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Research Article

Public health implications of microbial findings in commercially canned tomatoes in West Africa

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A B S T R A C T

Canned tomatoes are widely consumed, but microbial spoilage can compromise their quality. This study aimed to identify the microorganisms responsible for spoilage in various brands of canned tomatoes from West Africa. Six popular brands were purchased from markets in Nigeria, Benin, and Ghana. Microbiological screening involves culturing, morphological, and biochemical techniques to identify spoilage organisms. Total bacterial counts observed in the study were Salsa ($3.4 \pm 0.22 \times 10^3$), Gino ($4.2 \pm 0.31 \times 10^3$), Sarah ($5.8 \pm 0.35 \times 10^3$), Ginny ($3.0 \pm 0.34 \times 10^3$), Derica ($2.1 \pm 0.14 \times 10^3$), and Tasty Tom ($2.2 \pm 0.21 \times 10^3$). Fungal counts include: Salsa ($2.4 \pm 0.30 \times 10^3$), Gino ($2.3 \pm 0.51 \times 10^3$), Sarah ($2.4 \pm 0.21 \times 10^3$), Ginny ($5.8 \pm 0.12 \times 10^3$), Derica ($2.3 \pm 0.13 \times 10^3$), and Tasty Tom ($4.1 \pm 0.10 \times 10^3$). Bacterial isolates included *Bacillus* spp., *Staphylococcus aureus*, *Streptococcus* spp., *Pseudomonas* spp., and *Clostridium* spp., with *Bacillus* spp. (30%) being the most prevalent and *Streptococcus* spp. (10%) being the least bacteria. Fungal isolates comprised of *Saccharomyces* spp., *Candida* spp., *Mucor* spp., *Aspergillus niger*, and *Penicillium* spp., with *Aspergillus niger* (33%) being the most common while *Mucor* spp. (10%) being the least fungi. The study revealed significant microbial contamination in all canned tomato brands. High microbial counts indicate potential public health risks. Further research is crucial to understand the source of contamination. Implementing effective sanitization measures during production is essential to minimize spoilage and ensure food safety

INTRODUCTION

Tomatoes, a globally significant crop (Oscar *et al*., 2022), are susceptible to microbial spoilage throughout their production and distribution, leading to economic losses and potential health risks (Barth *et al*., 2009; Yeboah, 2011). This includes contamination with mycotoxins like aflatoxins, particularly prevalent in developing countries (Akinyele and Akinkunmi, 2012). Canned tomatoes, while offering convenience, require careful handling to prevent spoilage. Improper processing can allow the survival of spore-forming bacteria, such as *Clostridium* botulinum, which can produce the deadly botulinum toxin (Dhuey, 2021). Industrial canning of low-acid foods like tomatoes necessitates rigorous adherence to industrial canning practices, including the use of pressure canners to achieve temperatures exceeding 100°C, crucial for eliminating *Clostridium botulinum* spores (Date *et al*., 2011).

Concerns have arisen regarding the quality and safety of African canned tomato brands, with consumers often citing shorter shelf lives compared to foreign brands. These concerns have fueled speculation about the authenticity and manufacturing practices of these products. To address these issues, studies are crucial to assess the level of microbial contamination in African canned tomatoes and provide evidence-based recommendations to enhance their safety and quality for consumers.

The study assessed the microbial contamination and associated public health risks in commercially available canned tomatoes in West Africa

MATERIALS AND METHODS

Sample collection

Six (6) different brands of tin tomatoes were brought from Nigeria, the Republic of Benin, and Ghana, markets with the help of shipment facilities. The tin tomato products were Salsa (Ghana), De-Rica (Ghana), Gino (Nigeria), Tasty Tom (Nigeria), Ginny (Republic of Benin), and Sarah (Republic of Benin). The samples were taken to the laboratory for microbial isolation and identification.

Preparation of Sample

The cotton swab was soaked in 5 ml peptone broth and incubated aerobically overnight at 37 °C.

Processes of serial dilution

This was carried out by the procedure reported by (Cheesebrough, 2006). One (1) ml of canned tomato sample was added to nine (9) ml of sterile distilled water, and the test tube was labeled 10^{-1} and then shaken to obtain a complete mixture. One (1) ml of the mixture was then transferred into the next tube containing nine (1) ml of distilled water, and this was repeated up to 10^{-6}.

Isolation and purification

The serially diluted samples, zero-point one mil (0.1mil) were transferred into a sterile Petri dish, and sterilized nutrient agar was poured into the Petri dish under aseptic conditions and then solidified. The plates were incubated at 37 ^{0}C for 24 hours. After incubation, the number of discrete colonies was counted in terms of colony-forming units. Isolated single colonies were picked, purified on nutrient agar plates, sub-cultured, and stocked in nutrient agar slants with 1% NaCl for further studies (Cheesebrough, 2006).

Identification of bacterial isolates

Pure isolated colonies were differentiated using Gram's staining technique, followed by biochemical identification using relevant biochemical tests. Isolates were identified and named based on the following cultural, morphological, and biochemical characteristics as reported by (Cheesebrough, 2006).

Fungal identification

The fungal isolates were identified microscopically using the lactophenol cotton blue test. The identification was achieved by placing a drop of the stain on the clean slide with the aid of a wire loop, where a small portion of the mycelium from the fungal cultures was removed and placed in a drop of lactophenol. The mycelium was spread very well on the slide with the aid of the wire loop. A cover slip was gently applied with little pressure to eliminate air bubbles. The slide was then mounted and observed with x10 and x40 objective lenses respectively (Cheesebrough, 2006).

Data analysis

Descriptive statistics were employed for data analysis (Ogbeibu, 2005)

RESULTS

Table 1 presents the bacterial counts associated with the spoilage of tin tomatoes. Among the various products tested, the bacterial counts were as follows: Salsa ($3.4 \pm 0.22 \times 10^3$), Gino ($4.2 \pm 0.31 \times 10^3$), Sarah ($5.8 \pm 0.35 \times 10^3$), Ginny ($3.0 \pm 0.34 \times 10^3$), Derica ($2.1 \pm 0.14 \times 10^3$), and Tasty Tom ($2.2 \pm 0.21 \times 10^3$). The highest bacterial count was associated with the Sarah canned tomato product, while the lowest count was found in the Derica canned tomatoes. The percentage prevalence of the bacterial isolates showed that *Bacillus* spp. (30%) was the most dominant isolate followed by *Clostridium* spp. (22%), *Pseudomonas* spp. (20%), *Staphylococcus aureus* (18%), and *Streptococcus* spp. (10%) as shown in Table 2. Table 3 shows the fungal counts linked to the spoilage of tin tomatoes. The fungi count for the products tested were: Salsa ($2.4 \pm 0.30 \times 10^3$), Gino ($2.3 \pm 0.51 \times 10^3$), Sarah ($2.4 \pm 0.21 \times 10^3$), Ginny ($5.8 \pm 0.12 \times 10^3$), Derica ($2.3 \pm 0.13 \times 10^3$), and Tasty Tom ($4.1 \pm 0.10 \times 10^3$). The highest fungi count was associated with the Ginny tin tomatoes, while the lowest counts were linked to the Gino and Derica canned tomatoes. Figure 4 highlights the percentage prevalence of fungal isolates, *Aspergillus niger* (33%) was most prevalent while the least among the fungi was *Mucor* spp. (10%). Table 5 outlines the Characterization of bacterial isolates. The probable bacterial isolates identified were *Bacillus* spp., *Staphylococcus aureus*, *Streptococcus* spp., *Pseudomonas* spp., and *Clostridium* spp. Table 6 reveals the characterized fungal isolates. The probable fungal isolates identified were *Saccharomyces* spp., *Candida* spp., *Mucor* spp., *Aspergillus niger*, and *Penicillium* spp.

Table 1: Bacterial count (CFU/ml) of sampled tomato brands ($x10^3$)

Brands	Bacterial count
Salsa	3.4 ± 0.22
Gino	4.2 ± 0.31
Sarah	5.8 ± 0.35
Ginny	3.0 ± 0.34
Derica	2.1 ± 0.14
Tasty Tom	2.2 ± 0.21

Table 2: Percentage (%) prevalence of bacterial isolates

Isolate	(%)
Bacillus spp.	30
Staphylococcus aureus	18
Clostridium spp.	22
Pseudomonas spp.	20
Streptococcus spp.	10

Table 3: Fungal count (CFU/ml) of sampled tomato brands ($x10^3$)

Brands	Fungal count
Salsa	2.4 ± 0.30
Gino	2.3 ± 0.52
Sarah	2.4 ± 0.21
Ginny	$5.8 + 0.12$
Derica	2.3 ± 0.16
Tasty Tom	4.1 ± 0.10

Table 4: Percentage (%) prevalence of fungal isolates

Isolate	(%)
Penicillium spp.	20
Saccharomyces spp.	22
Aspergillus niger	33
Mucor spp.	10
Candida spp.	15

Table 5 outlines the Characterization of bacterial isolates. The probable bacterial isolates identified were *Bacillus* spp., *Staphylococcus aureus*, *Streptococcus* spp., *Pseudomonas* spp., and *Clostridium* spp. Table 6 reveals the characterized fungal isolates. The probable fungal isolates identified were *Saccharomyces* spp., *Candida* spp., *Mucor* spp., *Aspergillus niger*, and *Penicillium* spp.

Table 5: Characterization of bacterial isolates

	***Bacillus* spp.**	***Staphylococcus aureus***	***Streptococcus lactis***	***Pseudomonas* spp.**	***Clostridium* spp.**
Elt	Low	Convex	Convex	Low convex	Convex
Marg	All over	All over	All over	All over	All over
Col	Cream	Yellow	White	Cream	Cream
SP	Round	Round	Round	Round	Round
Size	Large	Average	Small	Average	Average
GS	+	+	+	-	+
Cell T	Rod	Cocci	Cocci	Rod	Rod
Cell A	Chain	Cluster	Chain	Alone	Alone
CT	+	+	-	+	+
Ox	-	-	-	+	-
CG	+	+	-	-	-
CIT	+	+	+	+	+
Ur	+	+	+	-	-
ID	-	-	-	-	-
GL	+	+	+	+	+

Key: Elt= Elevation; Marg= Margin, Col= Color; Sp=shape; G= Gram staining; Cell T= Cell type; Cell A= Cell arrangement; CT=Catalase; OX= Oxidase; CG= Coagulase; CIT= Citrate; Ur= Urease; ID= Indole; GL= Glucose

Table 6: Characteristics of fungal Isolates

Tentative genera	***Saccharomyces* spp.**	***Candida* spp.**	***Mucor* spp.**	***Aspergillus niger***	***Penicillium* spp.**
Cultural	Cream-colored colony with smooth edges.	Little-sized colony, with cream colony having convex shape.	White colony but flat.	The back is soft and fluffy, featuring a yellow reverse side.	Greenish on the surface surrounded by a whitish border.
Morphology					
Hyphae	Pseudo-hyphae	Pseudo-hyphae	Non-septate	With Septate	With Septate
Spore color	Not revealed	Not revealed	Not revealed	Brownish	Faded white
Spore nature	Chlamydospore	Chlamydospore	Sporangiophore	Conidiophores	Conidiophores
Structure	Budding	Budding	Sporangium	Foot cells	Brush like

DISCUSSION

The high microbial counts found in the analyzed canned tomato samples indicate potential issues related to raw material quality, inadequate processing, contamination during pre-processing or production, and insufficiently strict production practices. The bacterial counts ranged from 2.1 ± 0.14 to 5.8 ± 0.35 CFU/g, while fungal counts varied from 2.3 ± 0.16 to 5.8 ± 0.12 CFU/g. Isolated microorganisms included *Bacillus* spp., *Staphylococcus aureus*, *Streptococcus lactis*, *Pseudomonas* spp., *Clostridium* spp., *Saccharomyces* spp., *Candida* spp., *Mucor* spp., *Penicillium* spp., and *Aspergillus niger*. These findings are consistent with previous research by (Morka, 2022) on isolating pathogenic microbes in spoiled carrots. Total viable counts and levels of *Staphylococcus aureus* are commonly used as indicators of hygiene standards in food handling environments (Nik *et al*., 2014).

The presence of these microorganisms can be attributed to several factors. Tomatoes create a favorable environment for microbial growth and bacterial and fungal spores are commonly found in the climate, soil, and potentially contaminated water or organic manure (van-Dyk *et al*., 2016). The isolation of *Bacillus* spp. (30%) and *Clostridium* spp. (22%) is expected due to their spore-forming capabilities and prevalence as environmental contaminants, particularly in canned foods (Gopal *et al*., 2015). *Clostridium* and *Bacillus* species are known pathogens that can cause infections and food poisoning, thriving within a wide temperature range of 20-50°C (Grenda *et al*., 2023). Their presence in canned foods, even in small amounts, is concerning because temperature abuse and inadequate storage conditions often seen in retail settings can lead to their proliferation to unacceptable levels. *Bacillus* spp. and *Clostridium* spp. are recognized spoilage organisms in tomatoes, contributing to flat sour spoilage, putrefaction, rancidity, and off-flavors (Juliao *et al*., 2013).

Staphylococcus aureus (18%) and *Pseudomonas* spp. (20%) are opportunistic pathogens that can contaminate canned foods through contact with food producers, handlers, and equipment. *Proteus mirabilis* is linked to urinary tract infection (Odoki *et al*., 2019). *Aspergillus niger* (33%), while less frequently linked to human disease than other *Aspergillus* species, can lead to severe lung infections (aspergillosis) in certain occupational settings and may also contribute to fungal ear infections (otomycosis) (Yu *et al*., 2021).

Toxigenic strains of microorganisms are well-known transmitters of foodborne illnesses and thrive under temperature abuse conditions (Bintsis, 2017). The higher microbial counts observed in pre-enriched samples compared to direct cultures suggest the potential presence of stressed

microbes in the canned foods. Although these microorganisms may not be immediately detectable, they could multiply if the container is unsterilized or if storage conditions are not optimal.

These findings highlight the critical importance of regular surveillance and monitoring of canned foods in the market to ensure food safety and public health.

CONCLUSION

The microbial counts obtained from the analyzed samples were significantly high, indicating substantial microbial contamination. Additionally, the investigation revealed the presence of various bacterial and fungal species in the spoiled canned tomatoes. These findings highlight the need for further research to identify the specific sources and nature of the contamination. To reduce spoilage in canned food production, it is essential to implement sanitizing agents with strong antimicrobial compositions that destroy pathogens.

REFERENCES

Akinyele BJ, Akinkunmi CO 2012: Fungi associated with the spoilage of berry and their reaction to electromagnetic fields. *Journal of Yeast and Fungal Research,* **3**(4):49–57.

Barth M, Hankinson TR, Zhuang H and Breidt F 2009: Compendium of the Microbiological Spoilage of Foods and Beverages. New York, NY, USA: Springer. Microbiological spoilage of fruits and vegetables. *pp* 135-183.

Bintsis T 2017: Foodborne pathogens. *AIMS Microbiology*, **29**; 3(3):529-563.

Cheesbrough M 2006: District Laboratory Practical in Tropical Countries. Cambridge University Press, Edinburg building, Trumpington Street, Cambridge CB2 1IR, United Kingdom (Antimicrobial sensitivity testing). pp. 132-148.

Date K, Fagan R, Crossland S, Maceachern D, Pyper B, Bokanyi R, Houze Y, Andress E and Tauxe R 2011: Three Outbreaks of Foodborne Botulism Caused by Unsafe Home Canning of Vegetables—Ohio and Washington, 2008 and 2009. *Journal of Food Protection*, **74** (12): 2090-2096.

Dhuey E, Ruffley K and Pascall MA 2012: Characterization of morphological changes to an epoxy-based polymer used as a corrosion-preventative lining in retorted canned tomatoes. *Journal of Food Engineering*, **313**(7):110753.

Gopal N, Hill C, Ross PR, Beresford TP, Fenelon MA and Cotter PD 2015: The Prevalence and Control of *Bacillus* and Related Spore-Forming Bacteria in the Dairy Industry. *Frontier Microbiology*, **21**(6):1-18.

Grenda T, Jarosz A, Sapala M, Grenda A, Patyra E and Kwiatek K 2023: *Clostridium perfringens*-Opportunistic Foodborne Pathogen, Its Diversity and Epidemiological Significance. *Pathogens*, **12**(6): 1-12.

Juliao PC, Maslanka S, Dykes J, Gaul L, Bagdure S, Granzow-Kibiger L, Salehi E, Zink D, Neligan RP, Barton-Behravesh C, Lúquez C, Biggerstaff M, Lynch M, Olson C and Williams I 2013: National outbreak of type a foodborne botulism associated with a widely distributed commercially canned hot dog chili sauce. *Clinical infectious Diseases*, **56**(3):376-382.

Morka E 2022: Isolation of some pathogenic microbes associated with spoilt carrots (*Daucus carota L.*) obtained from local markets in Abraka, Delta State, Nigeria. *Dutse Journal of Pure and applied sciences*, **8** (1b):1-8.

Nik RN, Wan MWMB, Noor INJB and Nik NNHC 2014*:* Evaluation of environmental hygiene and microbiological status of selected primary school canteens. *Health and Environmental Journal*, **5**:110–127.

Odoki M, Almustapha AA, Tibyangye J, Nyabayo MJ, Wampande E, Drago KC, Agwu E and Bazira J 2019: Prevalence of Bacterial Urinary Tract Infections and Associated Factors among Patients Attending Hospitals in Bushenyi District, Uganda. *International Journal of Microbiology*, 4246780.

Ogbeibu AE 2005: Biostatistics. A practical approach to research and data handling. Mindex publisher. Benin City, Nigeria. 264pp.

Oscar CAA, Euloge SA, Adéyèmi BO, Sylvain DK, Edwige DA and Dominique CKS 2022: The tomato (*Solanum lycopersicum L.*) in community development: An overview focused on nutritional properties, agronomic constraints, recent achievements and future prospective. *International Journal of Frontiers in Biology and Pharmacy Research*, **3**(2): 8–16.

van Dyk BN, de Bruin W, du Plessis EM and Korsten L 2016: Microbiological Food Safety Status of Commercially Produced Tomatoes from Production to Marketing. *Journal of Food Protection*, **79**(3):392-406.

Yeboah AK 2011: A survey on postharvest handling, preservation and processing methods of tomato *(Solanum lycopersicum)* in the Dormaa and Tano South Districts of the Brong Ahafo Region of Ghana.

Yu R, Liu J, Wang Y, Wang H, Zhang H 2021: *Aspergillus niger* as a Secondary Metabolite Factory. *Frontier Chemistry*, **9**: 2296-2646.