

SANITARY-CONTAMINATED CONDITION OF COMMERCIAL BLENDERS AND ITS-THEIR CONTACT SURFACE IN THE LOCAL MARKET

ABSTRACT

Grinding or milling is a size reduction exercise in which pre-prepared food condiments are completely reduced to flour or powder (dry grinding) or paste (wet grinding). Different models of grinding machines are found scattered all over Port Harcourt metropolis. This study investigated the sanitary quality of manual and mechanical blenders. Standard microbiological procedures were adopted. The Mean Heterotrophic counts ranged from Log_{10} CFU/5cm² 4.2 - 5.1 for manual blender and its contact surfaces while the mechanical blenders and its contact surfaces had counts ranging from Log_{10} CFU/5cm² 4.2 - 4.8. The predominant bacterial species were *Staphylococcus* sp., *Salmonella* sp., *Escherichia coli*, *Bacillus* sp., *Aeromonas* sp., *Micrococcus* sp., *Enterobacter* sp., *Shigella* sp., *Protues* sp., *Klebsiella* sp., *Citrobacter* sp and *Serratia* sp., while the fungal species isolated were *Aspergillus niger*, *Fusarium* sp., *Penicillium* sp. and *Sacharomyces* sp. Gram positive and negative bacteria showed variabley degrees of resistance and susceptibility to the various antibiotics used

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INTRODUCTION

Blenders are a tool used to reduce huge food particles to a size that may be consumed. They are industrial power tools that cut or remove material using an abrasive wheel. A revolving abrasive wheel is used to cut metal from the surface of the work item during the process. throughout Nigeria. The many dry foods that are ground or blended in these machines include grains, rice, soybeans, sugar, chile, spices, black pepper, herbs, peanuts, etc. The high mortality rate being popular eommen in underdeveloped nations like Nigeria is made worse by insufficient food monitoring and poor health care delivery, which leads to a high intake of unhealthy food. (Kareem and Akinola, 2018).

When consumed by humans, high levels of microbial contamination and trace metals in food have the potential to be a source of disease. Because these contaminants can cause a variety of diseases, it is essential to continuously analyze foods for microbial and trace metal contamination. In Nigerian marketplaces, it is common practice to grind food in an unhygienic manner using old, worn-out grinders, and the operators are unaware of the health concerns associated with such practices (Jude and Prosper, 2016).

These blenders are made available in markets to satisfy consumer demand because most culinary components and spices must be adequately ground before use. Blenders, which are used to break down food ingredients into tiny pieces, are crucial and have grown in popularity throughout time because most households in our society no longer grind food on stones or pound it in mortars.

The majority of food items, including egusi, ogbono, pepper, crayfish, etc., are ground ~~by using~~ blenders that are sold in stores. These food ingredients, which cannot be utilized without grinding, are added to food to enhance flavor or impart a desired flavor. The majority of these food ingredients provide nutrients that could support the growth and proliferation of a variety of pathogenic and non-pathogenic microorganisms, including *Staphylococcus aureus*, *Bacillus* sp., and others, making the presence of microorganisms in the ones that have been used and re-used before being cleaned (if at all it is cleaned) of importance to public health. However, the sanitary quality of these blenders is largely undermined ~~by because~~ the occurrence of microorganisms such as *Xanthomonas* sp., *Escherichia coli*, *Pediococcus* sp., *Pseudomonas* sp., *Klebsiella* sp., *Lactobacillus* sp. and *Micrococcus* sp. (Obioma et al., 2019).

These microbial contaminants are deposited in the blenders and are ~~most~~ly associated with blended food as well as airborne contaminants. In the market, people who blend food end up reusing blenders without properly cleaning them, regardless of where the food comes from. This is probably due to the large number of people who come to blend food. Sometimes, the food is already or almost ready to spoil, as with some fresh tomatoes and peppers brought in for blending. As a result, some food spoilage microorganisms end up ~~o~~in the blender. These organisms may occasionally replicate and transfer to the new food brought for blending if they are not properly cleaned. In the typical Nigerian market, food ingredients must be blended before being used, and blenders are available at prominent locations to blend these ingredients.

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Since the majority of food ingredients are highly nutritious and can provide a favorable environment for microbial growth when residues are left behind in these blenders without being properly cleaned, the gap could pave the way for microbial proliferation and subsequent contamination of the ingredients that are being ground with the grinders because the majority of operators of these blenders do not pay hygienic attention to the use of these blenders. According to Tsado et al.,(2017) physiological harm and contamination with spoilage microorganisms are the most significant concerns. The majority of the microorganisms that are associated with blenders are primarily associated with the foods that are blended in them. Since foods ~~are have been found to be~~ high in oil, essential nutrients, and protein,(Olubi *et al.*, 2019). They provide adequate environment for microbial growth. During grinding, particles of these foods are left in the blender and microorganisms associated with the blended food ~~are is~~ left in the blender. These microorganisms may include *Baecillus* sp., *Micrococcus* sp., *Staphylococcus* sp., *Proteus* sp., *Enterobacter* sp. and *Enterococcus* sp.,~~in which while~~ fungal species like *Saccharomyces* sp., *Aspergillus niger*, *Cam+dida* sp., *Penicillium* sp., and *Rhizopus* sp. are predominant. Presence of some pathogenic species such as *Escherichia coli*, *Pseudomaonas* sp., and *Klebsiella* have also been documented (Azuonwu *et al.*, 2019).This study aims to determine the sanitary quality of blenders used in grinding some food ingredients in the market.

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MATERIALS AND METHODS

Study Area

Choba market was used as the study area.It is located in Port Harcourt metropolis, Rivers State it is a popular market where students and indigenes of Choba community visit for their daily wants. Due to its proximity to the University, it witnesses much influx of people on daily basis and blenders are used on a regular basis.

Sample Collection

A total of 60 swab samples ~~from~~(30 machine blenders and 30 hand blenders) comprising of table stand, handle, bowl, wooden stick and blender swabs were collected from~~the~~ Choba market. The sterilized cotton stick was dipped in 10 mL of peptone water (Merck, Germany), prior to swabbing- and an area of 5cm² on the inside of the blender was swabbed at each blending point sampled.



Figure 1. Pic. 1 Hand Blender used in Market Pic. 2 Machine Blender in Markets

Isolation of Microorganisms

After the swabbing process, the swabbed cotton sticks were returned to the universal bottles containing the 10 mL peptone water. The samples were immediately labelled and transported to the laboratory for further analysis. One millilitre (1ml) of stock solution was diluted in 9ml of peptone water and continued ten-fold serial dilution was done up to 10^{-5} .

One ml of each dilution was plated on freshly prepared agar plates Plate Count Agar, Mannitol Salt Agar, and MacConkey Agar in duplicates. These were incubated in a well-regulated incubator for 24 hours at 37°C for the isolation of bacteria pathogens. Pure cultures were obtained by sub-culturing distinct colonies on freshly prepared culture plates. Plate Count Agar, Mannitol Salt Agar, and MacConkey Agar were used for bacteria growth and potato dextrose agar for fungi isolation.

Identification and Characterization of Isolates

Examination of bacteria

Isolates were identified based on their cultural morphology on growth media, which include colony size, colour, opacity, consistency, colony pigmentation, elevation, odour, and swarming)

and biochemical characteristics, identification materials, reagents and protocols according to (Cheesebrough, 2006).

Examination of Fungi

The cultural morphology of each fungi isolates were identified according to their colour and shape, and for the cell morphology was done based on mycelia, hyphae, septate, and spore formation using lacto phenol blue. A piece of the mycelium from the Petri plates was mounted on a clean grease free slide using a sterile wire loop and covered with a cover slip, after taking a drop of lactophenol blue cotton was added and examined with the microscope.

Antibiotics Susceptibility Testing

Antibiotic sensitivity patterns of all the confirmed Gram's positive and negative isolates were performed by according to standard disk diffusion method according to Kirby-Bauer on Mueller-Hinton agar (Titan, Biotech Ltd, Indian) following the procedures recommended by CLSI (2012) (Eruteya and Osariemen, 2021). Eleven antibiotics were commonly used as antibiotics ($\mu\text{g}/\text{disc}$) viz. amoxicillin-clavulanate or Augmentin, Gentamycin, Nitrofurantoin, Erythromycin, Ofloxacin, Cotrimoxazole, Streptomycin, Tetracycline, Chloramphenicol, Nalidixic acid, Amoxicillin Abtek, (UK) were tested. From an overnight culture of the organisms, (0.5 MacFarland turbidity standards), bacterial culture was prepared in sterile saline, from which 0.1mL was aseptically placed on the surface of the agar. The plates were incubated at 37°C for 24h. Zone of inhibition was measured in millimeter.

RESULTS

Total Heterotrophic Bacterial Count of Manual and Mechanical Blenders Studied

The total heterotrophic bacterial counts obtained from the manual and mechanical blenders studied showed varying counts for the various samples. Mean total heterotrophic bacteria count of the different manual blenders and their contact surfaces were obtained: Bowl Log_{10} CFU/5cm² 4.2 Grinder 4.9 CFU/5cm², Handle 5.1CFU/5cm², Stick 5.1CFU/5cm² and Table 4.9CFU/5cm², while the mechanical blenders and their contact surfaces had counts were :

Bowl 4.7CFU/5cm², Grinder, 4.8 CFU/5cm², Handle 4.69 CFU/5cm², Stick 4.2 CFU/5cm² and Table 4.8 CFU/5cm²

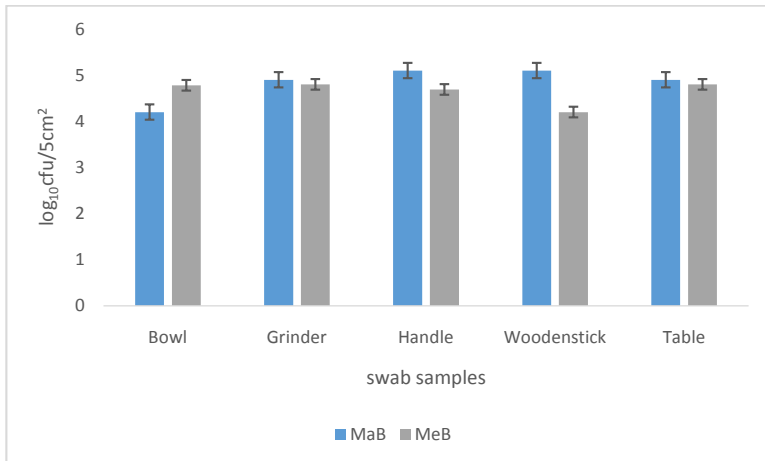


Fig .1: Mean Total Heterotrophic Bacterial Count Manual and Mechanical Blenders.

Total Fungal Count of Manual and Mechanical Blenders Studied

The fungal counts obtained from the manual and mechanical blenders studied showed varying counts for the various samples. Mean fungal counts of the different manual blender studied were: Bowl 3.7 CFU/5cm², wooden stick 3.3 CFU/5cm², Handle 3.4 CFU/5cm², wooden stick 4.1 CFU/5cm², Table 4 CFU/5cm². However, the Bowl, Grinder, handle, wooden stick and table had counts of 3.84, 3.5, 3.39, 4.6, 3.5 CFU/5cm² respectively for mechanical blenders (Fig. 2).

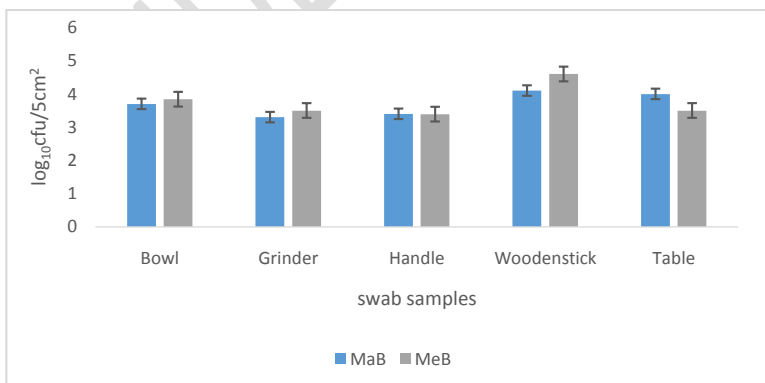


Fig 2: Mean Total Fungal Count of Manual and Mechanical Blenders

Staphylococcus Counts of Manual and Mechanical Blenders Studied

The Staphylococcus counts obtained from the manual and mechanical blenders studied showed varying counts for the various samples. Staphylococcus counts of the different manual blenders studied obtained were $\text{Log}_{10}\text{cfu/g}$ 5.2, 5.4, 2.2, 4.2, 4.1 $\text{CFU}/5\text{cm}^2$ for Bowl, Grinder, handle, wooden stick and table respectively. Staphylococcus counts of the different Mechanical blenders were $\text{Log}_{10}\text{cfu/g}$ 6.2, 6.5, 6.2, 6.6, 5 $\text{CFU}/5\text{cm}^2$ for Bowl, Grinder, handle, wooden stick and table respectively.

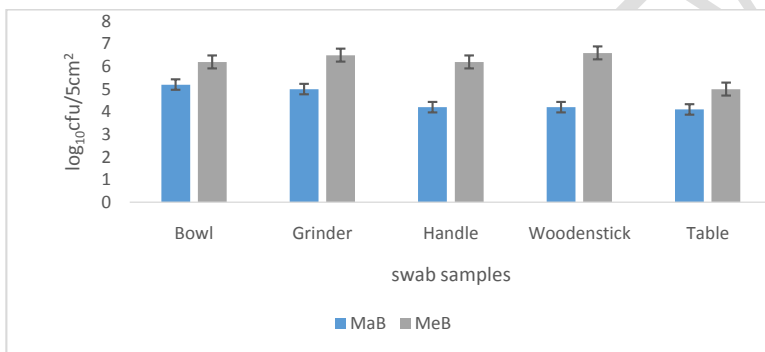


Fig .3: Mean Staphylococcus Counts of Manual and Mechanical Blenders Studied

Coliform Count of Manual and Mechanical Blenders Studied

The coliform counts obtained from the manual and mechanical blenders studied showed varying counts for the various samples. Mean coliform counts of the different manual blenders studied obtained were Log_{10} 2.4, 3.5, 2.9, 2.2, 3.1 $\text{CFU}/5\text{cm}^2$ for Bowl, Grinder, handle, wooden stick and table respectively. Mean coliform counts of the different mechanical blenders studied obtained were Log_{10} 1.5, 1.5, 2.4, 1.2, 1.1 $\text{CFU}/5\text{cm}^2$ for Bowl, Grinder, handle, wooden stick and table respectively. Much lower ranges were observed for mechanical blenders.

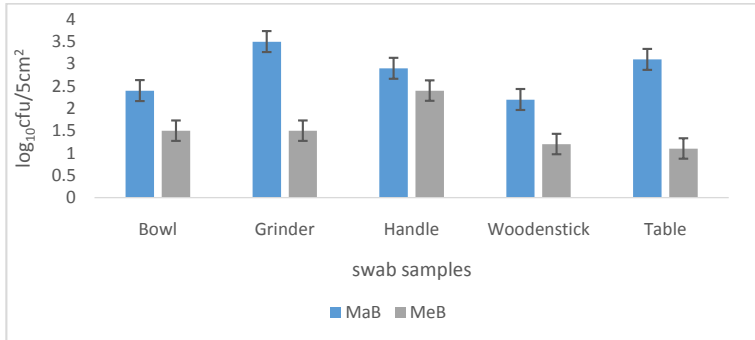


Fig 4 Coliform Count of Manual and Mechanical Blenders Studied

Salmonella Count of Manual and Mechanical Blenders Studied

The Salmonella counts obtained from the manual and mechanical blenders studied showed varying counts for the various samples. Log₁₀ 1.4, 3.5, 1.2, 1.8 CFU/5cm² for Bowl, Grinder, wooden stick and table respectively. None of the mechanical samples had Salmonella counts

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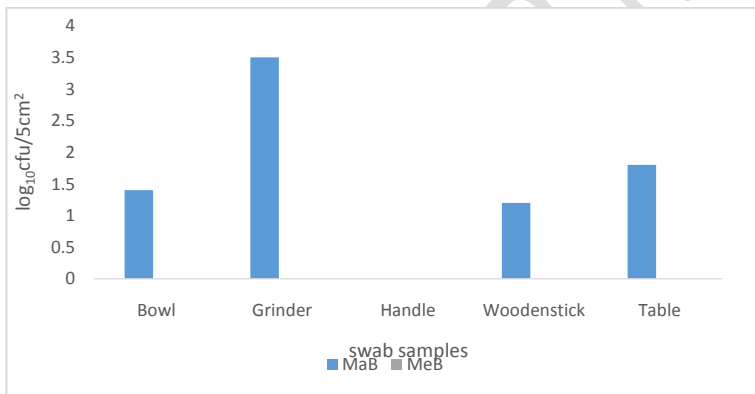


Fig .5: Mean Salmonella Count of Manual and Mechanical Blenders Studied

Table 1 Frequency of Occurrence of Bacterial Isolates from Manual Blenders

Isolate	Table		Grinder		Stick		Bowl		Handle		Prevalence (%)
	No. Isolated	Frequency (%)	No. Isolated	Frequency (%)	No. Isolated	Frequency (%)	No. Isolated	Frequency (%)	No. Isolated	Frequency (%)	
<i>Escherichia coli</i>	4	15	6	27	2	8	3	12	3	13	18 (15.1)
<i>Salmonella</i> sp.	2	7	1	4	4	16	2	8	-	-	9 (7.16)
<i>Shigella</i> sp	-	-	-	-	1	4	-	-	1	4	2(1.68)
<i>Staphylococcus</i> sp	6	23	6	27	6	24	7	29	7	31	32(26.8)
<i>Proteus</i> sp	4	15	1	4	1	4	1	4	1	4	8(6.7)
<i>Bacillus</i> sp	5	19	5	22	6	24	5	20	5	22	26(21.8)
<i>Enterobacter</i> sp	-	-	1	4	-	-	1	4	2	9	4(3.36)
<i>Klebsiella</i> sp	4	15	2	9	2	8	4	16	3	13	15(12.6)
<i>Citrobacter</i> sp.	1	3	-	-	1	4	-	-	-	-	2(1.68)
<i>Micrococcus</i> sp.	-	-	-	-	-	-	1	4	-	-	1(0.84)
<i>Serratia</i> sp.	-	-	-	-	1	4	-	-	-	-	1(0.84)
<i>Aeromonas</i> sp.	-	-	-	-	1	4	-	-	-	-	1(0.84)
Total	26	97	22	97	25	100	24	97	22	96	119

Table 2: Frequency of Occurrence of Bacterial Isolates from Mechanical Blenders

Isolate	Table		Grinder		Stick		Bowl		Handle		Prevalence (%)
	No. Isolated	Frequency (%)	No. Isolated	Frequency (%)	No. Isolated	Frequency (%)	No. Isolated	Frequency (%)	No. Isolated	Frequency (%)	
<i>Escherichia coli</i>	6	33	4	22	3	20	3	15	3	17	19(21.5)
<i>Salmonella</i> sp.	-	-	-	-	-	-	-	-	-	-	-
<i>Shigella</i> sp	-	-	-	-	-	-	-	-	-	-	-
<i>Staphylococcus</i> sp	5	27	8	28	5	33	6	31	5	29	26(29.5)
<i>Proteus</i> sp	3	16	1	5	2	13	1	5	2	11	9(10.2)
<i>Bacillus</i> sp	4	22	6	33	3	20	4	21	5	25	22(25)
<i>Enterobacter</i> sp	-	-	-	-	-	-	1	5	-	-	1(1.1)
<i>Klebsiella</i> sp	-	-	2	11	5	13	4	21	3	17	11(12.5)
<i>Citrobacter</i> sp.	-	-	-	-	-	-	-	-	-	-	-
<i>Micrococcus</i> sp.	-	-	-	-	-	-	-	-	-	-	-
<i>Serratia</i> sp.	-	-	-	-	-	-	-	-	-	-	-
<i>Aaromonas</i> sp.	-	-	-	-	-	-	-	-	-	-	-
Total	18	98	21	98	15	99	19	98	17	101	92

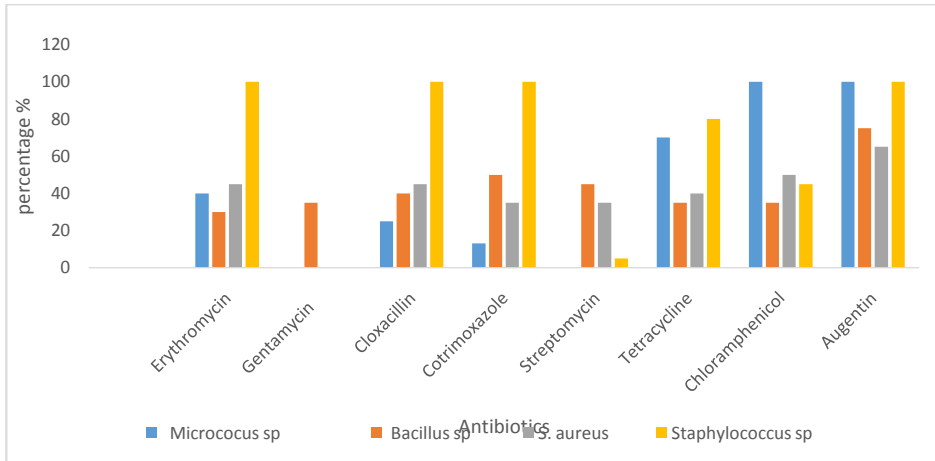


Figure 6. Antibiotic resistance of the isolated of gram positive bacteria from Mechanical and Manual Blenders(n=211)

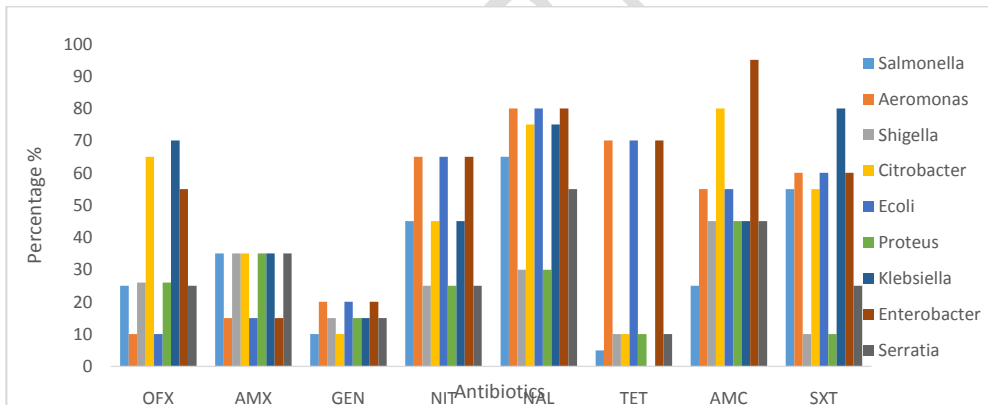


Figure 7. Antibiotic resistance of the isolated of gram negative bacteria from Mechanical and Manual Blenders(n=211)

Ofloxacin	OFX
Amoxicillin	AMX
Gentamycin	GEN
Nitofurattoin	NITT
Nalidixic acid	NAL
Tetracyline	TET
Augmentin	AMC
Cotrimoazole	SXT

DISCUSSION

Food condiments are completely reduced to flour, powder, or paste through the process of grinding or milling, also known as a size reduction exercise. Dry grinding is used, while wet grinding is used. In the Port Harcourt metropolis, various models of grinding machines can be found scattered all over. These machines contrast in many regards, for example, size, power rating, limit, working and support necessities and processing execution. Due to their consistently expanding utilization and support, crushing or processing has turned into a colossal industry. They are visited by thousands of people who come to the market to mix their ~~own~~ condiments for food. The majority of operators find it extremely challenging to thoroughly clean their blenders, let alone ~~to~~ concentrate on the various components, given the high demand and frequent use. The purpose of this study was to investigate the market's sanitary blenders for grinding food ingredients. The mean microbial counts obtained from the manual and mechanical blenders studied showed varying microbial loads for the various samples as shown in fig 1-5. The large number of people who come to blend food may be the cause of the high counts in these samples; those who blend end up reusing the blenders without properly cleaning them, regardless of where the food comes from. Sometimes, the food is already or almost ready to spoil, as with some fresh tomatoes and peppers brought in for blending. As a result, some food spoilage microorganisms end up ~~in~~ the blender. These organisms may occasionally reproduce without proper cleaning, and they may also transfer to the new food brought in ~~for~~ mixing. These microorganisms could have come from the food samples that were blended, or even better, from the water ~~that was~~ used to clean the blender before it was used, or even from the environment, like soil dust. Particulate matter carrying microorganisms may have settled on the blenders due to the busy market. Then again, in some cases, water utilized in cleaning the blenders might have been put away for a significant stretch of time, and presumably a few pathogenic microorganisms might have multiplied in the water. Additionally, the bacteria from the decayed food samples brought for blending may be deposited on the blender during the process if they have already gone bad. (Obioma et al., (2019). The bacterial species isolated ~~including were found of from~~ sampled food contact surfaces, respectively. Many reported studies spotted significant *Staphylococcus* sp., *Salmonella* sp., *Escherichia coli*, *Bacillus* sp., *Aeromonas* sp., *Micrococcus* sp., *Enterobacter* sp., *Shigella* sp., *Protues* sp. *Klebsiella* sp. *Citrobacter* sp and *Serratia* sp *Escherichia coli*, *Klebsiella* spp. and *Staphylococcus aureus* .

On the skin of humans, plants, soil, water, sewage, the intestines of animals and humans, and some dairy products, *Enterobacter* can be found. Segregating this from food or contact surface demonstrates waste defilement or possibly affirms unfortunate cleanliness practice. Micrococcus is some relatively harmless bacteria that can cause food poisoning through its enterotoxins and can be found in meat products, water, and soil. *Staphylococcus*, on the other hand, can be found everywhere. It is widespread on the skin and can also be found in the throat, nose, and other parts of the body. Enterotoxins produced by virulent strains can cause staphylococcal food poisoning, which is typically spread through food contaminated with toxins. It has a short latency period and symptoms go away within 24 to 48 hours. The incubation time is one to four hours. According to the CDC (2018), clinical symptoms include diarrhea, abdominal discomfort, and nausea. Food poisoning and its symptoms are typically brought on by foods with high levels of coliforms (WHO, 1993). Therefore, poor hygiene practices can be established in the sampled restaurants by the mere presence of coliforms in high concentrations without the associated presence of well-known enteropathogens. Even though *E. coli* was found, the presence of *Enterobacter* could also mean that food, water, or food handlers may have been contaminated by feces or that poor processing practices were used. (Little et al., 1998; Tambekar et al., 2007).

Since *S. aureus* is a typical component of the skin and nasal flora, its presence is mostly due to human interaction, which raises concerns about the operators' cleanliness procedures. Foods must, to the greatest extent feasible, be free of pollutants. Given that these organisms are pathogenic and have been linked to foodborne illnesses, their presence indicates a possible health concern (Granum, 2005; Wagner, 2009; CFIA, 2009). By using excellent hygiene techniques like excellent Manufacturing Practices (GMP) and Hazard Analysis Critical Control Point (HACCP), foodborne disease may be avoided. Food contamination may have been caused by improper handling, insufficient heating, or secondary contamination through contact with contaminated tools and utensils Gopal et al. (2015). Microorganisms can also be introduced to food contact surfaces as raw food products. (Humphrey et al., 2001). High humidity of raw foods and prolonged contact times can also increase the likelihood of contact surface contamination (Pérez-Rodríguez et al., 2010). The presence of similar pathogens on food contact surfaces further indicates their previous contamination from raw food. The presence of pathogens on contact surfaces can also be due to poor hygiene practices. Microorganisms can attach to food contact surfaces and find favorable conditions for

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their growth (Taché and Carpentier, 2014). Therefore, it is necessary to ensure that the surfaces are cleaned properly. Gram-positive and gram-negative bacteria show varying degrees of resistance and sensitivity to the different antibiotics used. Resistance patterns of bacteria associated with contact surfaces have been reported (Boma and Olieme, 2011; Akubueyi et al., 2011; Ezeonu and Ugwu, 2011 and David et al., 2011). Potentially pathogenic bacteria were isolated and identified from contact surfaces on manual and mechanical blenders. Bacterial strains have shown resistance to several common antibiotics. The distribution of these bacteria is proportional to the frequency of surface contact. This present study contributed to the scarcity of information on the hygienic condition of blender contact surfaces in the market. Isolation of pathogenic organisms from these surfaces suggests that they may be a source of disease transmission. Therefore, it is necessary to apply adequate hygiene measures that can help prevent contamination and interrupt the spread of disease through these surfaces. These commercial blenders should be cleaned daily and contact surfaces cleaned after each grinding. Proper and hygienic cleaning after each use of blenders in market place and daily cleaning and drying to avoid overnight microbial growth in blenders

References

Taché J, Carpentier B, 2014. Hygiene in the home kitchen: changes in behaviour and impact of key microbiological hazard control measures. *Food Control* 35:392-400.

Humphrey T, Martin K, Slader J, Durham K, 2001. *Campylobacter* spp. in the kitchen: spread and persistence. *J Appl Microbiol* 90:S6.

Pérez-Rodríguez F, Castro R, Posada-Izquierdo G, Valero A, Carrasco E, García-Gimeno R, Zurera G, 2010. Evaluation of hygiene practices and microbiological quality of cooked meat products during slicing and handling at retail. *Meat Sci* 86:479-85.

Ezeonu, I.M. and Ugwu, K.O. Incidence of diarrhea and antibiotics resistance profiles of enteric bacteria in HIV positive individuals. *Nigerian Journal of Microbiology*, 2011; 24(2): 2251-2260.

Obioma A, Testimonies C.A., and Marcus A.N. (2019). Isolation and identification of potential high risk pathogens from blenders used in grinding some food stuffs in a local community market

in rivers state: a public health concern. *Journal of Microbiology & Experimentation*, 7(4): 183-187.

Jude C.N. and Prosper N.E. (2016). Trace Metals in Food Condiments Processed with Manual Metallic Grinders. *The Pharmaceutical and Chemical Journal*, 3(1):172-177.

Kareem, B. and Akinode, R.A. (2018). Development of an Improved Domestic Grinding Machine.

International Journal of Current Engineering and Technology, 8(2):378-381.

Tsado, E. K., Ekpa, D., Salaudeen, M. T., Adesina, O. A., Yusuf, S. T. and Izuegbu, L. N. (2017).

Microbialstatus of dried pepper (capsicum spp.), tomato (*Lycopersicum esculentus*), and roselle (*Hibiscus sabdariffa*) marketed in Minna, Niger State, Nigeria. *Direct Res. J. Agric. Food Sci.*, 6 (1), pp. 13-18.

Nnaji, J.C and Emmanuel, P.N (2016). Trace Metals in Food Condiments Processed with Manual Metallic Grinders *The Pharmaceutical and Chemical Journal*, 2016, 3(1):172-177

Cheesbrough M. *District laboratory Practice in Tropical Countries*. Part 2. Cambridge University

Press; 2006. 143–157 p

Azuonwu O, Nnenna I, Douglass AS, (2016). Consequences of Haemolytic Disease of the Fetus and Newborn (HDFN) and the Clinical Significance of Antibody Screening in Prenatal Diagnosis:

A Study of Multigravida and Primigravida Women in Port Harcourt, Niger Delta. *Journal of Clinical Laboratory Medicine*. 2016;1(1):1–7.

Olubi O, Felix-Minnaar JV, Jideani VA (2019) Physicochemical and fatty acid profile of egusi oil from supercritical carbon dioxide extraction. *Heliyon* 5(1):e01083.

WHO (1993). World Health Organization Food Safety Unit. Contaminated food: a major cause of diarrhoea and associated malnutrition among infants and young children. *Facts Infant Feed*, 1, 1–4. <https://www.ncbi.nlm.nih.gov/pubmed/1234>

Little, C. L., Monsey, H. A., Nichols, G. L. & de Louvois, J. (1998). The microbiological quality of ready-to-eat dried and fermented meat and meat products. *International Journal of Environmental Health Research*, 8, 277-284.

Granum, P.E. (2005). *Bacillus cereus* as a Food-borne Pathogen. In: *Microbiology and Molecular Biology*. Pp. 409 - 420. Great Britain. Caister Academic Press. Retrieved from <https://www.caister.com/fbp>

Wagner, A. B. (2009). Epidemiology of food poisoning outbreaks in Singapore, 2001- 2005. *Epidemiological News Bulletin, Journal of Microbiology*, 31, 68 - 72.

CFIA (2009). Canadian Food Inspection Agency, *Salmonella Food Safety Facts*. Preventing foodborne illness. Retrieved from <https://www.canada.ca/en/publichealth/services/food-safety.html>

Gopal, N., Colin, H., Ross, P. R., Beresford, T. P., Fenelon, M. A. & Cotter, P. D. (2015). The Prevalence and Control of *Bacillus* and Related Spore-Forming Bacteria in the Dairy Industry. *Frontiers in Microbiology*, 6,1418.

Boma, A. and Oliemen, P. Sensitivity pattern among bacterial isolates neonatal Septicaemia in Port Harcourt. *Annals of Clinical Microbiology and Antimicrobials*, 2012; 11:7

Akubuenyi, F.C., Arikpo, G.E., Ogugbe, C.J., Mfongeh, J.F. and Akpanumun, E.V. Antibiotics resistance profile of waste water isolates obtained from University of Calabar Teaching Hospital and General Hospital ,Calabar,Nigeria. *Nigerian Journal of Microbiology*, 2011; 25: 2243-2250

David. O.M., Akinunmi, A., Oluduro, A.O., Egbegi, A.O. and Famurewa,O. Antibiotic resistance and plasmid profile of bacteria pathogens isolated from drinking water in AdoEkiti, Nigeria. *Nigerian Journal of Microbiology*, 2011; 25: 2339-234

Tambekar, D. H., Shirsat, S. D., Suradkar, S. B., Rajankar, P. N. & Bangin-War, Y. S. (2007). Prevention of transmission of infectious disease: Studies on hand hygiene in healthcare among students. *Continental Journal of Biomedical Sciences*, 1, 6 -10.

Granum, P.E. (2005). *Bacillus cereus* as a Food-borne Pathogen. In: *Microbiology and Molecular Biology*. Pp. 409 - 420. Great Britain. Caister Academic Press.

CDC (2018). Staphylococcal Food Poisoning. Retrieved from <https://www.cdc.gov/foodsafety/diseases/staphylococcal.html>

Onoriode C. Eruteya and Patience O.(2021) Osariemen Antibiotic Susceptibility of *Staphylococcus aureus* Isolated from Retailed Raw Beef at Choba Market, Rivers State *International Journal of Pathogen Research* 6(4): 25-30.

Clinical and laboratory Standard Institute (CLSI). *Performance Standard for Antimicrobial Susceptibility Testing; Twenty-second Information Supplement*. Wayne (PA): The Institute; 2012.

Konuku S, Rajan MM, Muruhan S.(2012) Morphological and biochemical characteristics and antibiotic resistance pattern of *Staphylococcus aureus* isolated from grapes. *Int J Nutr Pharmacol Neurol Dis.* ;2:70-73.