

Investigation on the microbial profile of canned foods

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A total of thirty (30) canned food samples comprising of six samples each of Sardines, Milk, Tomatoes, Meat and mixed vegetables were randomly collected from super stores, kiosks and local markets. All samples are within expiry date, none of which is bloated, leaking and/or physically damaged. Samples were analyzed by standard methods for total plate counts (aerobic and anaerobic incubations), and for spoilage, pathogenic and coliform organisms. The total aerobic plate count ranges from $< 10\text{cfu/g}$ to $1.4 \times 10^3\text{ cfu/g}$. Anaerobic plate count ranges from $< 10\text{cfu/g}$ to 1.0×10^2 . *Bacillus subtilis*, *B. coagulans*, *B. cereus*, *Clostridium perfringens*, *C. sporogenes*, *Staphylococcus aureus*, *Klebsiella* spp and *S. epidermidis* were isolated from some of the samples. The need for effective HACCP (Hazard Analysis Critical Control Point) is recommended to prevent under processing, pre-process and post-process contaminations, inadequate cooling, contamination from leakage through seams and pre-process spoilage.

Key words: Canned food, coliforms, expiry date, HACCP, pathogenic organisms, spoilage organisms, total plate counts.

INTRODUCTION

Canned foods or shelf stable canned foods are packed in hermetically sealed containers and are commercially sterile [1]. Canning is intended to destroy harmful microbes in food, however, with improper handling, cans become breeding grounds for microbes. Canning destroy the microbial contaminants, however, products undergo microbial spoilage and could cause food borne illness as a result of under processing, inadequate cooling contamination of the can resulting from leakage and pre-process spoilage. Some canned foods receive low-heat treatments and as such are prone to contamination by large number of different microorganisms' types.

Defective containers is a common place due to fault or bottleneck in the manufacture, improperly closed can or cans damaged due to bad packaging/transportation in such a manner as to permit recontamination of the can contents following the heat process (post-processing contamination).

Canned foods have been reported to be contaminated mainly by spore forming bacteria of the genera *Bacillus*, *Clostridium* and *Desulfotomaculum* [2]. If the contaminant

is a pathogen and the food is capable of supporting its growth, a health hazard exists [1,3,4].

B. coagulans and *B. stearothermophilus* have been implicated in canned tomato juice and milk causing flat sour spoilage with acid but no gas production from carbohydrate [5,6]. *B. cereus* and *B. licheniformis* contaminate milk causing broken cream and soft coagulum with blown cans [6,7].

Food poisoning by *C. perfringens* has been reported, poisoning has been associated most often with meat and gravies, however, *C. perfringens* spores are also found in milk and cheese and could grow to cause food poisoning [8,9].

Toarmina and Diorsa (2004) reported on the putrefaction and excessive gas formation of canned meat and sea foods caused by *Clostridium sporogenes* [10]. Spoilage of fermented Spanish olives "Zapateria" and explosion (rancidity and off-flavour) of chocolate candies have been associated with *C. bifermentans* and *C. sporogenes* [11,12].

Thermophilic spore formers may be more prevalent in under processed foods than mesophiles because they are more heat resistant, *C. thermosaccharolyticum* and *C. thermoaceticum* have been implicated in spoilage of canned foods [13,14]. Botulism is the most dreaded form of food poisoning and the botulinum toxin from *C.*

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botulinum is one of the most potent [8].

The ICMSF (International Commission on Microbiological Specifications for Foods) (1986) do not support incubation tests for canned foods for obvious reasons. It is however necessary for low acid canned foods that do not receive full botulinum cook; it is equally of use to manufacturers to monitor spoilage trends over long period of time and to monitor pathogens like staphylococci and *Salmonella typhi* that will not produce gas in many canned products [1].

The aim of this work is to determine the microbial profile (pathogen and spoilage organisms) in some canned foods within expiry date, with a view of educating the public on food safety.

MATERIALS AND METHODS

Sample Collection:

Thirty (30) samples of a canned foods comprising of two each of three different brands of canned meat, milk, mixed vegetables, sardines and tomatoes were examined. Samples within the expiry date as indicated on the container were randomly (without specific order) collected from kiosks and supper markets/shopping malls. Samples were taken to the laboratory for analysis. The information on the container/labels was recorded to include NAFDAC (National Agency for Food and Drug Administration and Control) number, manufacture and expiry dates, batch number, manufacturer's address, preservative(s) and compositions. Cans were examined for evidence of bloating, leakage and physical damage.

Sample Analysis:

Prior to analysis, the surface of the container was cleaned with 70% ethanol and tincture of iodine. Containers were opened near the flame of the Bunsen burner to avoid contamination. The PH of the samples was taken using pH meter (Jenway 3505, manufactured in England). Ten gram (10g) portions of the foods was blended in sterile warring blender and inoculated into triplicate tubes of 90ml Brain Heart Infusion (BHI) broth (Oxoid) and Cooked Meat medium (Oxoid). The tubes were incubated aerobically and anaerobically for 24-48 hours pre-enrichment at 15°C for psychrophiles, 37°C for mesophiles and 55°C for thermophiles. Triplicate plates of BHI agar and Nutrient agar was inoculated after pre-enrichment and incubated aerobically and anaerobically (Oxoid anaerobic Jar) at the same temperatures of the pre-enrichment broths. Ten gram (10g) portions of the foods was blended in 90ml peptone water (Fluka, Germany), the homogenates was diluted 10⁻² and plated via spread plate method on triplicate Plates of BHI agar, Nutrient agar, MacConkey agar and Eosine Methylene Blue (EMB) agar (Oxoid). Incubation was as described

above, except however, for MacConkey and EMB agar that was incubated aerobically at 37°C and 45°C for Coliforms.

At the expiry of incubation time, colonies were counted using colony counter (Stuart Scientific, UK). Results were expressed as cfu/g. Characteristics colonies on plates were Gram stained, purified by repeated subculture and stored on agar slants or agar stab if anaerobe, until further characterization. Tentative identification of isolates was done by Gram staining, indole test, urease test, catalase test, methyl red test, citrate utilization test, Voges proskeur test, gelatine liquefaction, starch hydrolysis, sugar fermentation tests, motility and cultural characteristics on culture media. Confirmatory identification was based on the methods of [15,16].

RESULTS

No blown, leaky or physically damaged can was observed in all the samples analysed. Cultures from the pre-enriched samples yielded more organisms than the directly cultured samples without pre-enrichment. Similarly aerobic culture produced more colonies than anaerobic culture.

The mean total plate counts for the canned foods are as shown in Table 1. It revealed that mixed vegetables, Tomatoes and Sardines had higher microbial loads compared to milk and meat products.

Incubation at 37°C and 55°C both aerobically and anaerobically yielded more counts than incubation at 15°C. Coliform was implicated in a sample of Sardine and two samples of mixed vegetables. Table 2, shows the micro organisms isolated from the analysed samples. *B. coagulans* and *S. aureus* are the predominant microorganisms isolated. *B. cereus* and *C. perfringens* was implicated in meat samples.

DISCUSSION AND CONCLUSION

The absence of blown and leaky cans could suggest that all the samples analysed within expiry date from manufacture is of acceptable quality for consumption. The canned foods examined had low microbial loads < 10⁶ within acceptable microbiological quality [17]. The combined effects of high temperature treatment, pH, preservatives and anaerobic condition of canning could have been responsible for the low microbial loads. Mixed vegetables, Tomatoes and Sardines had higher plate counts; these could be a reflection of the quality of the raw materials, under processing, pre-process contamination and to the level of stringency in their production.

The isolation of *B. coagulans*, *B. cereus*, *B. subtilis*, *C. sporogenes* and *C. perfringens* could be explained by the

Table 1. Mean pH and total plate counts of canned foods

Canned Foods	Mean Total Plate Count cfu/g						Coliform Count	Mean pH
	Aerobic incubation			Anaerobic incubation				
	15°C	37°C	55°C	15°C	37°C	55°C		
Meat	-	5.0x10 ¹	< 10	-	1.0x10 ¹	<10	-	6.24
Milk	-	1.0x10 ²	-	<10	-	<10	-	6.20
Mixed Vegetables	-	1.4x10 ³	1.0x10 ¹	<10	1.0x10 ²	<10	2.0x10 ²	5.30
Sardine	-	2.1x10 ¹	1.1x10 ¹	-	1.2x10 ¹	<10	<10	6.12
Tomatoes	-	1.3x10 ²	<10	-	<10	<10	-	4.25

- = No growth at expiry of incubation time

Table 2. Microorganisms isolated from canned foods

Canned Foods	Microorganisms isolated
Meat	<i>B. cereus</i> , <i>B. subtilis</i> , <i>C. Perfringens</i>
Milk	<i>B. coagulans</i> , <i>Bacillus spp</i>
Mixed Vegetables	<i>B. subtilis</i> , <i>S. aureus</i> , <i>Klebsiella spp</i> , <i>B. circulans</i>
Sardine	<i>S. aureus</i> , <i>C. sporogenes</i> , <i>Klebsiella spp</i>
Tomatoes	<i>B. coagulans</i> , <i>S. aureus</i> , <i>S. Epidermidis</i>

fact that they are spore formers and known common environmental contaminants, they have been implicated in canned foods [2,6,7]. *C. perfringens* and *B. cereus* are pathogens that can cause infection and food poisoning, they are known to have extreme wide growth temperature of 20-50°C [6,7,8]. The presence of *B. cereus* and *C. perfringens* in canned food, even though in very small amount, calls for concern as temperature abuse and poor storage conditions prevalent in kiosks and stores from where these products were purchased, could encourage proliferation of these organisms to unacceptable level.

B. coagulans, *B. subtilis* and *C. sporogenes* have been reported as spoilage organisms in Tomatoes, Milk, Meat and Chocolate products, causing flat sour spoilage, putrefaction, rancidity and off-flavour [5,6,10,11,12], their presence in canned food portend possible spoilage if storage conditions become favourable due to abuse.

S. aureus, *S. epidermidis* and *Klebsiella* are of human flora, they are known opportunistic pathogens. Contamination of canned foods could be via food producers/handlers and equipments. They are facultative and hardy organisms, thus their survival in canned foods could be explained. Toxigenic strains of *S. aureus* have been implicated in food born illness and are known to proliferate in conditions of temperature abuse [18,19,20,21]. That the pre-enriched samples yielded more organisms than the direct culture could be explained by the fact that shelf stable canned foods packed in hermetically sealed containers are not absolutely sterile and thus contain injured and suppressed micro-organisms that could proliferate if

storage conditions and integrity of the container is compromised. Regular surveillance and checks to monitor canned foods on sales is therefore necessary for effective food safety.

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