Microbiological quality of some groundnut products hawked in Bauchi, a Nigerian City

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Abstract

The microbial quality of roasted groundnut , Kulikuli, Yaji and Dankwa hawked in three major areas in Bauchi, Northeastern Nigeria was determined. The microbial load of the product from from each location differs, while that of bacteria isolates ranges from 1.16±0.32x10^5 to 5.92±0.59 x10^5 colony forming units/gram (cfu/g), the fungal count ranges from 1.91±0.32 x10^4 to 8.60±0.22x10^4 cfu/g of the samples. Roasted groundnut had the highest count of micro-organisms followed by Kulikuli, then Yaji and Dankwa had the least. The dominant mold in these products was *Aspergillus niger*, *Rhizopus Stolonifer* and *A. flavus* while the other associated fungi includes *Penicillum citrinum*, *Mucor* spp. and *Macrophomina phaseolina*. The bacterial isolates found associated with these groundnut products include *Staphylococcus aureus*, *S. aureginosa*, *Micrococcus* spp. and *Bacillus cereus*.

Key Words: Arachis hypogaea L, Kulikuli, Yaji and Dankwa, Bauchi, roasted groundnuts, microbial quality.

Introduction

Groundnut (*Arachis hypogaea* L.) occupies an important position in the economy of developing nations. The major groundnut producing countries are India, China and the United States. It was introduced into Nigeria in the 16th century and it has been estimated that about 1.4 million hectares are cultivated for groundnut in Nigeria (Salunkhe *et al.*; 1985; Irvine, 1970).

Groundnut is nutrient dense agricultural produce, which is very high in energy due to its high fat and protein content. The carbohydrate content of groundnut is relatively low, being under 30% of the whole nut. The nut has relatively high content of fiber. It is an industrial crop whose major utilization is a source of oil. (Elegbede, 1998).

Groundnut us widely consumed in Nigeria as roasted or boiled nuts, which could be cooked or eaten with boiled maize in the Western and Southern parts of the country. "Kulikuli" (groundnut cake) is the residue obtained after the extraction of oil and it is high in protein and used as supplement in feed and food. The groundnut cake is usually fried in oil and is used as a delicious snacks or food supplement.

Groundnut flour is obtained by grinding groundnut cakes into fine size, which can be used in making soup or stew, sauces, confectioneries, puddings and bakery products. "Yaji", is groundnut flour that has been mixed with different portions of ground spices like ginger, alligator pepper and salted to taste. "Dankwa" is a groundnut flour that has been mixed with roasted cereal flour in which some spice, like dried ground alligator pepper, are added. Sugar and salt are also added to the mixture before being pounded and molded into small balls that can be eaten without furhter processing.

As a result of improper processing and storage conditions, groundnuts and its products may be contaminated with microorganisms. The number and type of microbes present on the produce is important in deterioration and numerous molds may be involved, but most common are species of *Aspergillus, Penicillum* and *Fusarium* (Frazier and Westhoff, 1978). Abalaka and Elegbede (1981) isolated species of *Bacillus, Salmonella, Pseudomonas* and *Escherichia coli* from groundnuts.

Shewfelt and Young (1977) stated that mold development on peanuts before, during or after harvest is harzadous, particularly when *Aspergillus flavus,* which produces aflatoxins, that is carcinogenic is involved. Salunkhe *et al* (1985), reported that *A. flavus* and *A. parasiticus* grow and produce aflatoxins in groundnut. The major factors which lead to high contamination levels of groundnuts are shell damage, and kernel splitting (usually induced by insects) poor harveting and drought, (Elegbede, 1998). Tabata *et al.*, (1993) found aflatoxins in groundnut products collected in Tokyo between 1986-90.

The aim of this study was to determine the level of microbial contamination of hawked roasted groundnut and some groundnut products (Kulikuli, Yaji and Dankwa) in three major locations in Bauchi, North eastern Nigeria.

Materials and Methods

Samples of roasted gorundnuts and groundnuts products (Kulikuli, Yaji and Dankwa) were collected randomly bimonthly within October and December from three major locations which include Wunti, Yelwa and Railway areas respectively in Bauchi town in 1998 and 1999. A total of two markets were used in each location, while the freshly processed products were also obtained from the source where the hawkers purchased the products. The samples from each market were collected in sterile sampling bags and treated separately. The peeled roasted groundnut, Kulikuli and Dankwa were reduced to fine particles in the laboratory through the use of sterile porcelain pestle and mortar. One-gram (1g) of each of the blended samples was suspended in 9ml of quarter strength Ringer's solution in 25 ml conical flasks. Serial dilutions of the samples were then made from this initial dilution.

The total bacterial counts for each sample were determined with the pour plate method using Nutrient agar. All samples were tested in triplicates. For the mold

counts, Malt Extract Agar was used. The plates for bacterial counts were incubated at 36° C for 48hrs, while those for molds were incubated at 25° C for 4 days. All colonies appearing at the end of the incubation period were counted using a digital illuminated colony counter (A. Gallenkamp Co. Ltd.) and the counts expressed in colony forming units per gram (cfu/g) of the samples.

Colonies of bacteria developing on the plates were observed, isolated and re-isolated until pure cultures were obtained. The bacterial isolates were then identified using both morphological (colonial morphology, pigmentation, cell shape and gram stain reaction) and biochemical methods (such as catalase, oxidase, methyl red tests and glucose fermentation) using Collins and Lyne, (1987). The mold isolates were identified using cultural and morphological characteristics, with reference to Samson, *et al.*, (1981). The identity of the fungal isolates were further confirmed by comparison with the existing cultures already identified by the International Mycological Institute, Kew, London, obtained from the Seed Health Laboratory, International Institute of tropical Agriculture (IITA) Ibadan, Nigeria.

Results and Discussion

Freshly processed groundnuts product was found to be relatively free of microbial contamination. The bacterial species consistently isolated from hawked groundnut products were *Staphylococcus aureus, S aureginosa, Micrococcus* spp. and *Bacillus cereus* while the mold species isolated from the products in the selected markets were *Aspergillus flavus, A. niger, A. tamarii, P. citrinum, R stolonifer,* M. *phaseolina* and *Mucor* spp. (**Table 1**).

The presence of the isolated bacteria species in these products is of particular interest because of their possible involvement in different infection. *S. aureus* is known to cause enterotoxigenicity due to the production of enterotoxin. Some *Bacillus* species such as *B. cereus* are food poisoning bacteria, while others like *B. substilis* causes miscellaneous problems (Abalaka and Elegbede, 1981). These bacteria pathogens are ubiquitous in nature and as such could be found in soil, dust, bodies of insects, animals and humans that handle the groundnuts and its products (Frazier and Westhoff, 1978). They could be transferred to groundnuts during storage and processing and some could be carried over from farm before harvest. *Staphylococcus* spp have been isolated from soybean supplemented and unsupplemented maize products (Efiuvewevwere, 1999).

The presence of *A. niger, A. tamarii, A. flavus, R. stolonifer, mucor* spp. and *P. citrinum* on these products might be due to improper handling during processing and hawking. While the presence of *M. phaseolina* probably suggests a field to storage and processing. Some of these fungi, especially *Aspergillus* spp are able to survive in situations where free water is not available (Samson et al., 1981). Also the production of spores by these organisms on dried food products makes it possible for them to survive, since their spores are to some extent more resistant to dry conditions than the vegetative mycelia(Smith, 1960). The presence of these molds on roasted groundnut, Dankwa, Yaji and Kulikuli, may result in production of toxic substances which could lead to health hazard for the consumers. The fungus *A. flavus* attacks groundnut seeds producing the important metabolite, aflatoxin, which has been shown to be highly toxic to man, all domestic and laboratory animals (Aletor, 1990). Moreover, the presence of *R. stolonifer* has been reported to cause an elevation of pH beyond the safety value of 4.6 and makes environment more conducive for the growth of pathogenic bacteria (Efiuviwevwere and Akoma, 1997).

From the surveyed, the average level of contamination with bacteria ranges from $1.16\pm0.32 \times 10^5$ to $5.92\pm0.59 \times 10^5$ cfu/g, while that of molds ranged from $1.91\pm0.32 \times 10^4$ to $8.60\pm0.22 \times 10^4$ cfu/g (**Table 2 and 3**). The highest contaminated product was the roasted groundnut from the Railway areas while the highest level of contamination on other products was also

Table 1. occurence of microbial isolates on groundnut products from three major locations in Bauchin in 1998 & 1999

	GROUNDNUT PRODUCTS											
	YAJI			KULIKULI			ROASTED GROUNDNUT			DANKWA		
BACTERIAL	A	B	C	A	B	C	A	B	C	A	B	C
Staphylococcus aureus	+	+	+	+	+	+	+	+	+	+	+	+
S. aureginosa	-	+	+	+	+	+	+	-	+	+	+	-
Micrococcus spp	+	+	-	+	-	+	+	+	-	-	-	+
Bacillus cereus	-	+	-	-	+	+	-	-	+	-	-	+
MOLDS												
Mucor sp	-	-	-	+	+	+	-	-	-	+	-	+
Rhizopus stolonifer	+	+	+	+	+	+	+	+	+	+	+	+
Macrophomina Phaseolina	-	-	-	+	-	+	+	+	+	-	+	+
Penicillum citrinum	+	+	+	+	+	+	+	+	+	-	+	+
Aspergillus niger	+	+	+	+	+	+	+	+	+	+	+	+
Aspergillus tamarii	+	+	+	+	+	+	+	+	-	-	+	+
Aspergillus flavus	+	+	+	+	+	+	+	+	+	+	+	+

KEY:
A Wunti areas, B = Yelwa area, C = Railway areas
\+ Present
\- Absent

Table 2. The mean bacterial load (cfu/g)* of groundnut products from three major locations in Bauchi in 1998 and 1999

	GROUNDNUT PRODUCTS			
LOCATIONS	**YAJI**	**KULIKULI**	**ROASTED GROUNDNUT**	**DANKWA**
		Mean x 10^5		
Wunti	2.21±0.52*	3.61±0.42	4.25±0.65	1.16±0.32
Yelwa	5.25±0.42	4.22±0.45	4.65±0.62	1.96±0.42
Railway	3.66±0.32	5.60±0.61	5.92±0.59	2.89±0.40
Average	2.70±0.62	4.47±0.56	4.80±0.48	2.00±0.22

Counts recorded are mean of triplicate samples at each location in 1998 & 1999.
* Standard Deviation

Table 3. Mean mould counts (cfu/g) of groundnut products from three major locations in Bauchi in 1998 and 1999

	GROUNDNUT PRODUCTS			
LOCATIONS	**YAJI**	**KULIKULI**	**ROASTED GROUNDNUT**	**DANKWA**
		Mean x 10^4		
Wunti	4.2±0.42*	5.2±0.61	7.0±0.72	2.10±0.38
Yelwa	4.1±0.62	5.4±0.68	7.30±0.42	1.90±0.32
Railway	5.6±0.65	6.90 ±0.72	8.60±0.22	3.6±0.40
Average	4.63±0.56	5.83±0.67	7.63±0.45	2.53±0.33

Counts recorded are mean of triplicate samples at each location in 1998 & 1999.
* Standard Deviation

recorded from the same area. The railway area is highly commercialised with several commuters and passer-by, this probably resulted in dusty atmosphere usually experienced in such stations hence the high contamination. Roasted groundnut is usually exposed with many intending buyers touching with contaminated hands thereby contaminating the product. The lower microbial counts recorded for other products compared to that of roasted groundnut could be as a result of processing and spices added to these products. Spices have been reported to inhibit microbial growth (Zaika *et al.*, 1983 Adegoke and Skura, 1994; Ohlhawere, 1996).

The roasted groundnut, Kulikuli, Yaji and Dankwa used in this study were found contaminated with molds and bacteria, and these microbes might multiply to cause spoilage of these products under favourable condition and render them inedible or could even become vehicles of food poisoning and infection. Care should be taken from the harvesting stage of groundnuts through the processing stage to prevent contamination and infection with microbes. The hawkers of these products should also handle them in such a way that they would be prevented from insects, especially houseflies, which are known to transmit microbes. These groundnut products could also be packed in sealed transparent polyethylene (nylon) bags after production, before being displayed on the market stands as against exposing them in bowls or glass boxes.

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