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"Assessment and Evaluation of the Microbiological Safety Criteria in Some Food Products"

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Abstract

Food safety is a basic human right because it is important for life. Microbial contamination of food causes disease transmission and endangers the lives of millions of people. Therefore, evaluating and detection of the presence of pathogenic bacteria in food reduces these risks, as it clarifies the microbial safety practices that were applied to these products during the manufacturing stages and their conformity with the Egyptian standard specifications.

A total of 250 random samples of different meat products of burger, kofta, sausage, luncheon, and chicken luncheon samples (50 samples each) were randomly collected from different supermarkets in Giza Governorate, Egypt. Microbiological examination was carried out to detect some microorganisms that cause food poisoning and to assess the microbiological quality of these products according to the Egyptian standard specifications for each product using traditional examination methods.

The proportion of unacceptable aerobic bacteria in the samples of burger, sausage, luncheon, chicken luncheon and kofta was (62%), (64%), (60%) (66%) (66%), respectively. The obtained

results also indicated that the mean values of the total number of intestinal bacteria (cfu/g) were $2.2 \times 10^3 \pm 3.6 \times 10^2$, $2.1 \times 10^3 \pm 3.2 \times 10^2$, $1.9 \times 10^3 \pm 3.4 \times 10^2$, $2.1 \times 10^3 \pm 3.7 \times 10^2$, $2.2 \times 10^3 \pm 2.9 \times 10^2$ (cfu/g) for beef burger, sausage, luncheon, chicken luncheon and kofta respectively while the results showed that Salmonella was identified in (28%), (24%), (20%), (56%), (40%) beefburger, sausage, luncheon, chicken luncheon and kofta respectively. It also indicated that (50%), (62%), (62%), (58%) and (36%) samples of burger, sausage, luncheon, chicken luncheon and kofta, respectively, Unacceptable for Staphylococcus aureus. and found the highest percentage of Staphylococcus aureus in both kofta and sausage, while the incidence was lower in luncheon.

All data indicate a high rate of contamination in the samples studied and a lack of microbiological safety regulations for products, both of which endanger consumers and lead to economic loss.

Keywords: Aerobic bacteria count, Coliforms, E. coli, Staph aureus, Salmonella, meat products, food safety,and foodborne diseases.

Introduction

Food safety is a fundamental human right because it is vital for life. Unsafe food endangers billions of people. Millions of people fall ill every year and many of them die. Issues with personal, environmental, microbial and chemical hygiene can be found all along the food supply chain, which runs from the field to the fork or plate. In the past eating contaminated food has been linked to documented human tragedies and financial catastrophes due to intentional or inadvertent individual conduct and state failure to preserve food quality and safety. Concerns about food safety persist

in the twenty-first century. Local outbreaks may spread quickly and widely, leading to issues on a worldwide scale ***(Fung et al., 2018).***

One in ten people are affected by foodborne diseases annually ***(WHO, 2022.).*** While early epidemics were mostly caused by chemical contamination, more recent instances have been caused by microbiological pathogens. ***(Fung et al., 2018)*** 2011 saw the Enteropathogenic Escherichia coli (EHE.coli) outbreak in Germany connected to tainted fenugreek sprouts, where cases were documented in 8 European nations. And North America, causing53 fatalities. German farmers and companies paid US$1.3 billion in losses due to the 2011 E. coli outbreak there in losses, while receiving $236 million in emergency assistance from 22 member countries of the European Union payments ***(Yeni et al., 2016).***

Economically speaking, access to appropriate supplies of wholesome food is essential for supporting life, fostering health, and spurring economic progress ***(Scharff, 2012).*** Magnitude of the public health burden due to foodborne diseases is comparable to that of malaria or HIV AIDS ***(WHO, 2022).***

The "Safer Food, Better Health***"(WHO,2022)*** campaign launched by the World Health Organization on World Food Safety Day, aims to increase awareness of the need to reform food systems to deliver better health in a sustainable way to prevent most foodborne illnesses. If they're unsafe, they're not food ***WHO. (2022).*** Food safety is a prerequisite for food security. This slogan must always be in front of the eyes of governments, regulatory bodies, and those interested in the food industry, as well as consumers, in order to reach safe food. especially since food is biological food in nature. It has the ability to promote the growth of microorganisms that can be the cause of foodborne illnesses ***(Fung et al., 2018).***

One of the key sources of protein, vitamins, and minerals found in animals is meat. Meat can be contaminated during production, distribution, and storage, and it can help spread many foodborne illnesses over the world ***(Morshdy et al., 2018).***

Meat and meat products may become contaminated with pathogens because of poor hygiene standards in meat processing operations, posing a major risk to human health. Furthermore, it might be challenging to completely eradicate pathogens from food processing facilities because germs can adhere to meat contact surfaces, where they can persist even after cleaning and disinfection ***(Yang et al., 2012a).***

At the time of slaughter, dressing or evisceration, and further processing, recognized health measures determine whether meat has spoiled due to bacteria. Meat contamination products could result from using contaminated raw materials or collection containers, occurring during processing, or both. ***(Estrada -Garcia et al., 2004)***

Materials and Methods

Collection of samples:

250 hundred samples of different meat products of beef burger, kofta, sausage, luncheon and chicken luncheon (50 of each) were collected randomly from different supermarkets in Giza governorate, Egypt. To be examined microbiologically for detection of some food poisoning microorganisms. Each sample was kept in a separate sterile plastic bag and preserved in an ice box, then transferred to the laboratory under possible aseptic conditions without undue delay and examined as quickly as possible. Pathogens will be detected in these samples, according to the Egyptian Organization for Standardization ***(EOS, 2005)***

Preparation of samples *(FDA, 2012)*

To 25 g of sample, 225 mL of sterile peptone water was added to a sterile mixer and mixed well for 2.5 min, in which serial dilutions were prepared. The prepared samples were subjected to the **following bacteriological examinations:**

1. Determination of (APC)Aerobic plate count ***(ICMSF, 1996).***
2. Determination of total Enterobacteriaceae count***(ISO,2004).***using Violet Red Bile Glucose agar
3. Determination of total coliform count ***(ICMSF, 1996).*** Using Violet Red Bile agar media
4. Isolation and identification of E. coli***.(ICMSF,1996).***
5. Isolation and Identification of Salmonellae ***(ISO, 2002).***
6. Isolation and identification of Staph. Aureus***.(ISO,1999).*** Technique using Baird-Parker agar medium
7. Isolation and identification of Listeria ***(ISO,1996)***
8. Isolation and identification of Shigella ***(FDA, 2013)***
9. Isolation and identification of Clostridium perfringens***(FDA, 2001.)***

Results and Discussion

Inadequate sanitary procedures in meat processing facilities may lead to the pathogen contamination of meat and meat products, posing a major risk to human health. Furthermore, it can be difficult to completely eradicate pathogens from food processing facilities because germs can adhere to surfaces that come into contact with meat, where they can persist even after cleaning and disinfection ***(Yang et al., 2012).***

The most accurate indicator of meat quality, hygienic processing, and storage life of meat products are aerobic plate count (APC) ***(Buchananet al., 2018).*** It is evident from the result recorded in table (1) that the mean values of APC (cfu/g) were $1.8x10^6 \pm 3.4x10^5$, $2.0x10^7 \pm 3.8x10^6$, $1.9x10^5 \pm 3.5x10^4$, $2.3\ x10^5 \pm 4.0x10^4$

,$1.6x10^7$ $\pm 3.2x10^6$ for the examined samples of beef burger, sausage, luncheon, chicken luncheon and Kofta respectively. According to the security limit set out in EOS (2005). APC is in kofta and sausage (no more than 10^6), burger (no more than 10^5), luncheon products and chicken luncheon (no more than 10^4).It was found that the percentage of unacceptablesamples for aerobic bacteria is(62%),(64%),(60%),(66%),(66%) of the total samples examined for meat burgers, sausages, luncheon meats, and chicken Luncheon and kofta respectively. The highest level of APC was found in the chicken Luncheon and kofta, while the infection rate was lower in the Luncheon. This high bacterial count may be related to the different substances and procedures used in their formulation and preparation, as well as the cleanliness of the workers' hands and the raw materials used.***Mousa et al. (2014)*** were obtained lower results in the beef burger, luncheon, andsausages**. *(Shaltout et al. 2016)*** declared that the mean counts in luncheon, kofta, and sausage were 4.2 ± 0.1, 5.8 ± 0.1, and 6.1 ± 0.1 log CFU/g in Egypt, respectively.***Abuzaid et al. (2020)***calculated the mean of total bacterial counts of 80 types of meat products in Egypt and the counts were $11 \times 10^6 \pm 5.4 \times 10^6$, and $2.04 \times 10^6 \pm 0.12 \times 10^6$cfu/g for sausages and Kofta.***Abuelnagaet al. (2021)*** were obtained lower results in the beef burger, kofta, and sausage.

The obtained results in Table (2) revealed that the mean values of total Enterobacteriaceae count (cfu/g) were $2.2x10^3 \pm 3.6x10^2$,$2.1x10^3 \pm 3.2x10^2$,$1.9x10^3 \pm 3.4x10^2$,$2.1x10^3 \pm 3.7x10^2$, $2.2x10^2 \pm 2.9x10^2$ CFU /g for beef burger, sausage, luncheon, chicken luncheon and Kofta, respectively. Because some members of the enteric group are pathogens and can lead to serious infections and food poisoning, they areimportant in terms of epidemiology. In addition, the total amount of intestinal bacteria is seen as a sign of possible intestinal contamination in the absence of coliforms ***Mercury et al. (2018).***

Also it is clear from the results recorded in Table No. (2) that (62%), (66%), (70%), (70%), (60%) of the samples examined beef burgers, sausages, luncheon meats, Chicken luncheon and kofta, respectively were positive samples because they exceed the permissible limits according to the standard specifications. results showed Enterobacteriaceaeare present in significant amounts in products, which implies contamination, most likely from personnel, unclean equipment, surfaces, or raw food before processing. It is possible to use Total Enterobacteriacae to keep track of how hygienic meat products are handled, prepared, and stored. The results illustrated in table (2) revealed that Enterobacteriaceae Count that nearly similar to results with ***Abuelnaga et al. (2021*)** in luncheon, but higher in the beef burger, kofta and sausage. Also ***(Mousa et al. 2014)*** obtained lower results in the beef burger, sausages and luncheon.

The results obtained in Table No. (3) showed that the percentage of unacceptable samples representing positive samples for Staphylococcus aureus is (50%), (62%), (62%), (58%), (36%) of the examined samples of burger, sausages, luncheon kofta and chicken luncheon respectively. the highest level of Staphylococcus aureuswas found in both Kofta and sausages, while the incidence was lower in luncheon. These results came higher than that obtained by ***Shaltout et al. (2016*)** and ***Abuelnaga et al. (2021)*** in burger, sausages, luncheon, and kofta ***Podpečan et al. (2007)*** indicated that Meat contamination must be kept to a minimum throughout the production process. Contamination of muscle tissue during slaughter may occur by direct or indirect contact, for example, , with feces, skin, contaminated tools and equipment, personnel, and clothing. Staphylococcus can be carried on hands, nasal passages, or throats, and the main public health risk is the creation of heat stable toxin in food; So, Staphylococcus food poisoning should be avoided through hygienic food handling, appropriate cooking, and refrigeration.

The recorded results in Table (4) revealed that Salmonella was detected in 28 % ,24%,20 %,56%,40% beef burger, Sausage, Luncheon, chicken luncheon and Kofta respectively. Among the samples examined, the highest level of Salmonella was found in chicken luncheon samples while the infection rate was lowest in Luncheon. Salmonella contamination is a sign of improper slaughter procedures and a lack of hygienic and sanitary practices. The results illustrated in table (4) revealed that nearly similar to results with Abuelnaga et al. (2021) in Sausage, luncheon but higher in burger, Kofta. Also, it was higher with***(Shaltoutet al.2016).***

In Sausage and Kofta.The recorded results in Table(5) revealed that shigella was detected in 8 %, 14%, 18%, 12% beef burger, Sausage, Luncheon and Kofta respectively.While table (6) showed that the percentage of unacceptable samples representing positive samples for mold 14 % ,18% ,22%, of the examined samples of sausages, chicken luncheon and burger. The prevalence of mold in examined samples of Sausage obtained lower results with***Abuzaid et al. (2020)*** Results given in Table(7) that the mean values of anaerobic bacteria (cfu/g) were $1.2x10^2 \pm 6.1x10^1$, $2.8x10^2 \pm 1.1x10^2$,$2.8x10^2 \pm 1.6x10^2$of the examined samples of beef burger, Sausage and Kofta respectively and showed Acceptability of the examined samples of beef burger, Sausage, Luncheon, chicken luncheon and Kofta based on their anaerobic bacteria counts/g was 6%,16%,14%,10%,10% respectively were unaccepted.

The results achieved in Table (8) showed that the the prevalence ofListeria monocytogenesin examined samples ofchicken Luncheonwere6% of examined samples and negative results were recorded in chicken Luncheonthey free from Clostridium perfringensisolates according to EOS(2005)

The results in Tables (9)reported that E.coli was isolated from 14% of Luncheon, 18%of chicken luncheon,The presence of E. coli in contaminated food products is commonly attributed to fecal contamination when they are improperly handled and/or when inactivation treatments fail. The adaptation of E. coli at low pH and low levels can vary at different temperatures depending on the serotype***(Valero et al., 2010).***These results came lower than that obtained by***Magdyet al., (2010)*** were(37%) in Luncheon.

Conclusion

In light of the results of this study, it made it possible to conclude that all the examined samples were contaminated with different bacteria such as E. coli, Salmonella and Staph. Aureus and the higher APC obtained indicate that the health of individuals and the general public is at serious risk due to the poor personal hygiene habits of food handlers and handlers. Many foodborne illnesses can be prevented through simple measures such as good hand washing, access to proper washing facilities, wearing hand gloves, and applying the HACCP system throughout the food chain from farm to fork to reach the motto “Safer Food…Better Health". Toprotect public and individual health, government authorities must enforce food safety legislation.

Table (1): Analytical and Acceptability results of Aerobic plate counts/g (APC) in the examined samples of beef burger, sausage, luncheon, chicken luncheon and Kofta (n=50).

Meat products	postive samples		Min	Max	Mean ±SE**
	NO	%*			
beef burger	31	62	$3.5x10^2$	$7.6x10^6$	$1.8x10^6 \pm 3.4x10^5$
sausage	32	64	$4.3x\ 10^2$	$8.4x10^7$	$2.0x10^7 \pm 3.8x10^6$
luncheon	30	60	$2.6x\ 10^2$	$9.2X10^5$	$1.9x10^5 \pm 3.5x10^4$
chicken luncheon	33	66	$3.4x\ 10^2$	$9.5x10^5$	$2.3x10^5 \pm 4.0x10^4$
Kofta	33	66	$4.8x\ 10^2$	$9.5x10^7$	$1.6x10^7 \pm 3.2x10^6$

*The percentages were calculated according to the total number of examined samples.S.E** = Standard error of mean. Mean values with different superscripts in the same column were significantly differed ($p < 0.05$). According to the Egyptian Standard EOS (2005) for each product the permissible limits of APC for, Kofta and sausage (10^6), burger (10^5), luncheon,chicken luncheon (10^4)

Table (2): Analyticaland Acceptability results of Enterobacteriaceae counts/g in the examined samples of beef burger, sausage, luncheon,chicken luncheon and Kofta(n=50)

Meat products	positive samples		Min	Max	Mean ±SE**
	NO	%*			
beef burger	31	62	$3.5x10^2$	$9.5x10^3$	$2.2x10^3 \pm 3.6x10^2$
sausage	33	66	$9.3x\ 10^2$	$7.1x10^3$	$2.1x10^3 \pm 3.2x10^2$
luncheon	35	70	$9.5x10^2$	$8.4x10^3$	$1.9x10^3 \pm 3.4x10^2$
Chicken luncheon	35	70	$8.6x\ 10^2$	$9.2x10^3$	$2.1x10^3 \pm 3.7x10^2$
Kofta	30	60	$8.2x\ 10^2$	$6.1x10^3$	$2.2x10^3 \pm 2.9x10^2$

*The percentages were calculated according to the total number of examined samples.S.E** = Standard error of mean. Mean values with different superscripts in the same column were significantly differed ($p < 0.05$). According to the Egyptian Standard EOS (2005) for each product the permissible limits of Enterobacteriaceae for sausages, burgers, luncheon andchicken luncheon (10^2)

Table(3): Analyticaland Acceptability results of Staphylococcus counts/g in the examined samples of beef burger, sausage, luncheon,chicken luncheon and Kofta(n=50)

Meat products	positive samples		Min	Max	Mean ±SE**
	NO	%*			
beef burger	25	50	$3.5x10^2$	$9.8x10^3$	$6.2x10^2 \pm 2.3x10^2$
sausage	31	62	$4.3x\ 10^2$	$9.7x10^3$	$1.8x10^3 \pm 3.8x10^2$
Kofta	31	62	$3.5x\ 10^2$	$8.9x10^3$	$2.0x10^3 \pm 3.9x10^2$
Luncheon	18	36			
chicken luncheon	29	58			

*According to the Egyptian Standard EOS (2005) for each product the permissible limits of Staphylococcusfor sausages, burgers, (10^2) and luncheon, chicken luncheon (free)

* The percentages were calculated according to the total number of examined samples. S.E** = Standard error of mean. Mean values with different superscripts in the same column were significantly differed ($p < 0.05$)

Table(4): Incidence of Salmonellae isolated from theexamined samples of beef burger, sausage, luncheon,chicken luncheon and Kofta (n=50).

Meat products	Salmonella /g	Accepted samples		Unaccepted samples	
		NO.	%	NO.	%
beef burger	free	36	72	14	28
Sausage		38	76	12	24
Luncheon		40	80	10	20
chicken luncheon		30	44	20	56
Kofta		34	60	16	40

The percentages were calculated according to the total number of examined samples.

Table (5): Incidence of shigella isolated from the examined samples of beef burger, sausage, luncheon and Kofta

Meat products	Shigella/g	Accepted samples		Unaccepted samples	
		NO.	%	NO.	%
beef burger	free	46	92	4	8
Sausage		43	86	7	14
Luncheon		41	82	9	18
Kofta		44	88	6	12

The percentages were calculated according to the total number of examined sample

Table(6): Incidence of mold isolated from the examined samples of sausage, chicken luncheon,beef burger

Meat products	mold /g	Accepted samples		Unaccepted samples	
		NO.	%	NO.	%
Sausage	free	43	86	7	14
chicken luncheon		41	82	9	18
beef burger		39	78	11	22

The percentages were calculated according to the total number of examined samples

Table (7): Analytical and Acceptability results of anaerobic bacteria counts/g in the examined samples of beef burger, sausage, KoftaLuncheon,,(n=50).

Meat products	positive samples		Min	Max	Mean ±SE**
	NO	%*			
beef burger	3	6	2.6x10	$3.1x10^3$	$1.2x10^2 \pm 6.1x10^1$
sausage	8	16	2.1x 10	$4.8x10^3$	$2.8x10^2 \pm 1.1x10^2$
Kofta	5	10	3.2x 10	$7.8x10^3$	$2.8x10^2 \pm 1.6x10^2$
Luncheon	7	14			
chicken luncheon	5	10			

According to the Egyptian Standard EOS (2005) for each product the permissible limits of anaerobic bacteria for sausages, burgers, kofta, (10^2) luncheon and chicken luncheon(free).* The percentages were calculated according to the total number of examined samples.S.E** = Standard error of mean. Mean values with different superscripts in the same column were significantly differed ($p < 0.05$)

Table (8): Incidence of Clostridium perfringens and Listeria monocytogenes isolated from the examined samples of chicken luncheon (n=50).

microorganism	Meat products	limit	Accepted samples		Unaccepted samples	
	chicken luncheon	Free	NO.	% *	NO	% *
Listeria monocytogenes			47	100	3	6
Clostridium perfringens			50	100	0	0

* The percentages were calculated according to the total number of examined samples

Table (9): Incidence of E.coli isolated from the examined samples of Luncheon and chicken luncheon (n=50).

Meat products	E.coli/g	Accepted samples		Unaccepted samples	
		NO.	%	NO.	%
Luncheon	free	43	86	7	14
chicken luncheon		41	82	9	18

The percentages were calculated according to the total number of examined sample

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تتبع وتقييم معايير السلامة الميكروبيولوجية في بعض منتجات الأغذية

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الملخص العربى

سلامة الغذاء حق أساسي من حقوق الإنسان لأنها مهمة للحياة. يتسبب التلوث الميكروبي للأغذية في انتقال الأمراض ويعرض حياة الملايين من الناس للخطر. لذلك فإن تقييم واكتشاف وجود البكتيريا الممرضة في الغذاء يقلل من هذه المخاطر ، حيث يوضح ممارسات السلامة الميكروبية التي تم تطبيقها على هذه المنتجات خلال مراحل التصنيع ومطابقتها للمواصفات القياسية المصرية . تم جمع إجمالي 250 عينة عشوائية من منتجات اللحوم المختلفة من عينات برجر وكفتة وسجق ولانشون ولانشون دجاج (50 عينة لكل منها) بشكل عشوائي من محلات السوبر ماركت المختلفة في محافظة الجيزة ، مصر. تم إجراء الفحص الميكروبيولوجي للكشف عن بعض الكائنات الحية الدقيقة المسببة للتسمم الغذائي وتقييم الجودة الميكروبيولوجية لهذه المنتجات حسب المواصفات القياسية المصرية لكل منتج باستخدام طرق الفحص التقليدية . بلغت نسبة البكتيريا الهوائية غير المقبولة في عينات البرجر والسجق واللانشون ولانشون الدجاج والكفتة (62٪) ، (64٪) ، (60٪) (66٪) (66٪) على التوالي. كما أشارت النتائج المتحصل عليها إلى أن القيم المتوسطة للعدد الإجمالي للبكتيريا المعوية كانت
$2.2 \times 10^3 \pm 3.6 \times 10^2$, $2.1 \times 10^3 \pm 3.2 \times 10^2$, $1.9 \times 10^3 \pm 3.4 \times 10^2$, $2.1 \times 10^3 \pm 3.7 \times 10^2$, $2.2 \times 10^3 \pm 2.9 \times 10^2$ (cfu/g)
للبرجر،السجق ،لانشون ،لانشون الدجاج والكفتة على التوالي ، بينما أظهرت النتائج أن السالمونيلا تم التعرف عليها في (28٪) ، (24٪) ، (20) ٪) ، (56٪) ، (40٪) برجر ، سجق ، لانشون ، لانشون دجاج وكفتة على التوالي من العينات التتم فحصها كما أشارت إلى أن (50٪) و (62٪) و (62٪) و (58٪) و (36٪) من عينات البرجر ،السجق ،لانشون ،لانشون الدجاج والكفتة على التوالي غير مقبولة للمكورات العنقودية الذهبية . ووجدت أعلى نسبة من المكورات العنقودية الذهبية فى كلا من الكفتة والسجق بينما كانت نسبة الإصابة أقل فى لانشون اللحم .تشيرجميع البيانات إلى ارتفاع معدل التلوث في العينات التي تمت دراستها وعدم وجود لوائح السلامة الميكروبيولوجية للمنتجات،وهومايعرض المستهلكين للخطرويؤدي إلى خسارة اقتصادية.

الكلمات المفتاحية: عدد البكتيريا الهوائية ، القولونيات ، الإشريكية القولونية ، العنقوديات الذهبية ، السالمونيلا ، منتجات اللحوم ، سلامة الغذاء ، الأمراض المنقولة بالغذاء