales should be put in place.

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