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Assessment of Microbial Profile of Canned Foods

[a]*Uzoh C.V., [a]Adeshina A.A, [b]Igwe P.C, [c]Uzoh-chukwuma C.O, [a]Okeh C.O, [a]Inya I.E, [d]Uwanta L.I

[a] Department of Microbiology, Alex-Ekwueme Federal University Ndufu-Alike Ikwo, Ebonyi State.
[b] David Umahi Federal University of Health Sciences, Uburu, Ebonyi State.
[c] Department of Science Laboratory Technology, Akanu Ibiam Federal Polytechnic, Unwana, Ebonyi State.
[d] Department of Applied Microbiology and Brewing, Nnamdi Azikiwe University, Awka, Anambra State.

Abstract:

A total of twenty (20) canned food samples, comprising of four samples each of canned meat, milk, corned beef, fish and tomato paste collected from super markets, kiosks and open markets. All the samples were analyzed using standard microbiological procedures for aerobic and anaerobic plate counts considering pathogenic, spoilage organisms and coliforms. The aerobic plate count was from <12 cfu/g to 1.2 x 10^3cfu/g while the anaerobic plate count was from < 12 cfu/g to 1.3 x 10^2cfu/g. *Clostridium perfringens*, *Bacillus cereus*, *Bacillus subtilis*, *Bacillus licheniformis*, *Klebsiella* sp, *S. aureus*, *S. epidermidis* and *Bacillus coagulans* were isolated from some of the samples. These findings suggest inadequate sanitary procedures during production and insufficient adherence to safety standards hence, the need for improved processing standards, stricter hygiene protocols, and enhanced regulatory oversight to prevent foodborne illnesses and other health risks.

Introduction.

Canned foods are consumed by a wider population due to its convenience, availability and affordability. All the year round, variety of food items that required minimal preparation are made available through canning, which equally extends their shelf life(Appiagyeti *et al.*,2025).When refrigeration are not available, they are appropriate for camping and other outdoor activities (Masheswara *et al.*,2011). Canning is performed to kill organisms that causes spoilage and food-borne illnesses, but when handled inappropriately, it can form a suitable breeding ground for microorganisms. Canning ensures the exclusion of microbiological pollutants (FDA, 2021). Canned foods are susceptible to contamination by different microorganisms due to low heat processing, inadequate chilling, poor processing, leakage, pre-processing and post-processing processes (Lorenzo *et al.*, 2018). Canned foods have been reported to be contaminated with different spore forming microorganisms like *Bacillus* sp, *Clostridium* sp and Bacillus coagulans which may not generate gas(Jamroskovic *et al.*, 2016; Bintis, 2017). *Bacillus licheniformis* and *Bacillus cereus* usually contaminate milk leading to ruptured cans while toxins from meat are implicated in food poisoning when contaminated meat is consumed (Awasti *et al.*,2019). Aerobic plate counts cannot be used as reliable indicator for its safety upon consumption. It is very relevant in appraising the sanitary conditions of handling, manufacturing and storage(Ali et al.,2018) of the products. The aim of this work is to provide information about the microbial load of canned foods within expiry dates.

Materials and methods

Collection of sample

Twenty (20) samples of canned foods made of two each of the two different brands of canned meat, milk, corned beef, fish and tomato paste were carefully examined. The samples were collected from local markets, supermarkets, kiosks and other retail outlets while considering the NAFDAC registration number and expiration dates., distribution date. The batch numbers, manufacturer's address and other physical examination such as physical damage, bloating and leakages were observed and recorded.

Analysis of sample

The cans containing the samples were cleaned with 70% ethanol, opened and the pH from the various samples were measured. One gram(1g) portions of the

foods were blended in a sterile waring blender and inoculated into 9 ml of cooked meat medium and brain heart-infusion broth for pre-enrichment, then incubated aerobically and anaerobically for 24 hours at different temperatures of 15°C, 37°C and 55°C. Nutrient agar and Brain Heart Infusion agar plates were later inoculated and incubated both aerobically and anaerobically. One gram (1 g) of the foods were homogenized in 9 ml of peptone water and plated out on Nutrient agar, MacConkey agar, Eosin methylene blue and Brain heart Infusion agar. Incubation was the same excluding MacConkey and EMB agar which were incubated aerobically at 37°C and 45°C for determination of coliforms. After the duration of incubation, the colonies were counted using the colony counter and the unit of expression was cfu/g (Uzoh *et al*., 2024). The colonies were subjected to Gram-Staining, catalase test, indole test, Urease test, Methyl-red test, Voges proskauer test, Citrate utilization, Sugar fermentation test, gelatin liquefaction and starch hydrolysis test for further confirmation of their isolates.

Results

Table 1: Colony morphology and biochemical characteristics of the isolates

Isolate	Shape	Gram stain	Catalase	Indole	Urease	Methyl red	VP	Citrate	Sugar Glu	Gelatin	Starch hyd	
A	Rod	+	-	–	–	–	–	–	+	+	+	*C. perfringens*
B	Rod	+	+	–	+	+	+	+	+	+	+	*B. cereus*
C	Rod	+	+	–	–	–	+	+	+	+	+	*B. subtilis*
D	Rod	+	+	–	–	–	+	+	+	+	+	*B. licheniformis*
E	Rod	+	+	+	–	+	+	–	+	–	+	*B. coagulans*
F	Cocci	+	+	–	+	+	+	+	+	+	–	*S. aureus*
G	Rod	-	+	–	+	–	+	+	+	–	–	*Klebsiella sp*
H	Rod in chains	+	-	+	–	–	–	–	+	+	+	*C. sporogenes*

Gram = gram reaction, cat. – catalase test, oxi – oxidase test, ure - urease test, MR – methyl red test, cit. – citrate test

Table 2: Mean pH and preinoculated total plate counts of canned foods

	Mean Total Plate Count cfu/g							
	Aerobic incubation			**Anaerobic incubation**				
Canned Foods	**15°C**	**37°C**	**55°C**	**15°C**	**37°C**	**55°C**	**Coliform count**	**Mean pH**
Meat	-	$7.6x10^1$	<16	-	$6.5x10^1$	<16	-	6.11
Milk	-	$5.4x10^2$	-	<16	-	<16	-	6.05
Corned beef	-	$3.7x10^3$	$5.2x10^1$	<16	$5.4x10^2$	<16	$2.6x10^2$	5.10
Fish	-	$5.8x10^1$	$3.7x10^1$	-	$4.6x10^1$	<16	<16	6.00
Tomato paste	-	$3.9x10^2$	<16	-	<12	<16	-	4.10

Table 3: Mean pH and total plate counts of canned foods

	Mean Total Plate Count cfu/g							
	Aerobic incubation			**Anaerobic incubation**				
Canned Foods	**15°C**	**37°C**	**55°C**	**15°C**	**37°C**	**55°C**	**Coliform count**	**Mean pH**
Meat	-	$4.8x10^1$	<12	-	$1.4x10^1$	<12	-	6.11
Milk	-	$1.1x10^2$	-	<12	-	<12	-	6.05
Corned beef	-	$1.2x10^3$	$1.3x10^1$	<12	$1.3x10^2$	<12	$2.1x10^2$	5.10
Fish	-	$2.7x10^1$	$1.5x10^1$	-	$1.5x10^1$	<12	<12	6.00
Tomato paste	-	$1.6x10^2$	<12	-	<12	<12	-	4.10

Table 4: Microorganisms isolated from canned foods

Canned Foods	**Microorganisms isolated**
Meat	*C. perfringens, B. cereus, B. subtilis*
Milk	*B. licheniformis, B. cereus, B. coagulans*
Corned beef	*C. perfringens*, *B. subtilis*, *S. aureus*, *Klebsiella* spp
Fish	*B. subtilis*, *Klebsiella* spp, *S. aureus*
Tomato paste	*S. aureus, B. coagulans, C. sporogenes*

Upon examination, none of the canned samples had leaky, physical damage or was blown off. The aerobic culture plates produced more colonies than the anaerobic plates, while the pre-enriched samples yielded more organisms than the non-enrichment plates. The mean plate counts for the canned foods are shown in table 3. It was observed that the milk, corned beef and tomato paste had higher microbial loads when compared to meat and fish. The incubation at 15°C yielded lower microbial counts when compared to incubation at 37°C and 55°C (aerobic and anaerobic). Coliforms were observed in corned beef and fish samples. The organisms mostly implicated in these canned foods were Bacillus species (*Bacillus cereus* and *Bacillus coagulans*) *S. aureus* and *Clostridium perfringens*.

Discussion and conclusion

Since all the canned samples examined were not blown or never had a leaky can, it showed that they were within the expiration date and had no significant spoilage organisms. All the canned foods had microbial loads that were < 10^6 which was within the acceptable microbial limit. Canned foods can be potential sources of contamination with different aerobic and anaerobic microorganisms(Lorenzo et al.,2018). It was observed in this study that microbial counts were greater in aerobic than anaerobic incubation. This corroborates the work of (Mohammed Sharif *et al.*, 2023). However, this result contradicted a study by (Hamasalim, 2012) where he observed that aerobic bacteria were completely absent in the culture plates, where there were very low number of anaerobic microorganisms.

In this study, the combined effects of the pH, anaerobic condition, high temperature treatment and preservatives could be responsible for the relatively low microbial loads. Milk, corned beef and tomato paste had higher microbial counts than others. This could be as a result of the pre-process contamination and stringency level during production. The isolated organisms like *Bacillus subtilis*, *Bacillus cereus*, *Clostridium perfringens* and other *Bacillus* species are the spore formers which are known to be environmental contaminants of canned foods. (Mohammed Sharif *et al.*, 2023). The presence of these organisms that causes food poisoning although in very small number draws attention to poor storage

conditions and temperature abuse in the shops and kiosks where the canned foods were kept for sale to consumers. These temperature abuses could lead to unacceptable level of growth of these organisms. Since their temperature range is from 20°C to 50°C, any temperature abuse will lead to rapid proliferation and spoilage of the canned foods. This was similar to the work of (Tewari and Abdullah, 2015). In this study, it was observed that at lowest incubation temperature of 15°C there was less microbial growth for both aerobic and anaerobic conditions, unlike those at 37°C and 55 °C which were higher. This corroborates the work of (Cruz *et al*., 2022; Mohammed Sharif *et al*., 2025). The pre-enriched samples that exhibited growth of more organisms than the directly cultured ones showed that shelf-stable canned foods contained in hermetically sealed containers were not completely sterile, but rather contains suppressed and injured microorganisms which could proliferate upon mismanagement of the temperature and storage conditions. To guarantee proper food safety, regular monitoring and inspections on canned foods at their places of sale should be conducted at regular intervals.

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