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Research Article

MICROBIAL PROFILE OF PUFF PUFF SOLD ON THE STREETS OF LAGOS STATE

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ABSTRACT

The microbial quality of puff puff (ready to eat snacks) sold in ten selected local governments in Lagos State were investigated. A total of twenty puff puff were sampled i.e. two samples each from ten vending sites namely, Ikorodu, Island, Ikeja, Mushin, Oshodi, Ebute Meta, Shomolu, Ketu, Ojota, Surulere were microbiological analysed using pour plate method of 1ml of dilution factor of 10^{-3} aliquot inoculums of the samples. The total aerobic plate count and coliform count ranging from $0.9 \times 10^2 - 7.8 \times 10^2$ and $0.25 \times 10^2 - 4.7 \times 10^2$ respectively. The fungal count from the ten sites is within $0.25 \times 10^2 - 3.75 \times 10^2$. The bacteria isolated were identified to include, *Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa, Salmonella bongori, Klebsiella pneumoniae* and many *Bacillus* sp The fungi isolates in this study are *Saccharomyces cerevisiae, Saccharomyces rouxii* and *Candida valida*. The presence of *Escherichia coli* and *Enterococci* which are indicator organisms of feacal contamination calls for concern. Adoption of good manufacturing practice and hazard analysis critical control point (HACCP) are necessary to preventing occurrence of food borne pathogens.

Keyword: Microorganism, Quality and Puff puff.

1.1 INTRODUCTION

Snack is described as "high-energy" food such as doughnut, egg roll, sausage, chin chin, meat pie, puff puff and also crips of all types such as meat or fried fish and also African dish like mio-moi and bean cake etc. It contains some compositions in it such as carbohydrate, fat and oil, protein and water. It is usually eaten by all age groups with high popularity amongst youths in various institutions; in particular, school children and in the society at large. It is described as Ready to Eat Food (RTE), because of the status of food being ready for immediate consumption at the point of sale. However, there is very high tendency for the general populace to patronize ready to eat snacks or take away foods[1]. In addition, snacks (RTE) are regarded as potentially hazardous because such food can support the growth of pathogens which can result to food borne disease, resulting from the ingestion of the bacterial pathogens and their toxins as documented worldwide [2]. The microbial agents that cause food borne illness may include bacterial, such as *Salmonella*, *Staphylococcus aureus*, *Escherichia coli* (pathogenic strains), *Bacillus* sp, *Clostridium botulinum*, *Pseudomonas aeruginosa*, viruses such as Hepatitis A and E, fungi such as mold and yeasts [3]. Moreso, due to the nature of these foods and their method of preparation involving extensive handling, they are usually prone to contamination and cross contaminates from soil, water, air, human activities (baking and sales) storage and distribution facilities. A number of foods in Nigeria have been reported to have high level of contaminants[4]. Food poisoning organisms such as *staphylococcus aureus* and *Clostridium botulinum* and food infection organisms such as *Escherichia coli*, *Proteus* and *Salmonella* can emerge from the consumption of such foods [5].The consumption of snacks is due to the convenience or modern lifestyle, economic downturn, industrialization, materialism, quest for more wealth, lack of time to prepare proper meal and the low

purchasing power are reasons for the increased patronage for ready-to-eat food [6]. [5]estimated that a significant proportion of the approximately 1.5billion episodes of diarrhea and more than three million deaths globally recorded annually result from consumption of food with microbial pathogens and toxins. The major concern with ready-to-eat food (snacks) is their microbiological safety mainly because vending is done in places that may have poor sanitation. In some African countries, such foods have tested positive for various microorganisms of public health concern including feacal Coliforms, *Escherichia coli, Staphylococcus aureus, Salmonella sp, Bacillus cereus.* A study conducted by [7] observed that the presence of *Escherichia coli, Enterococcus, Klebsiella sp and Staphylococcus aureus* are of concern and further support the possibility of feacal contamination of product due to poor sanitation. *Bacillus* and *Pseudomonas sp* isolated are known to be environmental contaminants and opportunistic pathogens that have been implicated in food borne diseases and known to cause food spoilage that can lead to economic loss. [8] concluded that the most predominant bacterial contaminant was staphylococcus aureus with 25.56% this was traced to the fact that it is abundant in human body (skin, nail and hair), similarly, Bacillus cereus showed high percentage 18%, due to the fact that it forms abundant spore in soil, water and air and hence can be easily present in these foods. [4] isolated microorganisms from sausage and sea food respectively. The presence of *Staphylococcus aureus* could be as a result of it; being a common organisms on skin, hands and hair and hence their presence in sausage, may result in contamination due to handling, processing, transportation and storage. [1] had studied domestic water usage in Port-Harcourt metropolis and indicated the water source can serve as route of contamination such as well water, rain water and pipe borne water respectively. In addition, according to [9] the presence of *Escherichia coli* is an indication of feacal contamination of the water sources that were utilized in the processing of these food products. [10] isolated microorganisms from locally produced 'Robo' snack from melon seeds in Abeokuta metropolis. And these organisms were *Bacillus sp, staphylococcus aureus, Salmonella sp, Aspergillus fumigates*, were found in the Robo snack that is being prepared manually and with no consideration for sanitary practices; hazards in the forms of microbial contamination and ultimately food borne illness will occur when consuming such products. Some of these organisms might be picked up during grinding, mixing, kneading and molding. However, isolation of *Staphylococcus aureus* as well as *Salmonella* may be due to cross contamination of using unhygienic utensils, or it may be due to contamination from skin and mixture during the process of production; it can also be by non-human contact e.g. poor environment. This study therefore evaluates the microbial quality of puff puff prepared and sold on the streets in ten local government areas in Lagos state.

2.0 MATERIALS AND METHOD

2.1 Collection of Samples

Ten local governments in Lagos were sampled. Those sites were chosen because they are densely populated and they are highly patronized by people of different status. These locations include, Ikorodu, Island, Ikeja, Mushin, Oshodi, Ebute metta, Shomolu, Ketu, Ojota and Surulere respectively.

Two samples each of puff puff were purchased from those locations. The samples were aseptically collected in sterile polythene bag and transferred immediately to the laboratory for further analysis. All media used in this investigation were prepared according to manufacturer prescription

2.2 Methods

A 9.0ml amount of distilled and sterile water was pipetted into sterile screwed capped test tubes. Subsequently 1.0g of each sample was weighed into a sterile mortar and the sample was grinded with a sterile pestle with small portion 10^{-1} diluents. The sample was poured into a sterile flask. One ml (1.0ml) aliquot from 10^{-1} dilution was taken and transferred into the next dilution blank containing 9.0 ml amount of sterile water (10^{-2} dilution). The sample were serially diluted up to 10^{-3} dilution, poured plate technique was employed. A prepared molten Nutrient agar, MacConkey agar, Baird Parker agar, Salmonella Shigella agar and Potato Dextrose agar were poured into the Petri dishes after 1.0ml aliquot inoculum was placed into plate respectively. The plates were gently shaken to and fro for proper distribution of the inoculums. The plates were allowed to set and incubated inversely under aerobic condition at 35 ± 2^{o} c for 24 hours for bacteria while at 25 ± 2^{o}c for 3-5 days for fungi. The growth on each plate was examined at the end of incubation and colonies were counted using colony counter (cfu/g).

Table 1
TOTAL MESOPHILE AEROBIC MICROBIAL POPULATION IN PUFF PUFF SAMPLES USING 10^{-3} DILUTION.

Sample Site	Sample Code	Total Bacteria Count on Nutrient agar cfu/g	Coliform Count on Mac Conkey agar cfu/g	Staphylococcus Count on Baird Parker agar cfu/g	Salmonella shigella Count on SSA cfu/g	Fungi (Yeast and Moulds) Count on PDA Cfu/g
Ikorodu	A_1	$6.4X10^4$	$3.1X10^4$	$1.0X10^4$	$0.1X10^4$	$1.5X10^4$
	A_2	$7.0X10^4$	$2.9X10^4$	$1.3X10^4$	-	$1.9X10^4$
Mean count	→	$6.7x10^4$	$3.0x10^4$	$1.15x10^4$	$0.1x10^4$	$1.7x10^4$
Island	B_1	$7.6X10^4$	$4.5X10^4$	$0.8X10^4$	-	$2.6X10^4$
	B_2	$8.0X10^4$	$4.9X10^4$	$1.2X10^4$	-	$3.3X10^4$
Mean count	→	$7.8X10^4$	$4.7X10^4$	$1.0X10^4$	-	$2.95X10^4$
Ikeja	C_1	$5.0X10^4$	$3..7X10^4$	$1.1X10^4$	-	$2.2X10^4$
	C_2	$4.8X10^4$	$3.5X10^4$	$0.9X10^4$	-	$1.9X10^4$
Mean count		$4.9x10^4$	$3.6x10^4$	$1.0X10^4$	-	$2.05x10^4$
Mushin	D_1	$6.0X10^4$	$0.8X10^4$	$1.3X10^4$	-	$3.9X10^4$
	D_2	$5.6x10^4$	$0.5x10^4$	$1.2x10^4$	-	$3.6x10^4$
Mean count	→	$5.8x10^4$	$0.65x10^4$	$1.25X10^4$	-	$3.75x10^4$
Oshodi	E_1	$3.6X10^4$	$1.5X10^4$	$0.4X10^4$	-	$1.2X10^4$
	E_2	$3.1X10^4$	$1.2X10^4$	$0.6X10^4$	-	$1.0X10^4$
Mean count	→	$3.35x10^4$	$1.35x10^4$	$0.5X10^4$	-	$1.1x10^4$
Ebutemeta	F_1	$2.5X10^4$	$0.8X10^4$	$0.3X10^4$	-	$1.1X10^4$
	F_2	$1.8X10^4$	$0.6X10^4$	$0.4X10^4$	-	$1.2X10^4$
Mean count		$2.15X10^4$	$0.7X10^4$	$0.35X10^4$	-	$1.15X10^4$
Shomolu	G_1	$2.2X10^4$	$1.0X10^4$	$0.5X10^4$	$0.2X10^4$	$0.6X10^4$
	G_2	$2.0X10^4$	$0.8X10^4$	$0.6X10^4$	$0.1X10^4$	$0.7X10^4$
Mean count	→	$2.1X10^4$	$0.9X10^4$	$0.55X10^4$	$0.15X10^4$	$0.65X10^4$
Ketu	H_1	$3.1X10^4$	$0.2X10^4$	$0.7X10^4$	$0.1X10^4$	$1.8X10^4$
	H_2	$2.8X10^4$	$0.3X10^4$	$0.5X10^4$	$0.1X10^4$	$1.7X10^4$
Mean count	→	$2.95X10^4$	$0.25X10^4$	$0.6X10^4$	$0.1X10^4$	$1.75X10^4$
Ojota	I_1	$2.4X10^4$	$0.8X10^4$	$0.3X10^4$	$0.2X10^4$	$0.9X10^4$
	I_2	$2.0X10^4$	$0.5X10^4$	$0.2X10^4$	-	$1.0X10^4$
Mean count	→	$2.2X10^4$	$0.65X10^4$	$0.25X10^4$	$0.2X10^4$	$0.95X10^4$
Surulere	J_1	$0.8X10^4$	$0.4X10^4$	$0.1X10^4$	$0.1X10^4$	$0.2X10^4$
	J_2	$1.0X10^4$	$0.5X10^4$	$0.1X10^4$	$0.2X10^4$	$0.3X10^4$
Mean count	→	$0.9X10^4$	$0.45X10^4$	$0.1X10^4$	$0.15X10^4$	$0.25X10^4$

TABLE 2

BIOCHEMICAL TEST FOR TOTAL VIABLE ISOLATES ON NUTRIENT AGAR

Sample Site	Sample Code	Colour/Pigment	Gram Reaction	Cellular Morphology	Catalase Test	Oxidase Test	Indole Test	Motility Test	MR-methyl Orange	Vp- Voges	Urease activity	Citrate Utilization	Gelatin Hydrolysis	Starch Hydrolysis	Casein Hydrolysis	Spore Test	NO3 Reduction	Glucose	Sucrose	Lactose	Xylose	Sorbitol	SALICIN	MANNITOL	MALTOSE	ARABINOSE	RAFFINOSE	FRUCTOSE	Probable Identity
Ikorodu	A1	Cream	+ve	Rods	+	+	-	+	-	+	-	-	-	-	+	+	-	+	-	-	-	-	-	-	-	+	-	+	*Bacillus badius*
	A2	Cream	+ve	Rods	+	+	-	+	-	+	-	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	+	+	*Bacillus amyloliquefasciens*
Island	B1	Cream	+ve	Rods	+	+	-	+	+	-	-	-	+	+	+	+	+	+	-	-	+	-	+	+	-	-	-	+	*Bacillus brevis*
	B2	Cream	+ve	Rods	+	+	-	+	-	+	-	+	+	+	+	+	+	+	+	+	-	-	-	+	-	+	-	+	*Bacillus subtilis*
Ikeja	C1	Cream	+ve	Rods	+	+	-	+	-	-	-	+	+	+	+	+	+	+	+	-	+	-	+	+	-	+	-	+	*Bacillus megateriu m*
	C2	Cream	+ve	Rods	+	+	-	+	-	+	-	-	+	+	+	+	+	+	-	+	-	-	-	-	-	-	-	+	*Bacillus sphaericus*
Mushin	D1	Cream	+ve	Rods	+	+	-	-	-	+	-	-	+	+	+	+	+	+	+	+	-	-	-	+	-	-	-	-	*Bacillus mycoides*
	D2	Cream	+ve	Rods	+	+	-	+	-	-	+	-	-	-	-	+	+	+	+	+	-	-	-	-	+	-	-		*Bacillus ureae*
Oshodi	E1	Cream	+ve	Rods	+	-	-	-	+	-	-	-	+	+	-	-	-	+	-	+	-	-	-	+	-	-	-		*Corynebacterium striatum*
	E2	Cream Butter	+ve	Rods	+	+	-	+	-	+	-	+	+	+	+	+	+	+	+	+	-	-	-	+	-	-	-	-	*Bacillus cereus*
Ebute Meta	F1	Cream Butter	+ve	Rods	+	+	-	+	-	+	-	+	+	+	+	+	+	+	+	+	-	-	-	+	-	-	-	-	*Bacillus cereus*
	F2	Cream	+ve	Rods	+	+	-	+	-	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	*Bacillus polymyxa*
Shomolu	G1	Cream	+ve	Rods	-	-	-	+	-	-	-	-	-	-	+	+	+	+	+	+	-	-	-	+	+	-	-	+	*Clostridium tertium*

2.3 Identification of Isolates

The representative colonies were chosen from each plate based on the colonial morphology similarity; isolates were identified using various number of morphological and biochemical tests such; colonial characterisation, cellular characterisation Gram staining reaction

3.0 RESULT

4.0 DISCUSSION

Puff puff is very nutritious and contains nutrients necessary for microbial growth and metabolism which makes it susceptible to microbial contamination. In view of this, it is therefore mandatory that these foods must be free from contamination as much as possible to ensure safety from health problem after consumption and to promote quality assurance.

From the results of the analysis carried out on the puff puff samples as indicated in Tables 2 and 3, the bacteria isolated include *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Salmonella bongori*, *Escherichia coli*, *Klebsiella pneumonia*, many *Bacillus* sp such as *Bacillus cereus*, *Bacillus brevis*, *Bacillus subtilis* e.t.c. The sites A and B in Table 1 have the highest microbial load; these can be attributed to the level of exposure of these products, kind of lifestyle of the people living in those areas; unhygienic practice of the handlers as well as the raw materials.

The presence of *Staphylococcus aureus*, *Salmonella* sp, *Klebsiella* sp and many *Bacillus* sp and *Escherichia coli* suggested the possibility of feacal contamination of the food products due to poor sanitation practice[8]. However, these organisms are environmental contaminants and opportunistic pathogens and have been implicated to cause food borne infection which may result to great economic loss.

TABLE 3
BIOCHEMICAL TEST FOR STAPHYLOCOCCUS ISOLATES ON BAIRD PARKER AGAR

Sample Site	Sample Code	Colour	Gram Reaction	Cellular Morphology	Catalase Test	Oxidase Test	Indole Test	Motility Test	MR-methyl Orange	Vp- Voges	Urease activity	Citrate Utilization	Gelatin Hydrolysis	Starch Hydrolysis	Casein Hydrolysis	Coagulase Test	No3 Reduction	Growth in 10%	GLUCOSE	SUCROSE	LACTOSE	XYLOSE	RIBOSE	GALACTOSE	MALTOSE	MACTOSE	RAFFINOSE	ARABINOSE	Probable Identity
Ikorodu	A1	White	+ve	Cocci	+	+	-	-	-	+	-	-	-	-	-	-	-	+	+	+	+	-	+	-	-	+	-	+	*Staphylococus albus*
	A2	Orange	+ve	Cocci	+	-	-	-	-	+	+	-	-	-	-	+	+	+	+	+	+	-	+	+	+	+	-	-	*Staphylococus cereus*
Island	B1	White	+ve	Cocci	+	+	-	-	-	+	-	-	-	-	-	-	-	+	+	+	+	-	+	-	-	+	-	+	*Staphylococus albus*
	B2	Orange	+ve	Cocci	+	-	-	-	-	+	-	-	-	-	-	-	-	+	+	+	+	+	+	-	+	+	+	+	*Staphylococus ariettae*
Ikeja	C1	Cream	+ve	Cocci	+	-	-	-	-	+	+	-	-	-	-	-	+	+	+	-	+	-	-	-	+	+	-	-	*Staphylococus carirous*
	C2	White	+ve	Cocci	+	-	-	-	-	+	+	-	-	-	-	-	+	+	+	+	+	-	-	-	+	-	-	-	*Staphylococus simulans*
Mushin	D1	Yellow	+ve	Cocci	+	+	-	-	-	-	-	+	+	-	-	-	+	-	+	+	-	+	-	-	-	+	-	-	*Micrococcus varians*
	D2	Orange	+ve	Cocci	+	-	-	-	-	-	+	-	-	-	-	+	+	+	+	+	+	-	+	+	+	+	-	-	*Staphylococus aureus*
Oshodi	E1	Yellow	+ve	Cocci	+	+	-	-	-	+	+	-	+	-	-	-	-	-	+	+	-	+	-	-	-	-	-	-	*Micrococcus kristinae*
	E2	White	+ve	Cocci	+	+	-	-	-	+	-	-	-	-	-	-	-	+	+	+	+	-	+	-	-	+	-	+	*Staphylococus albus*
Ebute Meta	F1	Yellow	+ve	Cocci	+	-	-	-	-	+	+	-	+	-	+	-	-	+	+	+	+	-	-	-	-	+	-	-	*Staphylococus epidermidis*
	F2	Orange	+ve	Cocci	+	-	-	-	-	+	+	-	-	-	-	+	+	+	+	+	+	-	+	+	+	+	-	-	*Staphylococus cereus*
Shomolu	G1	Cream	+ve	Cocci	+	-	-	-	-	+	+	-	-	-	-	-	+	+	+	+	-	-	-	-	-	+	-	-	*Staphylococus homines*
	G2	Yellow	+ve	Cocci	+	+	-	-	-	+	+	-	+	-	-	-	-	-	+	+	-	-	-	-	-	+	-	-	*Micrococcus cadilus*
Ketu	H1	Cream	+ve	Cocci	+	-	-	-	-	+	+	-	-	-	-	-	+	+	+	+	-	-	-	-	-	+	-	-	*Staphylococus homines*
	H2	Red	+ve	Cocci	+	-	-	+	-	+	-	-	-	-	-	-	+	-	+	-	-	+	-	-	+	+	-	-	*Micrococcus roseus*
Ojota	I1	Yellow	+ve	Cocci	+	+	-	-	-	-	+	-	+	-	-	-	-	+	+	+	+	-	-	-	-	-	-	-	*Micrococcus luteus*
	I2	Cream	+ve	Cocci	+	-	-	-	-	+	+	-	+	-	-	-	+	+	+	+	-	-	-	-	-	+	-	-	*Staphylococus homines*
Surulere	J1	Red	+ve	Cocci	+	-	-	+	-	+	-	-	-	-	-	-	+	-	+	-	-	+	-	-	+	+	-	-	*Micrococcus roseus*
	J2	Cream	+ve	Cocci	+	-	-	-	-	-	+	-	-	-	-	-	+	+	+	+	-	-	-	-	-	+	-	-	*Staphylococus homines*

The presence of *Bacillus cereus* is due to the fact that it is an abundant spore former in soil, air and water, hence can be present in the food sample as a result of exposure of the product on the road side. This report is in agreement to the studies of [4, 9, 11], they isolated similar organisms from sausages, meat pie and sea foods, respectively.

The presence of *Saccharomyces cerevisiae* (baker's yeast) in Table 4 which is non-pathogenic was as a result of the major ingredient in the puff puff samples such as flour and sugar. Analysis showed that puff puff samples from Island had the highest plate count as shown in Table 1; this may be due to the fact that the area is densely populated and the high rate of activities which cause severe environmental pollution that gives rise to the contamination of food product by pathogenic organisms. Puff puff is eaten by all age groups with high popularity amongst school children and youths; it is therefore mandatory that this food must be safe and hygienic. Food borne illness can be prevented by good hygiene practice and clean environment during the preparation of food.

TABLE 4
BIOCHEMICAL TEST FOR YEAST ISOLATES ON POTATO DEXTTROSE AGAR (PDA)

Sample Site	Sample Code	Colour	Cellular Morphoology	Catalase Test	Motility Test	Urrease test	Ascospore Formation	Pseudomycellium	NO3 reduction	GLUCOSE	XYLOSE	RAFFINOSE	SUCROSE	FRUCTOSE	LACTOSE	MALTOSE	MANNITOL	MELIBIOSE	TREHALOSE	GALACTOSE	ARABINOSE	Probable Identity
Ikorodu	YA	Cream	Oval, Budding	+	+	-	+	-	-	+	-	+	+	+	-	+	-	+	+	+	+	*Saccharomyces cerevisiae*
Island	YB	Cream	Oval Budding	+	+	-	+	-	-	+	-	+	+	+	-	+	-	+	+	+	+	*Saccharomyces cerevisiae*
Ikeja	YC	Cream	Ellipsoidal	+	+	-	+	-	-	+	-	-	-	+	-	+	-	-	-	-	-	*Saccharomyces rouxil*
Mushin	YD	Cream	Small Cylindrical / Oval	+	+	-	-	+	-	+	+	-	+	+	-	-	-	-	-	-	-	*Candida valida*
Oshodi	YE	Cream	Cylindrical / Oval	+	+	-	-	+	-	+	+	-	+	+	-	-	-	-	-	-	-	*Candida valida*
Ebute metta	YF	Cream	Oval, Budding	+	+	-	+	-	-	+	-	+	+	+	-	+	-	+	+	+	+	*Saccharomyces cerevisiae*
Shomolu	YG	Cream	Oval, Budding	+	+	-	+	-	-	+	-	+	+	+	-	+	-	+	+	+	+	*Saccharomyces cerevisiae*
Ketu	YH	Cream white	Oval, Round, Budding	+	+	-	+	-	-	+	-	+	+	+	-	+	-	+	+	+	+	*Saccharomyces cerevisiae*
Ojota	YI	Cream white	Ellipsoidal	+	+	-	+	-	-	+	-	-	-	+	-	+	-	-	-	-	-	*Saccharomyces rouxil*
Surulere	YJ	Cream	Oval/Roun d Cylindrical	+	+	-	-	+	-	+	+	-	+	+	-	-	-	-	-	-	-	*Candida valida*

5.0 CONCLUSION

In conclusion, different bacteria and yeast isolated from puff puff samples are members of the family *Enterobacteriacea* namely *Staphylococcus aureus*, *Bacillus* sp, *Salmonella* sp, *Escherichia coli, Klebsiella* sp and *Pseudomonas aeruginosa*. The presence of *Staphyloccoccus aureus* could be traced to the fact that it is abundant in human body (skin, nails, hair). *Staphyloccoccus aureus* is known to cause *Enterotoxigenicity* due to the production of enterotoxin. Some *Bacillus* sp such as *Bacillus* cereus are food poisoning bacteria while Salmonella bongori is responsible for gastrointestinal disease called Salmonellosis, characterized by cramping and diarrhea. Also the fungal isolated includes *Saccharomyces cerevisiae*, *Saccharomyces rouxii* and *Candida validass*.

Therefore, the presence of these organisms in the puff puff is of public health significance since these food products are marketed without proper supervision from regulatory authorities like National Agency for Food and Drug Administration Control (NAFDAC), Food Agency Organization (FAO) and Standard Organization of Nigeria (SON).

5.1 RECOMMENDATION

From this research work, it was observed that improper packaging, lack of good storage and management of raw materials from wholesalers' end and unhygienic practices are involved during processing and these have contributed to the high microbial load of this snack.

It is therefore recommended that the following should be adhered to:

- The National Agency for Food and Drug Administration Control (NAFDAC) should enforce law on standard packaging of Puff puff before they are being displayed on market stands instead of exposing them into a glass boxes.
- Raw materials should be washed and clean thoroughly before they are used in the production of food products.

- Hand washing should be done always after using the toilet in order to avoid feacal contamination of food product.
- Public mass enlightenment programs should be implemented to create awareness since most producers, hawkers and buyers of this food product are illiterates and ignorant of the resulting negative implication on human health.
  Wearing of safety clothing such as hair net, apron, and hand gloves during food processing.
- Preparation of food should not be done on the street or open space like motor park and market place.
- There is need to exercise control over hawkers of all types in the community.

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