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Some microorganisms associated with ginger-based yaji in Wukari metropolis

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Abstract

The bacteriological and mycological quality of commercially and laboratory prepared Ginger based Yaji was investigated. Ten Ginger Yaji samples were purchased randomly from three wards within Wukari and compared with the laboratory prepared Yaji. The pH in water of all the Yaji samples was acidic and ranged from 4.87 ± 1.08 to 5.52 ± 0.07. The total viable bacteria count ranged from 1.0×10^8 cfu/ml to 4.0×10^9 cfu/ml, while the fungi count ranged from 2.0×10^8 cfu/ml to 1.7×10^9 cfu/ml. The predominant bacteria isolated were *Staphylococcus aureus* and *Staphylococcus epidermidis*. The fungi isolated were *Aspergillus* and *Penicillium* species. Sensory evaluation showed that commercially prepared Ginger Yaji (A) with 6.73 ± 1.95 is the most preferred, followed by the laboratory prepared Ginger based Yaji (F), with 6.57 ± 2.67, as the second most preferred, while Ginger Yaji (J), with the mean score of 3.17 ± 2.15 is the least preferred. This study had shown that microorganisms are associated with Ginger based Yaji which is as a result of poor hygienic measures taken by the producers, use of deteriorated spices and exposure of the Yaji to unsanitary environmental condition. There is need for public enlightment on the danger of microbial contamination of Yaji. Government should encourage industrial production of Yaji to enable compliance to Good Manufacturing Practices since the laboratory produced Yaji (sample F) was not contaminated.

Introduction

Spices have served as food additives for decades and have remained the major constituents of our daily diet. They are known to confer health benefits to consumers. In Nigeria, the common spices are Ginger *(Zigiber officinale)*, Garlic *(Allium sativum),* Red pepper *(Capsicum annuum)*, Black pepper *(Piper guineense)*, African Negro pepper *(Xylopia aethiopica)*, Ground nut *(Arachis hypogaea),* Curry leaf *(Murray koenigii)*, Fluted pumpkin *(Teifaria occidentalis)*, Nutmeg *(Myristica fragans),* Onion *(Allium cepa)*, Chilli pepper *(Capsicum frutescens)*, Tumeric *(Curcuma longa)*, Bitter leaf *(Vernonia amygdalina)*, Spinach *(Amaronthus hybridus)*, Moringa leaf *(Moringa oleifera)*, Okro *(Hibiscus esculenta)*, Alligator pepper *(Aframomum melegueta)*, Cloves *(Syzygium aromaticum)*, Garden egg plants *(Solanum melongena)*, and Celery leaf *(Cuminum cyminum)* (Akpamu *et al*., 2011; Nwaopara *et al.,* 2012). These spices are used singly or in combination in various food preparation or culinary. In some cases, they are mixed together to make special preparations which are used in serving other foods like fried yam, fried fish and cooked rice or yam. Examples of such preparation, is yaji which is used in Suya preparation, eating yam and other kinds of food (Nwaopara *et al.,* 2012).

Yaji is the mixture of different spices and additives for seasoning foods (Betumiblog, 2006). Generally, yaji can be made up of several spices depending on the type of the yaji required and these spices includes; *Zingiber officinale* (Ginger), *Allium sativum* (Garlic), *Syzygium aromaticum* (Cloves), *Capsicum annuum* (Red pepper), *Piper guineense* (Black pepper), *Xylopia aethiopica* (African Negro pepper), *Arachis hypogaea* (Ground nut), *Aframomum melegueta* (Alligator pepper), *Solanum melongena* (Garden eggplant), *Moringa oleifera* (Moringa leaf), *Pakia biglobosa* (locust bean), Maggi cube, and table salt (Nwaopara *et al*., 2004; Witchtl, 2004; Nwaopara *et al*., 2011; Nwaopara *et al*., 2012). According to History, the word Yaji was named after a 14th century Hausa ruler called Yaji, which means the 'Hot one' (Nwaopara *et al.,* 2009). Ginger yaji is one of the common types of Yaji and it involves the mixture of Garlic, Black pepper, Red pepper, Cloves, Alligator pepper, African Negro pepper, salt, Maggi cube, and Ginger as the dominant spices. The Yaji is called Ginger Yaji due to the quantity of ginger used, which

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is more than the quantity of the other spices. Ginger Yaji serve as seasonings in food such as cooked Rice and yam, Jollof rice, Fried yam, and Suya - a Nigeria meat delicacy (Nwaopara *et al*., 2012).

The ginger Yaji prepared by the Hausa people in Northern Nigeria are usually sold by Hawkers along the street, market and Suya producers. Ginger Yaji is an important food additives used for seasoning purpose. The spices contained in the Yaji improves nutritional quality of food, promote food processing and preparation, makes food appealing and improves its quality, and preservation of foods especially, *Allium sativum, Zingiber officinale*, and *Aframomum melegueta* which contains some antimicrobial properties (Mann, 2012).

However, some spices such as *Piper guineense, Capsicum annuum, Xylopia aethiopica,* and *Aframomum melagueta* may be contaminated with microorganisms at various stages of preparation. Growth of Bacteria and Fungi may occur within a damp environment where the Yaji was prepared and this lead to its contamination (Awe *et al*., 2009). Equipment and food (Yaji) handlers have also been associated with the contamination of ginger Yaji with various type bacteria such as *Bacillus cereus, Citrobacter freundii, Escherichia coli, Klebsiella* species, *Serratia* species, *Staphylococcus aureus,* and *Streptococcus* species as well as fungi species may be associated with Yaji spices (Awe *et al.*, 2009). Faulty food handling techniques especially storage of the Yaji at improper temperature for a long period of time, exposure to air or contact with utensils used with soil (Awe *et al.* 2009). Therefore, the objective of this study was to evaluate the microbial contamination of ginger based yaji.

Materials and Methods

Source of materials

Ten (10) commercially prepared ginger-based Yaji were purchased randomly from three wards (Puje, Avyi Hospital) in Wukari Government Area of Taraba state and were taken to the laboratory within an hour of purchase for analysis. The spices for the preparation of laboratory ginger-based Yaji cluding; garlic *(Allium sativum),* cloves *(Syzygium aromaticum)*, ginger (*Zingiber officinale)*, red pepper *(Capsicum annuum)*, African Negro pepper *(Xylopia aethiopica),* alligator pepper *(Aframomum melegueta)*, African Black pepper *(Piper guineense),* table salt, and maggi cubes were purchased from different sellers in Wukari new market, Taraba state, Nigeria. These were taken to the Biology laboratory of Federal University Wukari for processing into Yaji.

Preparation of ginger-based Yaji

The ginger-based yaji was prepared in the laboratory following the method described by Otunola *et al.* (2010). The Yaji spices were sorted and washed with sterilized water and then dried in the hot air oven set at 60^0C for 72 h and weighed before grinding. The measured quantities are black pepper (15g), red pepper (200 g), cloves (16 g), garlic (25g), ginger (208 g), African Negro pepper (10 g), maggi cubes (200 g), and table salt (50 g). The spices were subsequently mixed together and ground into powder using a manual grinding machine. The spices were sieved and packed in 10 sample containers, 10 Aluminium foil and 9 polyethene bags, containing 30 g, 10 g and 20 g of the Yaji respectively for further analysis.

Determination of pH

The pH in water of the Ginger Yaji samples were determined using pH meter.

Enumeration, isolation and identification of bacteria and fungi

The microbiological analysis was performed following a modification of the method described by Ogodo *et al.* (2015). Exactly 1 g of each yaji sample was added to 9.0 ml of sterile physiological saline in a test tube and ten-fold serial dilutions were made. Then 0.2 ml from the 10^{-6} was aseptically inoculated to plates of Nutrient Agar, Mannitol Salt Agar, MacConkey Agar and Potato Dextrose Agar using pour plate techniques. The culture plates were incubated at 37^0C for 24 h. The PDA plates were incubated at 25^0C. At the end of the incubation, the plates were examined for bacterial and fungi growth and then counted. Discrete bacterial and fungal colonies were subcultured on fresh media for purity cultured onto freshly prepared Nutrient Agar plates by streaking and then, incubated at 37^0C for 24 h.

The pure bacteria cultures obtained were identified using a four step characterization process reported by Okereke and Kanu (2004). Identification was done using Baggey's Manual of Determinative bacteriology (Holt *et al*., 1994). The isolated fungi were identified based on their colony characteristics as well as their vegetative and reproductive structures as observed under the microscope. Some macroscopic and microscopic characteristics considered include; color of the colony, shape of the conidia head, pattern of arrangement of spores on the conidia (Tatah *et al*., 2016). Identification was done with reference to Feng and Ma (2010).

Table 2. Enumeration of the microorganisms

Sample	Nutrient Agar (TVC)	MacConkey Agar (TCC)	Mannitol Salt Agar (TSC)	Potato Dextrose Agar (TFC)
A	NOG	NOG	NOG	$3.0x10^8$
B	$4.0x10^9$	NOG	$5.0x10^8$	$7.0x10^8$
C	$3.0x10^8$	NOG	NOG	$5.0x10^8$
D	$1.0x10^8$	NOG	NOG	$2.0x10^8$
E	NOG	NOG	NOG	$1.5x10^9$
G	$1.0x10^8$	NOG	NOG	$2.0x10^8$
H	NOG	NOG	NOG	$1.3x10^9$
I	NOG	NOG	NOG	$1.7x10^9$
K	NOG	NOG	NOG	$2.0x10^8$

NOG = No Observable Growth; TVC = Total Viable Count; TCC = Total Coliform Count; TSC = Total Staphylococci Count; TFC = Total Fungal Count

Sensory evaluation of commercially and laboratory prepared ginger based Yaji

The sensory evaluation of the Ginger based Yaji was conducted on a nine-point Hedonic scale using the preference test method. Questionnaire was prepared using a Hedonic scale which contains the following preference of test parameters; like extremely (9), like very much (8), like moderately (7), like slightly (6), Neither like nor dislike (5), Dislike slightly (4), Dislike moderately (3), Dislike very much (2), and Dislike extremely (1). The questionnaires were given to thirty (30) panelists who tested eleven (11) different Ginger Yaji samples labeled from letter A to K along with fried yam and Suya of which letter F was the laboratory prepared ginger based Yaji. Furthermore, the information was collected from the panelist and analysis was carried out using the Preference test method, described by Ihekoronye and Ngoddy, (1985).

Results

The pH in water of all the ginger Yaji samples were acidic and ranged from 4.87 ± 1.0^8 to 5.52±0.07 (Table 1). The total viable bacteria count (TVBC) ranged from 1.0×10^8 cfu/ml to 4.0×10^9 cfu/ml, while the fungal count ranged from 2.0×10^8 cfu/l to 1.7×10^9 cfu/ml (Table 2). Table 3 shows that *Staphylococcus* species, *Aspergillus* species and *Penicillium* species were isolated from the samples. The predominant bacteria species isolated were *Staphylococcus aureus* (50%) and *Staphylococcus epidermidis* (50%). *Aspergillus niger* is the predominant fungi species (33.3%) while *Penicillium* species was the least (11.1). The result of the sensory evaluation shows that Ginger Yaji (A) with 6.73±1.95, is the most preferred, followed by Ginger Yaji (F), with a mean score of 6.57±2.67, as the second most preferred, while Ginger Yaji (J) with the mean score 3.17±2.15 is the least preferred (Table 4). The order of preference of the Ginger Yaji samples is as follows; A>F>D>K>E>B>C>I>G>H>J at P-value>0.05.

Table 1. pH in water of the ginger Yaji samples

Samples	pH
A	5.17±0.55
B	5.35±0.29
C	5.25±0.44
D	5.45±0.13
E	5.43±0.21
F	4.87±1.08
G	5.29±0.35
H	5.18±0.35
I	5.17±0.52
J	5.17±0.64
K	5.52±0.07

Values are mean of triplicate determination; No significance difference at P>0.05.

Table 3. Frequency of isolation of microorganisms in Yaji

Microorganisms	**Percentage (%)**
Staphylococcus aureus	50.0
Staphylococcus epidermidis	50.0
Aspergillus flavus	22.2
Aspergillus niger	33.3
Aspergillus fumigatus	22.2
Penicillium species	11.1
Aspergillus candidus	11.1

Discussion

The pH values obtained showed that the Ginger Yaji samples were slightly acidic, thereby, indicating that the Yaji could permit and tolerate the growth of some bacteria and fungi. The bacteria and fungi counts obtained may be due to poor hygienic

Table 4. Scores for preference and sensory evaluation of the various ginger samples

Ginger yaji	Preference test value
A	6.73±1.95
B	5.90±2.11
C	5.50±1.57
D	6.23±2.13
E	6.07±1.86
F	6.57±2,67
G	4.77±2.52
H	4.70±2.32
I	4.93±2.41
J	3.17±2.15
K	6.20±2.31

standard of preparation and handling (Adebesin *et al*., 2001; Awe *et al.*, 2009). Some of the organisms isolated have been implicated as causative agents of food poisoning (Ray, 2004). However, other species isolated produce toxins such as aflatoxins which affects liver, hence leading to liver damage (Carlson and Ensley, 2003).

The International Commission on Microbiological Specification for Food (ICMSF) recommended the limit for bacteria contaminants in a mixture of spices which are in the range of 10^1 to 10^5cfu/g total microbial plate count, 10^1 to 10^3cfu/g for mould and yeast, and 0/20 g for *Staphylococcus aureus*. It was observed that the Total Viable Bacteria Count (TVBC) and fungi count of ten (10) different Ginger Yaji samples analysed in the present study are above this recommended limits. This observation could be due to faulty food handling techniques as well as food storage at improper temperature for long period of time (Awe *et al.*, 2009). The level of microbial contamination of the commercial yaji samples in the present study could also be attributed to the production of these Yaji under unhygienic environments, exposure to moisture or the use of insufficient dried spices or raw materials mixed together before packaging as well as the use of dirty packaging materials.

The presence of *Staphylococcus aureus* in the Yaji samples is an indication of human contamination after processing. *Staphylococcus aureus* produces enterotoxin which is characterized by short incubation period, violet nausea, diarrhoea and vomiting. *Staphylococcus aureus* and *Aspergillus niger* are the major contaminants of the Ginger based Yaji. The presence of *Aspergillus flavus* and *Aspergillus fumigatus* in the Yaji might be due to air contamination. Also, reports have indicated that excessive consumption of the Yaji can lead to liver damage or failure (Nwaopara *et al*., 2009; Ezejindu and Aligwekwe, 2013) which can be related to microbial contamination. In the present study, the preference test analysis have shown that ginger Yaji (A) with 6.73±1.95 was the most preferred, followed by the Ginger Yaji (F) with 6.57±2.67 while Ginger Yaji (J), with 3.17±2.15 was the least preferred of the Ginger based Yaji. This indicates that laboratory prepared yaji (sample F) was of good quality and compared favourably with sample A (a commercial yaji sample).

Conclusion

The present study has shown that bacteria and fungi can contaminate ginger-based yaji in wukari metropolis. The microbial contaminants is of public health significance. Hence, there is need monitor the stages of yaji production to ensure that, the production is done under good sanitary conditions. Also, there is need for industrial production of Yaji to enable compliance to Good Manufacturing Practices (GMP) since the laboratory prepared Yaji was not contaminated.

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