Bacteriological evaluation of corned beef with special reference to spore forming bacteria

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Abstract

Forty random samples of corned beef were collected from different supermarkets in Cairo city. The samples were examined for aerobic plate count, *S. aureus* counts, aerobic spore forming count (*B. cereus* count) and anaerobic count as well as for detection of *Clostridium perferingens*. The mean values of total aerobic count and total anaerobic count were ($2.3x10^3$ and $3.75x10^2$ cfu/g) respectively. While the mean values of *S. aureus* and *B. cereus* count were ($2.66x10^2$ and $7.5x10^2$ cfu/g) respectively. *Clostridium perferingens* was detected in two samples. The presence of microorganisms could be as a result of the denting and rusting which could have created a puncture on the can, post-processing contamination and heat resistance of the organisms spores during retorting and inadequate processing.

Key words: *Clostridium perferingens , B. cereus, S. aureus,* corned beef .

Introduction

Rich nutrient matrix meat is the first choice source of animal protein for many people all over the world **(Heinz and Hautzinger, 2007)**.Commercial canned corned beef is consumed by sailors, tourists, soldiers, and people on picnic and in our homes due to its convenient form of transportation. The contents of these cans should remain unspoiled indefinitely if processing of these containers has been conducted properly. Extremely perishable meat and meat products provide favorable growth condition for various microorganisms **(Dave and Ghaly, 2011)**. Bacterial spoilage and food poisoning of corned beef may be due to aerobic or anaerobic bacteria or spore forming bacteria either aerobic or anaerobic. *S. aureus* is one of the aerobic food poisoning organisms. Bacillus cereus is aerobic spore forming, while *Cl. perfringens* is anaerobic spore forming.

The true incidence of staphylococcal food poisoning in the USA, as well as in other countries, is unknown, because this illness is not a reportable disease in most countries . The numbers of confirmed outbreaks of food poisoning reported in the US to the CDC from 1977 – 1997. The number of outbreaks ranged from 1 – 34 and the total cases ranged from 3696 (1997) to 22132 (1985), **(Bergdol and Wong, 2006)**.

Most meat is contaminated with staphylococci but normally this is not of concern because the organisms do not usually multiply rapidly on raw meat and they are destroyed in cooking process. Staphylococci that are present on the meat before processing are rarely involved in food poisoning outbreaks. In case of meat products involved in food poisoning, the causative organism result of post -processing contamination. The contamination of raw meats is properly from multiple sources, including human handlers. Normally foods were found to be contaminated with staphylococci particularly if they had been handled by humans. However, staphylococci would not grow sufficiently on many foods to produce enterotoxins and cooking before consumption would destroy the organisms **(Bergdoll and Wong 2006)** .

Bacillus cereus is a group of ubiquitous facultative anaerobic spore forming gram positive rods commonly found in soil the spores frequently contaminate a variety of foods, including meat and meat products and other foods. Foodborne illness associated with toxins produced by *B. cereus* can result in self limiting diarrhea or vomiting **(Sandra, 2012)**.

Clostridium perfringens is Gram – positive spore – forming bacteria (bacillus) distributed in the environment **(Granum, 1990)**, and it is one of the most common causes of foodborne illnesses in the united states **(Shandera *et al*., 1983; Bean and Griffin, 1990)**.

Cooked meat products such as ham, roast beef, and corned beef are frequently associated with foodborne outbreaks of *Cl. perfringens* gastroenteritis **(CDC, 1994)** .Consumption of meat products contaminated with large number of vegetative cells of *Cl. perfringens* organism can cause symptoms such as acute abdominal pain and diarrhea within 8 – 15 hrs after ingestion **(FDA – CFSAN, 2001)**. Raw meat and ingredients as spices are the primary source of microorganisms **(ICMSF, 1996)**. *Cl. perfringens* is frequently isolated from meat – containing food commodities such as soups and stews, and from herbs and spices. In food commodities minority of the isolated strains carry the gene encoding the enterotoxin Cpe and are thus potentially pathogenic. Strains isolated from meat – containing food commodities carry the Cpe gene were more than ten of the strains isolated from herbs and spices **(NIPH, 2011)**.

This work is therefore aimed to investigate and determine the microbial status and wholesomeness of commercial corned beef product

Materials and Methods

Forty random samples of local corned beef were collected from the markets in Cairo

-Preparation of samples according to **AOAC (2002).**

-Aerobic and Anaerobic count according to **APHA (2001 a).**

-Aerobic spore forming count (*B. cereus* count) according to **APHA (2001 b).**

-*Staphylococcus aureus* counts according to **FDA (2001)**

-Isolation of *Clostridium perfringens* according to **FDA–– CFSAN (2001).**

Table (1). Bacteriological analysis of examined samples (cfu/g). (No. of samples=40)

	Aerobic plate count (APC)	*S. aureus* count	*B. cereus* count	Anaerobic count
Min	<100	<10	<10	<100
Max	$5x10^4$	$3x10^3$	$8x10^3$	$2x10^3$
Mean	$2.3x10^3$	$2.66x10^2$	$7.5x10^2$	3.75×10^2
± SE	1.29×10^3	9.48× 10	2.94×10^2	1.21×10^2

Table (2). percentage of Accepted and Rejected corned beef samples according to ES (Egyptian Standardization) (No. of samples=40)

Parameter	APC		*S. aureus* count		*B. cereus* count		Anaerobic count	
	no	%	no	%	no	%	no	%
Accepted	26	65%	30	75%	32	80%	32	80%
Rejected	14	35%	10	25%	8	20%	8	20%

Table (3). Percentage of *Cl.perfringens* isolates (No.of samples=40)

No. of detected *Cl. perfringens*	Percentage%
2	5%

Discussion

Table (1) illustrates that the mean values of APC, *S. aureus, B. cereus* and anaerobic count were 2.3 x 10^3, 2.66 x 10^2,7.5 x 10^2 and 3.75 x 10^2 cfu/g respectively with minimum values <100, <10, < 10 and < 100 cfu/g and maximum values, 5x 10^4, 3 x 10^3, 8 x 10^3 and 2 x 10^3 cfu/ g respectively, These results agree with those reported by **Oranusi *et al*. (2012)**. It is unusual for commercially processed foods to be implicated in staphylococcal food poisoning but a number of cases occurred in England from canned corned beef in Argentina, Brazil and Malta **(Anonymous, 1979a , 1979b, 1979c)**. However, this was not due to the failure of the processing procedures, but to leaky seams or improperly sealed cans that allowed staphylococci to enter the cans during the cooling process. Sufficient growth of the staphylococci in the can occurred to produce enterotoxin before the food was consumed **(Anonymous, 1989).**

The rejected samples due to APC, *S.aureus*, *B. cereus* and anaerobes were 35%, 25%, 20% and 20% respectively as they are non confirming by **E.O.S.Q.C. (2005)**. In **(Table 2)**, *B. cereus* count and anaerobic counts respectively, agree with the results recorded by **Refaie *et al*. (1993)** and **Ngoka and zuegbu (2006)**. Their presence could be as a result of the denting and rusting which could have created a puncture on the can, post- process contamination, and heat resistance of the spores of the organisms during retorting and inadequate processing. Bacillus was the only organism identified in dented and rusty cans. Bacillus are aerobic spore-forming and so their presence could be as a result of the environment being favorable for their growth.

The spores of *B. cereus* may survive the cooking process and may be implicated in the food in vegetative forms as it may grow at minimum temperature 4 – 12°C and maximum 45 – 50°C **(ICMSF 1996)**. This agree with that reported by **HPA (2009)** which noted that not all strains of *B. cereus* produce toxins that either the emetic or diarrheal toxins are distinct, the emetic toxin that is performed in food is both acid and heat stable .The spore form of *Cl. perfringens* is more resistant to heat than vegetative cells and can withstand heating at 100oC for up to 1 h . As a result, the spores from of *Cl. perfringens* can survive normal processing conditions for making processed meat products such as ham, roast beef and corned beef .

Instead of being inactivated during cooking, as in vegetative cells, almost the spores are activated by heat. Since *Cl. perfringens* can grow in wide temperature range between 10 and 52° C **(FDA – CFSAN, 1998)** and at temperature between 30 and 47°C **(Craven, 1980 ; Juneja *et al* ., 1994)**, the heat – activated spores of *Cl. perfringens* in finished meat products could be of public health concern . The temperatures of cooked meat products are not properly maintained, the spores of *Cl. perfringens* can germinate and actively multiply to dangerously high dose level, posing a potential public health risk.

The incidence of *Cl. perfringens* percent was 5% **(Table 3)** .

Prevention and control

The staphylococci are ubiquitous organisms that cannot be eliminated from our environment. At least 30- 50% of individuals carry these organisms in their nasal passage or throats, or over their hands .Corned beef is exposed to can leakage any time that permits the contamination with staphylococci and other organisms. Not all of staphylococci may be enterotoxin producers, but 30- 50% may be .In case of corned beef leakage contamination by staphylococci is not processed further after contamination and even heated. Food poisoning caused by *Cl. perfringens* has been historically linked to gross temperature abuse in finished food **(Foster, 1997 ; CDC, 1994)**. Rapid cooling and proper temperature control are critical to the prevention of food borne *Cl.perfringens* gastroenteritis. The U.S Department Agriculture (USDA) requires that the internal temperature of the slowest cooling point in cooked beef, roast beef and corned beef should be cooled from 48.9 to 12.8 °C for 6h or less, and the cooling should continue to 4.4° C prior to boxing **(USDA, 1993)**

Process deviation and temperature abuse are

practically inevitable in various real world – operations of cooling distribution, storage, retail and serving of cooked meat products. Assessing potential bacterial growth in cooked meat products undergoing dynamic (discrete or continuous) temperature changes has been a challenge for food microbiologists and food safety risk assessors. Most mathematical models available in predictive microbiology are kinetic models for estimating bacterial growth under constant temperature conditions **(McDonald and Sun, 1999)**.

USDA and FSIS (2005) conducted a quantitative risk assessment of *Cl. perfringens* in ready to eat (RTE) and partially cooked meat and poultry products. The purpose of the risk assessment was twofold:

1) evaluate the public health impact of changing the allowed maximal growth of *Cl. perfringens* during manufacturing stabilization (cooling after cooking step) of RTE and partially cooked meat and poultry products; and

2) examine whether the steps taken to limit the growth of *Cl. perfringens* occurring in and partially cooked foods would also be adequate to protect against growth of *Cl. botulinum*.

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التقييم البكتريولوجى للحم المحفوظ (الكورندبيف) مع التركيز على الميكروبات المتجرثمة

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الملخص العربى

تم جمع 40 عينة من اللحم المحفوظ(الكورندبيف) المحلى التصنيع الموجود باسواق محافظة القاهرة وتم فحصها بكتيرولوجيا (العد البكتيرى الكلى –عد الميكروب العنقودى الذهبى –عد الميكروبات الهوائية المتجرثمة (الباسيلس سيرس)-عد الميكروبات اللاهوائية وعزل مكروب الكلوستريديم بيرفيرنجينز) واظهرت النتائج ان متوسط العد الكلى للميكروبات الهوائيةواللاهوائية 3، 2 × 10^3 ، 3.75× 10^2 خلية /جرام على التوالى ومتوسط عد الميكروب العنقودى الذهبى و الميكروبات الهوائية المتجرثمة 2.66× 10^2 ، 5 ، 7 × 10^2 خلية /جرام على التوالى وتم عزل ميكروب الكلوستريديم بيرفرينجيز من عينتين . كما تمت الاشارة لاسباب وجود هذه الميكروبات وطرق تلافيها فى المنتج اثناء التصنيع .