Annals of Agricultural Science, Moshtohor (ASSJM)

https://assjm.journals.ekb.eg/

www.fagr.bu.edu.eg

 ISSN:1110-0419

Original Article Vol. 61(2) (2023), 507 – 512 DOI:10.21608/ASSJM.2023.317238

Evaluation of Microbiological Quality of some Meat Products Sold in Cairo-Egypt.

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Abstract

Ninety meat samples were chosen at random from food stores with high ratings in the Great-Cairo Governorate (30 samples of each of Burger, Kofta, and minced meat). The presence of pathogenic bacteria like *Staphylococcus aureus*,*Listeria monocytogenes*, *Salmonella typhimurium*, and *Bacillus cereus* was examined bacteriologically in the samples.

However, *Salmonella typhimurium* and *Listeria monocytogenes* were found in 22 and 19% of the examined samples, respectively. *Staphylococcus aureus* was found in 10% of the examined samples with average counts of 7cfu/g, and *Bacillus cereus* was found in 11% of the examined all samples with an average counts of 3cfu/g.

One hundred sixty-eight pathogenic bacterial isolates, including 27 *Staphylococcusaureus* isolates there were 51, 30, and 60 isolates of *Listeriamonocytogenes*, *Bacillus cereus*, and *Salmonella typhimurium*, respectively. With the aid of Hi identification kits and latex test kits, only 114 of the 168 testes isolates were identified as pathogenic species. The results indicated that these foods might be an infection source for consumers. When preparing and serving food, safety measures ought to be taken to control the quality of the raw materials and the environmental and hygienic conditions.

Keywords: Super-markets; Egyptian, Burger; Kofta ; minced meat ;microbiological analysis and pathogens.

Introduction

One of the most important sources of protein for people living in developed nations is meat and meat products. Millions of people around the world consume beef burgers, which are virtually the most popular meat dish. The typical methods (such as grinding, cooking, and adding salt) used to make hamburgers increase the formation of reactive, making the finished product extremely susceptible to oxidation. (Ladikos &Lougovois 1990; Ghazya*et al*, 2021).

The public's awareness of food, particularly meat and meat products, which are one of the most significant sources of human infections with a variety of foodborne pathogens (Norrung *et al*., 2009; Fouad *et al*., 2015), has significantly increased as a result of the increasing number and severity of food poisoning outbreaks around the world (Forsythe, 2008).Nevertheless, meat and meat products continue to be a significant food group in the diets of many consumers (Rosergant *et al*., 1999; Delgado, 2003; Speedy, 2003), and foodborne illness from them is regarded as one of the most serious in the world (Balaban & Rasooly 2000; Argudn *et al*., 2010). Particularly products made from raw and minced meat and not subjected to heat treatment are thought to be significant sources of pathogenic spp. that have caused severe gastroenteritis in humans, such as luncheon, burgers, and minced meat (Karmi, 2013).

98% of the test minced meat, 60% of the sausage, 48% of the rice grains, 44% of the Koshari or ice cream and 36% of the pasteurised milk samples all contained *B. cereus* (Saleh *et al.*,1993). According to Shehu and Adesiyun's 1990 report, 39.5% of milk contained *E. coli*. Food-borne illnesses caused by enterotoxigenic *Escherichia coli* have been documented and recovered from a variety of processed and unprocessed food sources (Firstenberg & Sullivan 1997). The safety of microorganisms in food is becoming a global concern for public health. Approximately 76 million foodborne illnesses are thought to occur in the United States each year (Meng & Doyle, 1998; El-Shenawy *et al.*, 2016a).Numerous human diseases are caused by microorganisms found in both fast food and traditional fast food. *Listeria* spp. is frequently found in chilled and frozen foods, whereas Salmonella is frequently found in chicken and undercooked eggs (Angelillo *et al.*, 2000; Abosereh

et al., 2016). The incidence of *Camphylobacter* spp, *Staphylococcus* spp, *E. coli*, and *Yersinia* spp. as well as other foodborne microorganisms has been documented by Kaneko *et al.* (1999), Pelczar *et al*. (2006), and El-Kholy *et al*. (2016). In order to assess the general bacteriological state of some meat products sold in the Egyptian market, this work has been done. In order to provide a general understanding of the health and safety condition of this food product, with a focus on the likelihood of the presence of some pathogenic microbes, including *Staphylococcusaureus* counts, Sal*monella typhimurium, L. monocytogenes*, and *Bacillus cereus.*

Materials and Methods

Meat products samples:

Ninety samples of meat productswere randomly collected in Great-Cairo Governorate. All samples were collected aseptically, placed in sterile containers, stored at 4ºC and transferred to the laboratory. All samples were examined at the same day.

Samples preparation:

Twenty-five gm. of each sample was mixed, homogenized in sterile mixer and diluted with 225 ml buffered peptone water .Ten-fold dilutions of homogenates were prepared and subjected to all the microbiological analysis **(El-Shenawy*et al*., 2022).**

Microbiological Analysis:-

Ten-fold dilutions of the homogenates samples were inoculated onto plates of selective media.The aerobic colony count (ACC) was carried out according to the method described by **Hussien *et al*., 2022**using plate count agar (M091, Himedia, Mumbai). Plates were incubated at 30± 1Cº for 72± 2h.**Coliform group** was determined after the method reported by **Fouad *et al*., 2022a**using violet red bile agar (VRBA) (M049, Himedia, Mumbai). Plates were incubated 24h at 30- 37ºC.For detection of *Salmonella typhimurium*, (25g) of each sample was mixed with 225ml of sterile buffer peptone water and incubated at 35 ºC for 24 hrs. One to ten ml of this mixture was transferred to selenite cystein broth and incubated at 35 ºC for 72 hrs. Plates of *Salmonella*&*Shigella* ager were streaked from the last process and incubated at 35 ºC for 24 hrs. Growth of *Salmonella typhimurium* is appears as colorless colonies with black centers **(Shazly*et al*., 2022).***L. monocytogenes*** was detected by mixing 25 ml of the sample with 225ml *Listeria* selective enrichment supplement (M890A, Himedia, Mumbai) **(El-Shenawy*et al*., 2016b)**. Samples were incubated at 30º C for 7 day. A plate of oxford agar base (M1145, Himedia, Mumbai) supplemented with Listeria supplement was daily streaked from each sample and incubated at 35º C for 48h. Suspected colonies were picked up and propagated for further specific morphological, biochemical tests.

Enumeration of *S. aureus* in samples was carried out by spreading 0.l ml of each dilution onto the surface of Baird Parker media supplemented with egg yolk and potassium tellurite solution. Plates were incubated at 37 ºC for 48 hrs, typical colonies, which appear gray-black, shiny and convex with a narrow white margin surrounded by a clearing zone, were counted **(Doha*et al*., 2017; Hussein*et al*., 2020).** Suspected colonies were picked up and propagated for further specific morphological and biochemical tests. *Bacillus cereus* was determined by the surface plating technique using the *Bacillus cereus* agar medium, supplemented with polymyxin B and egg yolk. Plates were incubated at 37 ºC for 48 hrs, a typical colony, which appears peacock blue-coloured and surrounded by precipitation zone were counted and tested for further specific identification **(Fouad *et al*., 2022b).**

Purification and Identification of the isolated

Three to five suspected isolates of each organism, isolated from each positive sample, were subjected for identification using the microscopic examination as well as their chemical and biochemical confirmation tests according to Bergy's Manual **(Neath*et al*., 2009).** Additional kits used to help for accurate identification including Hi Staphylococcus identification kit, Hi Staphylococcus Latex test kit, Hi*Listeria* identification kit, Hi*Listeria* latex test kit, Hi *Salmonella* identification kit and Hi *Salmonella* Latex test kit. All results of identification tests done for these isolates were compared with a specific reference strains obtained from ATCC.

Results and Discussion

Ninety samples of products meat including thirty samples each of burger, kofta, and minced meatweremicrobiologically investigated.

Data in Table (1) show that the average of total bacterial count ranged from $18x10^2$to $34x10^2$ according to the type of meat product. Burgercontained the highest records of total bacterial count while, Koftacontained the lowest ones.In addition, data in Table (1) reveal that the incidence percentage of abovementioned parameter was 100% for various meat product sandwiches. According to El-Sherbeeny *et al*. (1985), 68% of the samples had aerobic colony counts (30°C) that were higher than 106cfu/g. These results agree with their study results.

Table 1. Microbiological quality of some meat products.

Type/No. of sample		Burger (30)	Kofta (30)	minced meat (30)
Total bacterial count	Positive samples	30(100%)	30(100%)	30(100%)
	Average cfu/g	$34x10^2$	$18x10^2$	$24x10^2$
Coliform group	Positive samples	17(57%)	16(53%)	9(30%)
	Average cfu/g	$14x10^2$	$11x10^2$	$9x10^2$
Staphylococcus aureus	Positive samples	3(10%)	4(13%)	2(7%)
	Average cfu/g	7	10	7
Salmonella typhimurium	Positive samples	9(30%)	6(20%)	5(17%)
Listeria monocytogenes	Positive samples	5(17%)	6(20%)	6((20%)
Bacillus cereus	Positive samples	5(17%)	7(23%)	6(20%)
	Average cfu/g	3	4	3

According to a **Bryan *et al*., 1997; Kubheka *et al*., 2001** report, these foods were left at room temperature, which might have encouraged the growth of contaminating bacteria, increasing bacterial counts.

Respecting the coliform group counts, reveal that the average of coliform group ranged from $9x10^2$ to $14x10^2$according to the type of meat product. Burger had the highest concentrations of coliform, whereas minced meat had the lowest. Depending on the type of meat product, the contamination rate varied from 9% to 17%. These findings are consistent with those of (Bezerra *et al*., 2010), who noted that 31.4% of samples of hamburgers were deemed unfit for human consumption and that coliform was present in those samples. Therefore, the likelihood of faecal coliform contamination in sandwiches sold along Brazilian roadsides is comparable to that which occurs in other Latin American nations (Garin *et al*., 2002). Coliforms are still regarded as markers for evaluating the general hygienic status of surfaces that come into contact with food (Jackson *et al*., 2007).

According to data in Table (1), the average S. aureus count varied depending on the type of meat product from 7 to 10. Burger and minced meat had the lowest S. aureus counts, whereas kofta had the highest. Depending on the type of meat product, the contamination rate varied from 7% to 13%. According to data in Table (1), the average S. aureus count varied depending on the type of meat product from 7 to 10. Burger and minced meat had the lowest S. aureus counts, whereas kofta had the highest. Depending on the type of meat product, the contamination rate varied from 7% to 13%.

According to Christison *et al*. (2008), improper handling, cross contamination, and poor temperature control may be to blame for the presence of S. aureus in ready-to-eat foods. S. aureus is always added when people come into contact with cooked food (Surkiewicz *et al*., 1973). S. aureus is destroyed during processing, so its presence in processed foods usually denotes contamination from food handlers' skin, mouths, or noses (Neela *et al.*, 2004). S. aureus has significant economic significance because, in addition to spreading diseases, it can also cause asymptomatic infections because of its capacity to colonise throughout an organism (Okura *et al*., 2005).

These results agree with those published by (El-Sherbeeny *et al.*, 1985), who revealed that 41% of samples tested positive for Staphylococcus aureus and that 58% of those samples had a count of at least 103/g. The presence of S. aureus was also found in the examined samples of grilled chicken, chicken luncheon, beef shawerma, beef burger, yoghourt, and veta at rates of 40%, 10%, 20%, 30%, 20%, and 20%, respectively (Hassan *et al.*, 2009).

In the samples of hamburger, Kofta, and minced meat, S. typhimurium was found in 30, 20, and 17%, respectively. The main causes of Salmonella outbreaks at food service establishments are improper food preparation and handling (Jay, 1992). As of January 16, 2003, Trinidad and Tobago had 49 cases of salmonellosis from weeks 1 to 52 of 2002. (CAREC, 2003).

In the burger, kofta, and minced meat samples, L. monocytogenes was found in 17, 20, and 20% of the samples, respectively. This outcome might be the result of vendors' careless coughing and sneezing, which can contaminate the goods. Additionally, nose picking with the hands and improper hand washing could both be significant sources of contamination (Ologhobo *et al*., 2010).

Instead, these findings contradict those of Mosupye and Von Holy (2000), who found that *Listeria monocytogenes* was not present.

In the burger, kofta, and minced meat samples, *Bacillus cereus* was found in 17, 23, and 20% of the samples, respectively. The obtained results likely reflect contaminated hand washing water from the sandwich makers, insufficient hand washing, inadequately heated food, and improper ingredient storage conditions. Compared to El-Sherbeeny *et al*(1985) .'s findings, which found that presumptive *Bacillus cereus* was isolated from 37% of samples and that their counts were 103/g or higher, these results show lower counts.

The obtained results are consistent with (Mosupye and Von Holy, 2000), who discovered that 17% of

the examined samples contained *Bacillus cereus*. The fried vegetables had the highest percentage of samples that tested positive for *B. cereus* (31%), according to (Gadaga *et al*., 2008). From the positive examined samples, 168 isolates were chosen for identification or confirmation as *S. aureus*, *L. monocytogenes*, *B. cereus*, and *S. typhimurium* on various selective agar media, including Baird parker agar base medium, Listeria oxford base medium, *B. cereus* agar medium, and Salmonella Shigella agar medium. These isolates' sources and numbers are displayed in Table (2).

Table 2. lists the sources and counts of the various isolates that were found.

Type/No. of sample	Burger (30)		Kofta (30)		Minced meat (30)		Total No.	
	isolates	Strains	isolates	Strains	isolates	Strains	isolates	Strains
S. aureus	9	6	12	8	6	4	27	18
L. monocytogenes	15	10	18	12	18	10	51	32
B. cereus	9	8	12	10	9	7	30	25
S. typhimurium	27	20	18	11	15	8	60	39
Total No. isolates/ Strains	60	44	60	41	48	29	168	114

According to their morphology, physiological, and biochemical traits, all of the aforementioned isolates were identified; however, only 51 *L. monocytogenes* were found. *S. typhimurium*, *B. cereus*, and S. aureus isolates were all identified based on their morphology, physiological, and biochemical characteristics; however, only 51 isolates were successfully identified using additional kits, including the Hi *Salmonella* identification kit and Hi *Salmonella* latex test kit, Hi Listeria identification kit and Hi Listeria latex test kit, Hi Staph identification kit and Hi Staph latex test kit.

According to their morphological and cultural characteristics, these isolates were collected for identification. Bergey's Manual of Systematic Bacteriology (Neath *et al.,* 2009). Nevertheless, the isolated pathogenic bacteria were identified using the rapid detection techniques (Hi kits and Latex test kits). The 114 strains that were identified were distributed as follows, according to the data: 18 *S. aureus* strains, 32 *L. monocytogenes* strains, 25 B. cereus strains, and 39 *S. typhimurium* strains, respectively.

According to the Egyptian Standards' (ES) microbiological requirements, 47% of meat samples were rejected because they failed to meet one or more requirements.

Overall, 53% of the Egyptian meat product was approved for export to the EU using the traditional microbiological method. These samples (53%) are approved in accordance with the ES listed in Table (3).

Table 3. Meatproducts samples as complies with the Egyptian Standards.

Meat products	No. of examined samples	No. of accepted samples
Burger (30)	30	17
Kofta (30)	30	16
minced meat (30)	30	9
Total	90	42

Most cases of foodborne illnesses and intoxication are caused by improper food handling, which includes improper use of preparation and storage temperatures, cross-contamination, and poor personal hygiene (Goncalves, 1998). When food handlers don't maintain good personal hygiene or prepare food properly, they run the risk of becoming carriers of microorganisms through their hands, mouths, and skin, among other possible routes (Silva *et al*., 2009).Many of the foods sold in our neighbourhoods are highly contaminated with pathogenic microorganisms. Foods sold close to polluted areas are susceptible to pathogenic microbial contamination. The incidences of food borne illnesses and intoxications have been linked by documented evidence to the presence of pathogenic microorganisms in food.

Conclusion

The findings of this study show that the burger's hygiene conditions were extremely subpar and may pose a serious threat to human health. Utilizing high-quality raw materials, employing effective heat treatment and properly cleaning and sanitizing utensils can all help reduce this cross-contamination.

References

Abosereh N.A., Salem Abd El Ghani, Rasha S. Gomaa and Mohamed T. Fouad (2016). Molecular Identification of Potential Probiotic

Lactic Acid Bacteria Strains Isolated from Egyptian Traditional Fermented Dairy Products. Biotechnology 15 (1-2): 35-43.

Angelillo IF, Viggiani NM, Rizzo L and Bianco A. (2000). Food handlers and foodborne diseases: knowledge, attitudes, and reported behavior in Italy. Journal of food protection, 63(3):381-385**.**

Argudín, M. Á., Mendoza, M. C. and Rodicio, M. R. (2010). Food Poisoning and *Staphylococcus aureus* enterotoxins Toxins. Vol. 2. No. (7).: 1751–1773.

Balaban, N., Rasooly, A. (2000). Staphylococcal enterotoxins. International J. F. Microbiol. Vol. 61. No. (1); 1–10.

Bezerra, A.C.D.; Reis, R.B. and Bastos, D.H.M. (2010). Microbiological quality of hamburgers sold in the streets ofCuiabá - MT, Brazil and vendor hygiene-awareness. Ciênc. Tec. Aliment., 30 (2):121-132.

Bryan, F.L.; Jermini, M.; Schmitt, R.; Chilufya, E.N.; Mwanza, M., Matoba, A.; M.f.u.m.e. and E., Chibiya, H. (1997). Hazards associated with holding and reheating foods atvending sites in a small town in Zambia. J. Food Prot., 60: 391-398.

Bukar, A.; Yushau, M. and Adikwu, E.M. (2009). Incidence and identification of potential pathogens on hands of some personnel in some small –scale food industries in Kano Metropolis. Nigeria. Biol. Environ. Sci. J. Trop., 6:4-10.

CAREC (2003). Report on communicable diseases. Caribbean Epidemiology Surveillance (CAREC) Report,23(1): 12-18.

Christison, C.A.; Lindsay, C.A. and HolyA. von (2008). Microbiological survey of ready-to-eat foods and associated preparation surfaces in retail delicatessens, Johannesburg, South Africa. Food Control, 19: 727–733.

Delgado, C. L. (2003). Rising Consumption of Meat and Milk in Developing Countries has created a New Food Revolution. J. Nutr.133 (11). 3907 – 3910.

Doha, Mohamed A., Minar Mahmoud Hassanein, Tamer M. El-Messery, Mohamed T. Fouad, Marwa M. El-Said, KaremFouda and Adel Gabr Abdel-Razek. (2017). Amelioration of Type 2 Diabetes Mellitus by Yoghurt Supplemented with Probiotics and Olive Pomace Extract. J. Biol. Sci., 17:320-333.

El-Kholy, W., Azzat B. Abd El-Khalek, Sahar H.S. Mohamed, Mohamed T. Fouad and Jihan M. Kassem (2016). Tallaga Cheese as a New Functional Dairy Product. American J. Food Technology, 11(5):182-192.

El-Shenawy Moustafa A. Zeinab I. Sadek, Samy Mohamed Abdelhamid, Mohamed T. Fouad(2022). Incidence of some pathogens in beef burger sold in Cairo. Egypt. J. Chem. 65, (5), 319 – 324.

El-Shenawy, Moustafa A., Rashed A. Zaghloul, Ibrahim H. Abbass, Amira I. Esmail and Mohamed T. Fouad (2016a). Incidence of some epidemiologically relevant food-borne pathogens in street-vended sandwiches. Journal of Pharmaceutical, Biological and Chemical Sciences 7 (2), 468-474.

El-Shenawy, Moustafa, Mahmoud Abd El-Aziz, WagihElkholy and Mohamed T. Fouad (2016b). Probiotic Ice Cream Made with Tiger-nut (Cyperusesculentus) Extract. American J. Food Technology, 11(5):204-212.

El-Sherbeeny, M.R.; Saddik, M.F.; Frank, L. and Bryan, F.L. (1985). Microbiological profiles of foods served by street vendors in Egypt. Int. J. Food Microbiol., 2(6):355-364.

Firstenberg, E. R. and Sullivan, N. M. (1997). ColiRapid Detection System: a rapid method for the detectionof Escherichia coli 0157 in milk and other foods. Journalof Food Protection 60(3):219-225.

Forsythe, S. J. (2008). The Microbiology of Safe Food. Department of life sciences. Nottingham Trent Univ. ISBN: 978-0-470-99942-4.

Fouad M.T, AmrMoustafa, Laila Hussein, RamyRomeilah, Mostafa Gouda. (2015). In-Vitro Antioxidant and Antimicrobial Activities of Selected Fruit and Vegetable Juices and Fermented Dairy Products Commonly Consumed in Egypt. Research Journal of Pharmaceutical, Biological and Chemical Sciences 6 (2): 541-550.

Fouad, Mohamed T. Ahmed M. S. Hussien, and Moustafa A. El-Shenawy (2022a). Production of pasta using tiger nut and fermented permeate with some probiotic bacteria Egypt. J. Chem. 65, (4), 569 – 578.

Fouad, Mohamed T. Asmaa G. Abu-El-Khair, Safaa, M. Fawzy and Moustafa A. El-Shenawy (2022b). Bacteriological Quality of Sausage Sold in Great Cairo Area. Egypt. J. Chem. 65, (5), 307 – 312.

Gadaga,T.H.; Samende, B.K.;Musuna,C. and Chibanda, D. (2008). The microbiological quality of informally vended foods in Harare, Zimbabwe. Food Control, 19: 829–832.

Garin, B.; Aidara, A.; Spiegel, A.; Arrive, P.; Bastaraud, A.; Cartel, J. L.; Aissa, B. B.; Duval, P.; Gay, M.; Gherardi, C.; Gouale, M.; Karou, T. G.; Kruy, S. L.; Soares, J. L.; Mouffok, F.; Ravaonindrina, N.; Rasolofonirina, N.; Pham, M.; Mouafo, M.; Catteau, M.; Mathiot, C.; Mauclere, P. and Rocourt, J. (2002).Multicenter study of street foods in 13 towns on fourcontents by the food and environment hygiene studygroup of the international network of Pasteur andAssociated Institutes. J. Food Prot., 65:146-152.

Ghazya, O.A., M.T. Fouad, H.H. Saleha, A.E. Kholif, T.A. Morsy. (2021). Ultrasound-

assisted preparation of anise extract nanoemulsion and its bioactivity against different pathogenic bacteria. Food Chemistry. 341:1-7.

Goncalves, P.M.R. (1998). Toxinfeccoes Alimentares: uma revisao. Higiene Alimentar, 12(53): 38-44.

Hassan, N.S.; Seham; Esmail, A. and Mahmoud, A. H.(2009). Bacteriological assessment of some ready-to-eat foods. Kafr El-Sheikh, Vet. Med. J., Sci. Congress, 3: 474-487.

Hussein H. A. & Mohammed T. Fouad&Khaled A. Abd El-Razik&Amal M. Abo El-Maaty& C. D'Ambrosio4 & A. Scaloni& A. M. Gomaa. (2020). Study on prevalence and bacterial etiology of mastitis, and effects of subclinical mastitis and stage of lactation on SCC in dairy goats in Egypt. 52:3091–3097.

Hussien Ahmed M. S., Mohamed T. Fouad and Moustafa A.El-Shenawy (2022). Production of functional Pan Bread from Mixture of Tiger Nut Flour, Milk Permeate and Hard Wheat Flour. Egypt. J. Chem. 65, (3), 517 – 525.

Jackson, V.; Blair, I. S.; McDowell, D. A.; Kennedy, J. and Bolton, D. J. (2007). The incidence of significant foodborne pathogens in domesticrefrigerators. Food Control, 18: 346–351.

Jay, J.M. (1992). Foodborne gastroenteritis caused by *Salmonella* and *Shigella*.Modern Food Microbiol. pp. 507-526.Chapman and hall, New York.

Kaneko KI, Hayashidani H, Ohtomo Y, Kosuge J, Kato M, Takahashi K. (1999). Bacterial contamination of ready-to-eat foods and fresh products in retail shops and food factories. Journal of food protection, 62(6):644-649.

Karmi, M. (2013). Prevalence of Salmonella in Meat Products. Fac. Vet. Med. Aswan Univ. Glob. Vet. 11 (5): 685-688.

Kubheka, L.C.; Mosupye, F.M. & von Holy, A. (2001). Microbiological survey of street-vended salad and gravy in Johannesburg city, South Africa. Food Control, 12(2):127-131.

Ladikos D. and V. Lougovois, (1990). "Lipid oxidation in muscle foods: a review," Food Chemistry, vol. 35, no. 4, pp. 295–314, 1990.

Meng J, Doyle MP. (1998). Emerging and evolving microbial foodborne pathogens. Bulletin de l'InstitutPasteur.; 96(3):151-163.

Mosupye,F.M. and Von Holy, A.(2000). Microbiological hazard identification and exposure assessment of street food vending in Johannesburg, South Africa. Int. J. Food Microbiol., 61: 137-145.

Neath, P.H.A.; Mair, N.s.; Sharpe ،M. Elizabeth and Holt, J.G. (2009). Bergy,s Manual Bergy,s Manual of Systematic Bacteriology. S (Eds.) Pub. Williams and Wilkins, 2605.

Neela, B.; Andrew, J. and Allyson, C. (2004). An observational study of food safety practices by street vendors and microbiological quality of street-purchased hamburger beef patties in Trinidad, West Indies. Int. J. Food Safety, 3: 25-31.

Norrung, B., Andersen, J. K. and Buncic, S. (2009). Safety of Meat and Processed Meat. Food Safety and Nutrition. Pp.: 3-29.

Okura, M.H.; Jannini, A. E.; Oliveira, G.B.; Pereira, K.S.; Borges, L.; Ferreira, M.G.N.and Alvim, N.F.M.(2005). A contaminação em salgados (coxinhas) encontrados no centro da cidade de Uberaba, MG / The contamination in salty (savories) found in the center of the city of Uberaba, MG**.,** 19(132):65-68.

Ologhobo, A. D.; Omojola, A. B.; Ofongo, S. T.; Moiforay, S. and Jibir, M.(2010). Safety of street vended meat products - chicken and beef suya. African J. Biotec., 9 (26): 4091-4095.

Pelczar M.J, Chan E.C.S and Krieg NR. (2006). Microbiology 5th edition. Tata McGraw-Hill Publishing Company Limited, New Delhi.

Rosergant, M. W., Leach, N. and Gerpacio, R. V. (1999). Alternative Futures for World Cereal and Meat Consumption. Proceeding of the Nutrition Society, 58 (2). Pp.: 219-234.

Saleh, Y.E.; EL-Fouly, M.Z.; Khalil, M.S. and Abo-State, M.A. 1993). Incidence and characterization of Bacillus cereus isolated from Egyptian foods. Qatar Univ. J., 13(1): 75-80.

Shazly Ahmed B., Mohamed T. Fouad, Mostafa Elaaser, Rehab S. Sayed and Mahmoud Abd El-Aziz (2022). Probiotic coffee ice cream as an innovative functional dairy food. J Food Process Preserv., 1-13.

Shehu, L. M. and Adesiyun, A. A. (1990). Characteristicsof strains of *Escherichiacoli* isolated from locally -fermented milk (Nono) in Zaria, Nigeria. J. Food Protection53:574-577.

Silva, C.S.; Germano, M.I.S. and Germano, P.M.L. (2003). Condicoes Higienico-sweets sold in metropolitan Kano, Nigeria. Bayero J. Pure Appl. Sci., 2(1):154-159.

Speedy, A. W. (2003). Global Production and Consumption of Animal Source Foods. J. Nutr. 133. 4048-4053.

Surkiewicz, B.F.; Harris, M.E. and Johnston, R.W. (1973). Bacteriological survey of frozen meat and gravy produced at establishments under federal inspection. Appl. Microbiol.,26: 574 -580.