Official Journal Issued by Faculty of Veterinary Medicine

Benha Veterinary Medical Journal

Journal homepage: https://bvmj.journals.ekb.eg/

Since 1990

Original Paper

Bacteriological quality of canned meat marketed in Beni-Suef, Egypt

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ARTICLE INFO

Keywords

C. perfringens

Canned meat

Enterococci.

S. aureus

Received 26/08/2020
Accepted 13/09/2020
Available On-Line 01/10/2020

ABSTRACT

Because of rapid and busy lifestyle, canned meat are widely consumed in Egypt. Therefore, the main objective of the current study was to evaluate the bacteriological status of canned meat marketed in Beni-Suef city. A total of 150 samples of canned meat represented by canned beef, corned beef, canned chicken sausage, canned chicken luncheon, canned luncheon and canned sausage (25 each) were examined for anaerobic plate count, *Staphylococcus aureus* count, *Enterococci count*, total Clostridia count and isolation of *Clostridium perfringens*. The highest prevalence of Clostridia were recorded in corned beef and canned sausage (60% each), while their lowest ones wherein canned beef and canned poultry sausage (28% each). Twenty, 24%, 16, 12%, 24% and 24% of canned beef, corned beef, canned chicken sausage, canned chicken luncheon, canned luncheon and canned sausage, respectively, exceeded the permissible limitsof the Egyptian Organization for Standardization and quality in relation to *S. aureus* count. Enterococci was not be detected from canned chicken luncheon and canned sausage, while the levels of detection in canned beef, corned beef, canned chicken sausage, and canned luncheon were 12, 28, 4, and 12%, respectively. *C. perfringens* failed to be isolated from all the examined samples. It could be concluded that some of the examined samples were exceeding the local and international permissible limits for the examined bacteria, which may reflect under processing or poor storage conditions.

1. INTRODUCTION

Canned meat products are common meals, because they are available, they are suitable for working families, canteens and cafeterias. They are also easy to be prepared during camping and different activities, as well as, where a fridge may not be available. The basic raw material is either beef or poultry in chopped or comminuted form, and additional ingredients may include spices, soya protein, starch, nitrite, salt, ascorbates, and phosphate (Abdullah, 2007).

Canned meat is a meat or poultry product with a water activity above 0.85 which receives a thermal treatment before or after being packed in a hermetically sealed container. These products remain stable and retain their organoleptic quality at room temperature for several years (shelf stable), therefore they are called commercially sterile canned meat. Shelf stability could be defined as the condition achieved by application of heat which is sufficient alone or in combination with other ingredients in rendering the product free of microorganisms capable of growing at room temperatures. Canned meat are thermally processed to make the food shelf stable for long period. The heat treatment carried out at temperatures above 100 °C at every point of the container. This process results in complete inactivation of all vegetative bacteria and partial inactivation of spore –forming bacteria (André et al., 2013). Despite thermal processing, canned foods are susceptible to microbial spoilage. Spoilage is caused by growth of microorganisms following contamination through leakage or under-processing (Warren et al., 1998)

Anaerobic bacteria such as clostridia are the most important group of the microorganisms which may be found in sound canned meat and are responsible for many public health hazards, as well as, spoilage of these products, because of their spores are able to survive the high canning temperature. *C. perfringens* is one of the genus clostridia, which is widely spread and inhabitant in soil and man (Barnes, 1985).

Canned foods have been involved in enteric infections and food poisoning outbreaks in different countries, including cases of typhoid fever, botulism, salmonellosis and staphylococcal poisoning (Foster, 1997). The bacteriological examination of canned meat is carried out to evaluate the possible presence of bacteria of public health importance, as well as, to evaluate hygienic conditions of the canned meat; including temperature abuse and hygiene during handling, processing and storage. Although anaerobic plate count of a food is not a sure indicative of its safety for consumption, it is of a great importance in judging the hygienic conditions of production, handling and storage (Ali et al., 2018)

Many types and trades of canned meat and poultry are widespread in Egypt now a day because of the rapid and

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busy lifestyle as well as easiness of their preparation. Therefore, the main goal of the current study was to assess the microbial load of canned meat and canned chicken products collected from different supermarkets and grocery stores in Beni-Suef city (canned beef, corned beef, canned chicken sausage, canned chicken luncheon, canned luncheon and canned sausage) for anaerobic plate count, *Staphylococcus aureus* count, *Enterococci count*, Total Clostridia count and isolation of *C. perfringens*, as well as, to compare the obtained results with International and local microbiological standards.

2. MATERIAL AND METHODS

2.1. Collection of samples:
One hundred canned beef samples and fifty samples of canned chicken (150 all) were randomly collected from grocery stores and supermarkets in Beni-Suef City. The beef samples were canned beef, corned beef, canned beef luncheon and canned beef sausage (25 each). Poultry samples were represented by canned chicken luncheon and canned chicken sausage (25 each). Each sample was wrapped, separately, in sterile plastic bag and transferred in an insulated ice box under complete aseptic condition to the Laboratory of Food Hygiene Department, Faculty of Veterinary Medicine, Beni-Suef University for microbiological investigation.

2.2. *Preparation of samples*:
The samples were prepared according to technique recommended by ICMSF (1996a) as follows:
Before bacteriological examination, the surface of each can was sterilized by piece of cotton soaked in 70% alcohol (ethanol). Cans were opened near to flame of the Bunsen burner to avoid contamination. Then, the cans were opened by using sterile can opener. Twenty-five grams from each sample were taken from different parts and aseptically transferred into sterile homogenizer flask containing 225ml of 0.1% peptone water (Oxoid, CM509) under complete aseptic conditions. The content was homogenized for 2 min and then allowed to stand for 5min at room temperature, then one ml was transferred to sterile test tube containing 9 ml of 0.1% peptone water by using sterile pipette , from which further decimal tenfold dilution were prepared up to 10^{-4}.

2.3. Bacteriological examination:
2.3.1. Anaerobic plate count:
The pouring technique recommended by APHA (2001) was used for enumeration of anaerobic bacterial count, in which 1 ml from each dilution was transferred to sterile plates, and then 15 ml of sterile plate count agar (PCA, Oxoid CM0463B, Hampshire, England) poured over the food homogenate. The plates were incubated at 35°C for 48 hrs under anaerobic conditions using anaerobic jar and kits.

2.3.2. Enumeration of Staphylococcus aureus
Aliquot (0.1 ml) of canned meat homogenate was streaked onto Baird Parker Agar (Oxoid, CM1127) and typical colonies (black to dark gray with an opaque zone surrounded by a clear halo) were picked up and transferred to agar slant for biochemical identification (APHA, 2001).

2.3.3. Enumeration of Enterococci:
The technique recommended by APHA (2001) was applied. Briefly, one hundred microliter of decimal dilution were spread onto Kanamycin Aesculin Azide agar medium (Oxoid, CM0591) plates with its supplement (Oxoid, SR0092). The inoculated plates were incubated at 42 °C for 24-48 hrs. Suspected colonies (gray round colonies about 2 mm in diameter surrounded by brown black zone) were counted.

2.3.4. Total Clostridia Count:
Enumeration is carried out as that described by ICMSF (1996b) and using Reinforced Clostridium Agar (RCM, CM0151).

2.3.5. Isolation of Clostridium perfringens:
Isolation of *C. perfringens* was carried out according to Roberts and Greenwood (2003). Briefly, each sample was inoculated into freshly prepared cooked meat medium (Oxoid, CM0081), and anaerobically incubated at 37 °C for 24 hrs in an anaerobic jar. A loopful from the cooked meat medium is streaked onto neomycin sheep blood agar (Oxoid, CM0271) plate, followed by incubation at 37 °C for 18-24 hrs. under complete anaerobic condition. The characteristic colonies failed to be detected (double zone of hemolysis around colonies on blood agar).

2.4. Statistical analysis:
Statistical data analysis was carried out using SPSS 17.0 for windows (SPSS Inc, Chicago, IL, USA)

3. RESULTS

3.1. Total anaerobic count:
The mean values of anaerobic plate count were 10^4 $\pm10^3$ CFU/g in canned beef, $8\times10^2\pm$ 2×10^2 CFU/g in corned beef, $2\times10^2\pm73$ CFU/g in canned chicken sausage, 3×10^2 ±68 CFU/g in canned chicken luncheon, $6\times10^3\pm1.5\times10^3$ CFU/g in canned luncheon and $6x10^2\pm2\times10^2$ CFU/g in canned sausage (Table 1).

3.2. Staphylococcus aureus count:
The mean values of total *S. aureus* count were $10^2\pm80$ CFU/g in canned beef, $2\times10^2\pm10^2$ CFU/g in corned beef, 16±8 CFU/g in canned chicken sausage, 24±14 CFU/g in canned chicken luncheon, $3\times10^2\pm10^2$ CFU/g in canned luncheon, 28± 9 CFU/g in canned sausage (Table 2).

3.3. Enterococci count:
Enterococcus count had mean values of 16±10 CFU/g in canned beef, 76±41 CFU/g in corned beef, 4±4 CFU/g in canned chicken sausage, $<10^2$ CFU/g in canned chicken luncheon $2\times10^2\pm10^2$CFU/g in canned luncheon,$<10^2$ CFU/g in canned sausage (Table 3).

3.4.Total clostridia count:
The mean values of total clostridia counts were $3\times10^2\pm$ 2×10^2 CFU/g in canned beef, $6\times10^2\pm$ 2×10^2CFU/g in corned beef, 48±16 CFU/g in canned chicken sausage, $10^2\pm29$ CFU/g in canned chicken luncheon, $10^3\pm3\times$ 10^2CFu/g in canned luncheon and $1\times10^2\pm$ 27 CUF/g in canned sausage (Table 4).

4. DISCUSSION

Low result for anaerobic counts in canned beef were reported by Ali *et al.* (2008), Oranusi *et al.* (2012), Abdulhay and Salloom (2015) and Saleh *et al.* (2015) and by AL-Hisnawi *et al.* (2010) and Nader *et al.* (2016) in

corned beef. Moreover, Abdulhay and Salloom (2015) recorded low results in canned chicken. However, similar results were reported by Saleh *et al.* (2015) in corned beef and Pal *et al.* (2018) in canned beef. Moreover, Taman (2003) recorded high results in corned beef and canned sausage while, Nader *et al.* (2016) recorded higher results in canned luncheon.

Table 1 Total anaerobic count of the examined canned meat samples

Product	No of samples	Positive samples		Min	Max	Mean	±SE
		No	%				
Canned beef	25	17	68%	<10	3×10^5	10^4	10^3
Corned beef	25	19	76%	10	4×103	8×102	2×102
Canned chicken sausage	25	12	48%	<10	1.4×10^3	2×10^2	73
Canned chicken luncheon	25	16	64%	<10	1.3×10^2	3×10^2	68
Canned luncheon	25	20	80%	<10	3.3×10^4	6×10^3	1.5×10^3
Canned sausage	25	18	72%	<10	6×10^3	6.1×10^2	2×10^2

SE: standard error of mean

Table 2 Sta*phylococcus aureus* count in canned meat samples

Products	No of samples	Positive samples		Min	Max	Mean	±SE
		No	%				
Canned beef	25	2	20%	$<10^2$	2×10^3	10^2	80
Corned beef	25	6	24%	$<10^2$	3×10^3	2×10^2	10^2
Canned chicken sausage	25	4	16%	$<10^2$	10^2	16	8
Canned chicken luncheon	25	3	12%	$<10^2$	3×10^2	24	14
Canned luncheon	25	6	24%	$<10^2$	2×10^3	3×10^2	10^2
Canned sausage	25	6	24%	$<10^2$	2×10^2	28	9

SE: standard error of mean

Table 3 Enterococcus count in canned meat samples

Products	No of samples	Positive samples		Min	Max	Mean	±SE
		No	%				
Canned beef	25	3	12%	$<10^2$	2×10^2	16	10
Corned beef	25	7	28%	$<10^2$	10^2	76	41
Canned chicken sausage	25	1	4%	$<10^2$	10^2	4	4
Canned chicken luncheon	25	0	0	$<10^2$	$<10^2$	0	0
Canned luncheon	25	3	12%	$<10^2$	2×10^3	2×10^2	10^2
Canned sausage	25	0	0	$<10^2$	$<10^2$	0	0

SE: standard error of mean

Table 4 Total Clostridia count in the examined canned meat samples

Products	No of samples	Positive samples		Min	Max	Mean	±SE
		No	%				
Canned beef	25	7	28%	<10	3×10^5	3×10^3	2×10^2
Corned beef	25	15	60%	<10	8×10^3	6×10^2	2×10^2
Canned chicken sausage	25	7	28%	<10	3×10^2	48	16
Canned chicken luncheon	25	13	52%	$<10^2$	5×10^2	10^2	29
Canned luncheon	25	13	52%	$<10^2$	1.1×10^4	10^3	3×10^2
Canned sausage	25	15	60%	$<10^2$	5×10^2	1.2×10^2	27

SE: standard error of mean

The variable anaerobic counts of different canned meat and poultry products in the current study may be due to the differences in canning practices (time and temperature of processing), handling from producers to consumers and different storage conditions (Zaharan *et al.*, 2008). Moreover, the low number of anaerobic bacteria indicates the processing of this products was correct and/or addition of some preservatives, especially nitrites, which have an important role in reducing the growth of anaerobic bacteria and their inhibition. This agrees with Mohammed (2013), Nader *et al*. (2016), and Abdul aali and Alobaidi (2018). On the other hand, high numbers of anaerobes recorded in some samples may be attributed to the bad quality of raw meat, as well as, heavily contaminated additives and spices which may considered the main source of microbial contamination. Furthermore, inadequate heat treatment during processing is the main cause of the high anaerobic count in addition to storage of the end product at high temperature (FAO, 1992).

Low results were reported by Nasser (2014), Saleh et al. (2015) and Abdul aali and Al obaidi (2018). However, Chekol and Ashenafi (2009) failed to detect *S. aureus* in canned meat. On the other hand, high results of *S. aureus* count in canned beef were reported by Ali et al. (2008) and Saleh et al. (2015).

Twenty percent, 24%, 16, 12%, 24 and 24% of canned beef, corned beef, canned chicken sausage, canned chicken luncheon, canned luncheon and canned sausage, respectively exceeded the permissible limits (free from *S. aureus*) of EOS (2005), and the limit (20 CUF/g) recommended by Centre of Food Safety (2014) in relation to *S. aureus* count.

The variation in the obtained results may attributed to the differences in manufacture practices, handling from producers to consumers and the effectiveness of hygiene

applied during production (Ahmed, 1991). Furthermore, high *S. aureus* count recorded in some samples may be due to under-processing of canned meat (inadequate temperature and/or time), infected handlers, and heavily contaminated raw ingredients.

High result of Enterococcus count in canned beef was reported by Ali *et al.* (2008), while Pinter *et al*. (2009) failed to detect *Enterococcus* in canned meat.

According to microbiological Guidelines for Food recommended by Centre for Food Safety (2014) Codex Alimentarius Commission (1985) 28, 12, 4, 12% of obtained corned beef, canned beef, canned chicken sausage, canned luncheon samples, respectively were above the permissible limit.

The presence of Enterococci in the examined samples is due that they are very tolerant to high temperature and salinity. Enterococci are one of the most thermo-tolerant non-spore forming bacteria, therefore, they may survive the canning process (Pillar and Glimore, 2002). Moreover, high counts of Enterococci in the examined samples reflects poor sanitary practices during manufacture, handling, storage and distribution (Girafa, 2002)

Low results were reported by Al- obaidi (2005) and AL-Hisnawi *et al.* (2010) in corned beef; by Khafagy *et al*. (2008) in canned luncheon andby Mohammed (2013) in canned beef, While Hamasalim (2012) failed to detect *clostridia*in canned chicken. Moreover, Atwa and Abou El-Roos (2011) reported similar results, while Khafagy *et al*. (2008) reported high result in canned beef, corned beef and canned sausage.

The low numbers of Clostridia in the examined samples may be due to the proper preparation of this meat and efficient canning, and possibly the addition of some preservatives especially nitrites, which have an important role in reducing the growth of genus *Clostridia* (Hamasalim, 2012; Mohammed, 2013)

Clostridium perfringens failed to be isolated from any canned meat samples. Similar results were reported by Al-obaidi, (2005), Iskander (2005), Hamasalim(2012), and Mohammed (2013). On the other hand, Atwa and Abou El-Roos (2011) isolated *Clostridium perfringens* from canned beef.

According to EOS (2005) canned meat must be free from *Clostridium perfringens*. This agreed with the obtained result of all examined samples. The failure of detection of *Clostridium perfringens* may be due to the high processing temperature, added sodium chloride, sodium nitrite level, and other additives, which have an important role in reducing the growth of *Clostridia*(Al-obaidi,2005; Hamasalim, 2012; Mohammed, 2013).

5. CONCULOSION

It could be concluded that some of the examined samples were exceeding the local and international permissible limits for the examined bacteria which may reflects under processing or poor storage conditions. Therefore, bacteriological monitoring of canned meat products is very important to assess their quality and to detect deviation from permissible limits.

ACKNOWLEDGMENT

This study was financially supported from Faculty of Veterinary Medicine, Beni-Suef University, Beni-Suef, Egypt**.**

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