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Microbiological Hazards Evaluation of Some Egyptian Falafel Restaurants in Sohag Governorate

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Abstract

The purpose of this study was to identify the presence of some disease-causing bacteria in falafel sandwiches, food handler hands, and food contact surfaces. Random samples were collected from 5 falafel restaurants in Sohag Governorate. As well as applying food safety requirements to control the types of disease-causing bacteria. The results indicated that the total bacterial count (cfu/g) in all restaurants ranged from 5.09 to 6.63 in falafel sandwiches, from 3.02 to 4.69 in hand swabs, and from 3.24 to 4.37 in surface swabs. The *Escherichia coli* in all restaurants ranged from 3.61 to 4.79 cfu/g in falafel sandwiches, from 2.23 to 3.58 cfu/g in hand swabs, and from 2.17 to 2.80 cfu/g in surface swabs. *Staphylococcus aureus* was found in all tested samples, ranging from 2.02 to 3.74 cfu/g in falafel sandwiches, from 2.63 to 5.27 cfu/g in hand swabs, and from 2.57 to 4.53 cfu/g in surface swabs. *Salmonella* was detected in all tested samples of all restaurants, from 2.61 to 2.99 cfu/g in falafel sandwiches, from 2.21 to 3.43 cfu/g in hand swabs, and from 2.31 to 4.00 cfu/g in surface swabs. By applying food safety requirements, the total bacterial count was significantly low and ranged from 1.14 to 2.14 cfu/g. The count of *Staphylococcus aureus* decreased significantly in all samples, and *Escherichia coli* and *Salmonella* were not detected in all tested samples.

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INTRODUCTION

Foods that are served in restaurants may get contaminated by microorganisms at any point during preparation, handling, and storage, or even while being served. It can come from contaminated raw materials or cross-contamination from the air, water, dust, human and animal wastes, as well as from many other sources (Osimani *et al.,* 2013). It has been documented that many Ready-to-eat (RTE) vendors in LMICs frequently lack awareness of appropriate hygiene practices, which could make the food more susceptible to microbial contamination (Al Mamun *et al.,* 2013a, b). Food handlers play a crucial role in the transmission of foodborne infections, which has been a long-standing problem in public health. Although there are many ways that bacteria can contaminate food, proliferate, and infect people, it is also possible that these illnesses are spread by the people who handle the food. These food handlers contribute to food contamination in a variety of ways, including by using themselves as a vehicle, preparing food improperly, poor personal hygiene, and contact with cuts, wounds, hair, or mouth. Additionally, soiled surfaces and equipment may have a bigger impact on the burden of foodborne germs (Zain and Naing, 2002; Käferstein, 2003; WHO, 2004; Campos *et al.,* 2009 and Assefa *et al.,* 2015). *Escherichia coli's* presence indicates improper application of good manufacturing practices (GMPs) during food preparation, which can be directly or indirectly linked to food contamination by faeces (Mohamedin *et al.,* 2015). Lambrechts *et al. (*2014) said that *Coliform bacteria* also suggest the presence of other extremely dangerous bacteria, such as *Salmonella*, *Shigella*, or *E. coli* species, such as *E. coli* O157:H7, which may result in serious systemic infections. Food handlers' poor hygiene habits are closely linked to the presence of *Staphylococcus spp*. in food samples (Yang *et al.,* 2016; Tomasevic, 2016). Finally, according to the food safety management system separating raw food from RTE food, cleaning surfaces in touch with food, and maintaining personal hygiene are all crucial steps in preventing cross contamination (FSA, 2015). The Hazard analysis and critical control point (HACCP) application has also helped to lower the overall microbial count in food (Tomasevic *et al.,* 2016). Therefore, International standards, such as HACCP, must be implemented by food operators to lower the incidence of foodborne illnesses by monitoring the production of food (Ravishankar *et al.,* 2010). The objective of this study was to evaluate microbiological quality and potential health concerns of some falafel restaurants in Sohag governorate, as well as how to control it by comparing the obtained results with that in the applying case of food safety requirements.

MATERIALS AND METHODS

Materials

Random samples were collected from 5 falafel restaurants (falafel sandwich, food handler hand swab and food contact surface swab) from various restaurants in Sohag governorate to estimate the total bacterial count, *Escherichia coli*, *Staphylococcus aureus* and *Salmonella bacteria.* The collected samples were immediately transferred to the laboratory for testing their suitability for consumption as per the standard specification.

Chemicals

All chemicals used in this study were purchased from Sigma and Al- Gomhoria company. The redistilled water was used.

Methods
Sample preparation:

For falafel sandwiches, 10 g of each sample was combined with 90 ml of sterile solution (9g NaCl/1L distilled water) in a blender. The swabs were placed directly into the solution (9g NaCl/1L distilled water) under sterile conditions to produce a 1/10 dilution. Several types of bacteria were counted using serial dilutions (Mahmoud, 2013). The outcomes are stated as colony forming units (cfu) per gram of sample.

Total bacterial count:

According to A.P.H.A. (1976); Difco (1984); Ahmed (2022), the total bacterial counts were determined using the plate counts

technique on a nutrient ager medium. The plates were incubated for 48 h at 37 °C.

Coliform group bacteria count:

The A.P.H.A. (1976); Difco (1984) and Ahmed (2022), identified a method for determining *Coliform* group bacteria using MacConkey agar medium. The plates were incubated for 24 h at $37°\pm2°$ C.

Staphylococcus aureus count*:*

The presence *of Staphylococcus aureus* was determined using Mannitol salt ager medium, as defined by Difco (1984); Ahmed (2022). The plates were incubated for 24 to 48 h at $37°\pm2°$ C.

Detection of *Salmonella*:

The presence or absence of *Salmonella* was determined using *Salmonella Shigella* agar medium, as defined by FAO (1979); Ahmed (2022). Plates were incubated for 24 h at $35°$ C. *Salmonella* emerged as black colonies with metallic sheet on some of them.

Application of domestic frying process:

Food safety requirements have been applied, taking into account optimal conditions and critical control point (frying- serving).

Statistical analysis

The measured data was analyzed for variance using one-way and two-way ANOVA, as required by SAS software. (SAS ver. 9.2, SAS Institute, 2008), acceding to Gomez and Gomez (1984). The least significant differences (LSD) between means at 5% level of significant for studied parameters, were estimated according to Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

Total bacterial count of falafel sandwiches, hand swabs and surface swabs collected from 5 restaurants:

Results in figure (1) revealed that a significant difference in total bacterial count among the average of falafel sandwiches, hand swabs and surface swabs in all restaurants. For falafel sandwiches, the total bacterial count in the restaurant No.1, 2, 3, 4 and 5 was 5.09, 5.99, 6.63, 5.95 and 5.14 cfu/ g, respectively. The highest total bacterial count was found in restaurant No.3 while, the lowest bacterial count was found in restaurant No.1. New South Wales (NSW) Food Authority (2012) indicated that the total bacterial count in fully cooked RTE foods (falafel sandwiches) should not exceed 5 cfu/ g. Hence, all studied falafel sandwiches samples collected from restaurants are not of good quality according to NSW standard. The increase in the total bacterial count in falafel sandwiches of all restaurants may be due to the food was handled carelessly, contaminated during or after cooking, or was otherwise unclean. Other studies have demonstrated that several surfaces in kitchens can become infected while vegetables are being prepared, and that contaminated bacteria can survive for extended periods of time. Cross contamination may happen in certain circumstances (Gillespie *et al.,* 2000). The data in the same figure revealed the total bacterial count in the hand swabs taken from food handlers. The total bacterial counts in the restaurant No.1, 2, 3, 4 and 5 were 4.69, 3.53, 3.87, 4.36 and 3.02 cfu/ g, respectively. Regarding hand swabs, the highest total bacterial count was found in restaurant No.1 and the lowest total bacterial count was in restaurant No.5. The presence of total bacterial count in hand swabs may be due to those who handle food wash their hands improperly. This is consistent with Ajao and Atere (2009) findings. Data in the same figure also revealed a significant difference in total bacterial count among surface swabs in all restaurants. The total bacterial count in the restaurant No.1, 2, 3, 4 and 5 were 4.37; 3.50; 3.64; 3.60 and 3.24 cfu/ g, respectively. The highest total bacterial count was found in restaurant No.1 while restaurant No.5 recorded the lowest bacterial count in the surface swabs. The increase in total bacterial count in surface swabs may be due to the cleaning techniques used on surfaces in touch with food are insufficient. This is agreeing with **Losito *et al.* (2017).**

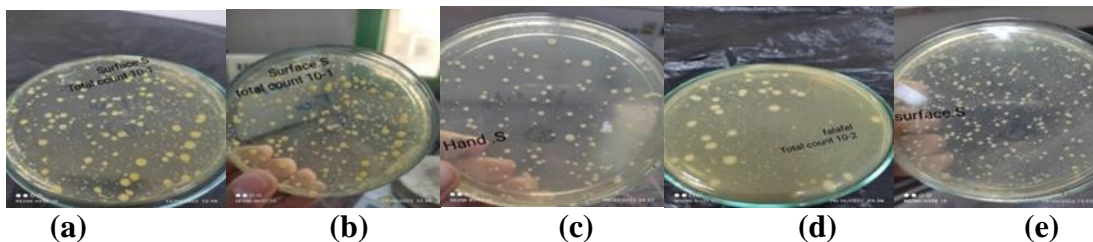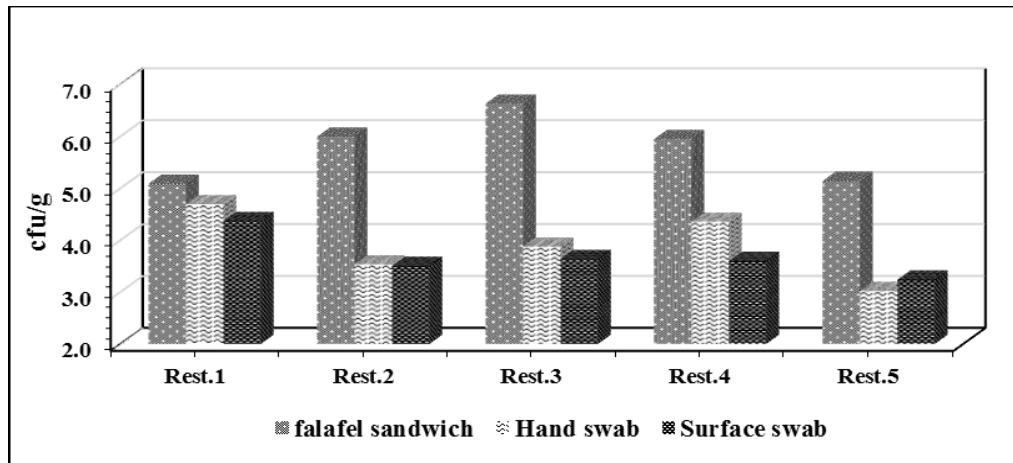(a)   (b)   (c)   (d)   (e)

Figure (1): Total bacterial count (cfu/g) of falafel sandwiches, hand swabs and surface swabs collected from 5 restaurants.
Total bacterial count in (e) Hand swab   (a,b,c) Surface swab   (d) Falafel sandwich

***Escherichia coli* of falafel sandwiches, hand swabs and surface swabs collected from 5 restaurants:**

The data presented in the figure (2) show significant differences in *Escherichia coli* count among the average of falafel sandwiches, hand swabs and surface swabs in all restaurants. For falafel sandwiches, the *Escherichia coli* count in the restaurant No.1, 2, 3, 4 and 5 was 4.17; 3.88; 3.70; 4.79 and 3.61 cfu/ g, respectively. The restaurant No.4 had a significantly mean *E. coli* count higher than the other restaurants. On the other hand, restaurant No.5 had a relatively lower mean *E. coli* count. *Escherichia coli's* presence indicates improper application of GMPs during food processing, which can be directly or indirectly linked to food contamination by faces (Mohamedin *et al.,* 2015). In addition, Jay (2005) mentioned that the presence of these organisms in food that is ready to consume indicates that hygienic standards and practices were not followed throughout the production and packaging of this food product. The same figure (2) also revealed *Escherichia*

coli count in hand swabs taken from food handlers in all restaurants. Restaurants No.1, 2, 3 and 4 recorded the *E. coil* count as 2.37, 2.47, 3.58 and 2.23 cfu/ g, respectively. Restaurant No.3 had a substantially higher mean *E. coli* count than the other restaurants However, the *E. coil* was not detected in restaurant No.5. The presence of *E. coli* in samples may be due to contamination during growth has been linked, according to Bichai *et al.* (2008), to the use of contaminated irrigation water. According to Angelillo *et al.* (2000), contamination caused by human handling, the use of contaminated containers or post-harvest washing in contaminated water can increase the prevalence of intestinal infections. Data in the same figure shows the surface swabs examine in contact with food in all restaurants. Restaurants recorded the *E. coil* count in restaurant No.1, 2, 3, 4 and 5 as 2.80, 2.49, 2.62, 2.17 and 2.36 cfu/ g, respectively. Restaurant No.1 had the highest count of *E. coil* compared to other restaurants, whereas restaurant No.4 had the lowest count of *E. coil*. These results are consistent with

Mohamedin *et al.* (2015) they stated that surfaces in contact with ready-to-eat food may be contaminated with *E. coil* through the contaminated water used.
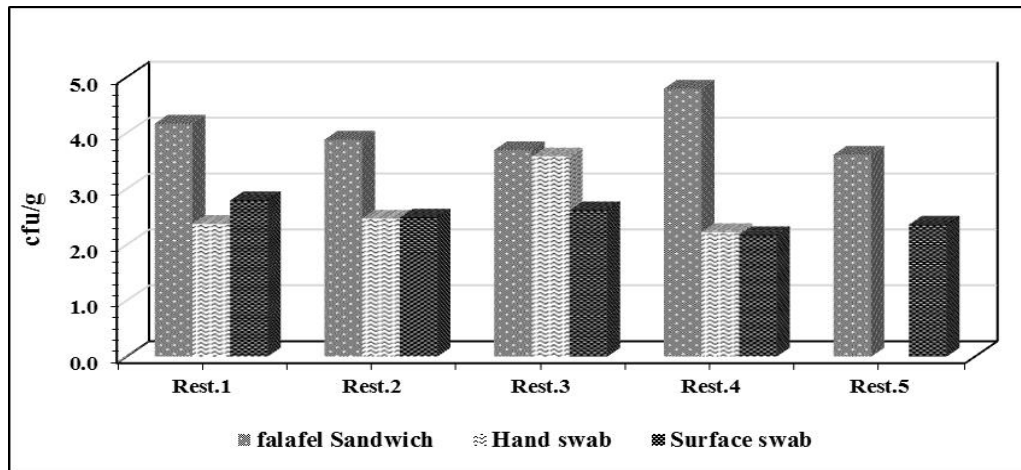

(a)   (b)   (c)   (d)   (e)   (f)

Figure (2): *Escherichia Coli* bacteria (cfu/g) of falafel sandwiches, hand swabs and surface swabs collected from 5 restaurants.
Escherichia Coli count in (b,d,e,f) Falafel sandwich   (c) Surface swab   (a)Hand swab

Staphylococcus aureus of falafel sandwiches, hand swabs and surface swabs collected from 5 restaurants:

There was a significant difference in *Staphylococcus aureus* count among the average of falafel sandwiches, hand swabs and surface swabs taken from all restaurants. For falafel sandwiches, restaurants No.1, 2, 3, 4 and 5 recorded *Staphylococcus aureus* count was 3.31, 3.74, 2.95, 3.65 and 2.02 cfu/ g, respectively. The restaurant No.2 had the highest mean *Staphylococcus aureus* count (3.74 cfu/ g). Restaurant No.5 had a much lower mean *Staphylococcus aureus* compared to the other restaurants (2.02 cfu/ g). Burt *et al.* (2016) asserted that *S. aureus* enters human food through the skin, open wounds, and respiratory passages. Since it is still present in cooked RTE foods, customers may be exposed to numerous health concerns. Thus, depending on how much contaminated food was eaten and how susceptible an individual was to the toxin, different symptoms may show up. *Staphylococcal* food poisoning can cause vomiting, nausea, diarrhea, and stomach pain among other symptoms (Amusan *et al.,* 2010). The data in the same figure (3) revealed a significant difference in *Staphylococcus aureus* count among hand swabs taken from food handlers. Restaurants No.1, 2, 3, 4 and 5 recorded *Staphylococcus aureus* count as 5.27, 3.46, 3.44, 2.98 and 2.63 cfu/ g, respectively. The restaurant No.1 had a significantly higher mean *Staphylococcus aureus* count than the other restaurants. The presence of *Staph aureus* in hand swabs may be due to the fact that *Staphylococcus* species are resident flora of human skin and hence easily contaminate surfaces on touch could be the cause of their prevalence in all hand swabs and easy-contact surfaces (Oranusi and Olorunfemi, 2011; Oranusi and Braide, 2012). Data in the same

figure also shows a significant difference in *Staphylococcus aureus* count among surface swabs taken from the food contact surfaces in the 5 restaurants. Restaurant No.4 had a significantly higher mean *Staph aureus* count (4.53 cfu/ g) than the other restaurants. Restaurant No.5 had the lowest count of *Staph*

aureus (2.57 cfu/ g) compared to the other restaurants. Studies have shown that harmful bacteria such *S. aureus* can survive on surfaces in contact with food for an extended period time, increasing the risk of foodborne diseases (Kusumaningrum *et al.*, 2003).
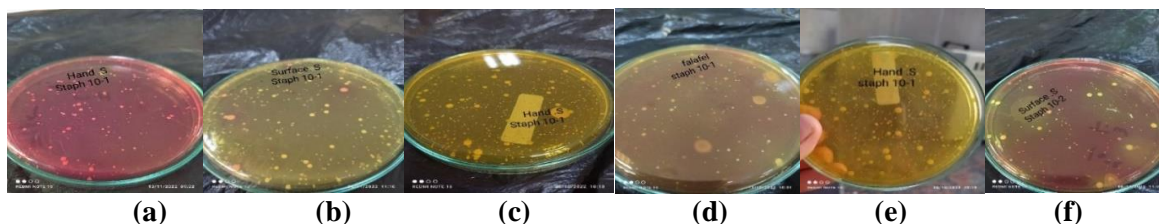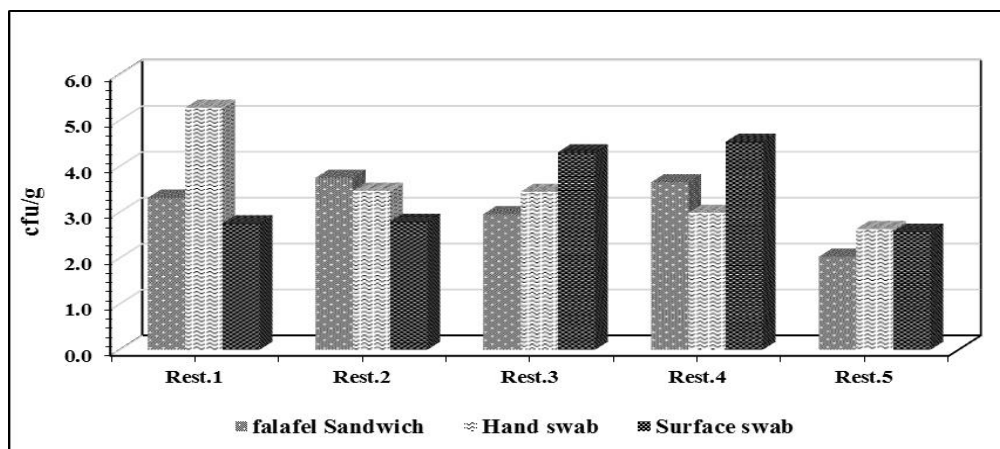

(a)   (b)   (c)   (d)   (e)   (f)

Figure (3): *Staphylococcus aureus* count of falafel sandwiches, hand swabs and surface swabs collected from 5 restaurants.
Staphylococcus aureus count in (b,f) Surface swab   (a,c,e) Hand swab   (d) Falafel sandwich

Salmonella of falafel sandwiches, hand swabs and surface swabs collected from 5 restaurants:

The data presented in figure (4) illustrate significant differences in *Salmonella* count among the average of falafel sandwiches, hand swabs and surface swabs in all restaurants. For falafel sandwiches, the *Salmonella* count in the restaurant No.1, 2, 3, 4 and 5 recorded 2.77, 2.99, 2.89, 2.61 and 2.86 cfu/ g, respectively. Restaurant No.2 had the highest mean *Salmonella* count compared to the other restaurants; however, restaurant No.4 had a relatively lower. The Agency (2009) indicated that the *Salmonella* count in ready-to-eat food must be free of *Salmonella* (0 cfu/ g). All falafel sandwich in all restaurants exceeded the

permissible limits from the collected samples. This increase in *Salmonella* count in falafel sandwich may be due to the primary source of the *Salmonella spp.* contamination of those sandwiches was the green salad. This finding is consistent with observations made by El-Gazaly and Ahmed (2003), and Salem (2004) that *Salmonella* can survive for several days in vegetables like tomatoes and celery. According to Odu and Akano (2012), food vendors' poor manufacturing practices may be the cause of pollution. Because these microorganisms are known to cause food poisoning and food borne illnesses, this is a public health problem. Data in the same figure revealed *Salmonella* count in hand swabs taken from food handlers in all restaurants. The *Salmonella* count in restaurant

No.1, 2, 3, 4 and 5 recorded 2.49, 2.21, 3.43, 2.35 and 2.53 cfu/ g, respectively. Restaurant No.3 had a substantially higher mean *Salmonella* count than the other restaurants. Restaurant No.2 had a much lower mean *Salmonella* count. The presence of *Salmonella* count in hand swabs may be due to *S. typhi* is typically spread through food or water that has been contaminated with human faces. Carriers who work as public food handlers or health care providers can pose a major threat to the public's health. This is consistent with Easa (2010) findings. Data in the same figure also shows a significant difference in *Salmonella* count among surface swabs taken from the food contact surfaces in the 5 restaurants. Restaurant No.1 had a significantly higher mean *Salmonella* count (4.00 cfu/ g) than the other restaurants. Restaurant No.5 had the lowest count of *Salmonella* (2.31 cfu/ g). The Agency (2009) indicated that the *Salmonella* count on surface must be free of *Salmonella* (0 cfu/ g). All the samples exceeded the permissible limit. The increase in *Salmonella* count in surface swab may be due to the existence of significant cross-contamination among the contact surfaces during the operation may be indicated by the elevated microbiological load discovered on the contact surface Ayalew *et al.,* (2015). In general, most of the samples that were looked into investigated tended to have pathogenic counts that were higher than the recommended safety level put forward by the Egyptian Organization for Standardization and Quality Control (EOSQC), indicating that those foods may be dangerous enough to be fed to humans. Fast food should therefore be avoided outside and replaced with other, healthier dishes (Awad-Allah and Mostafa, 2008).
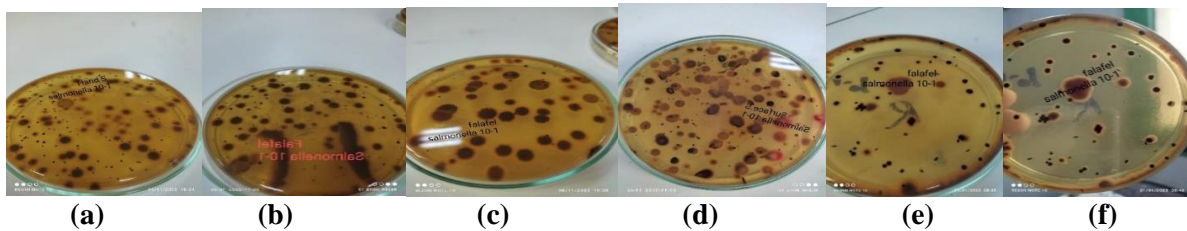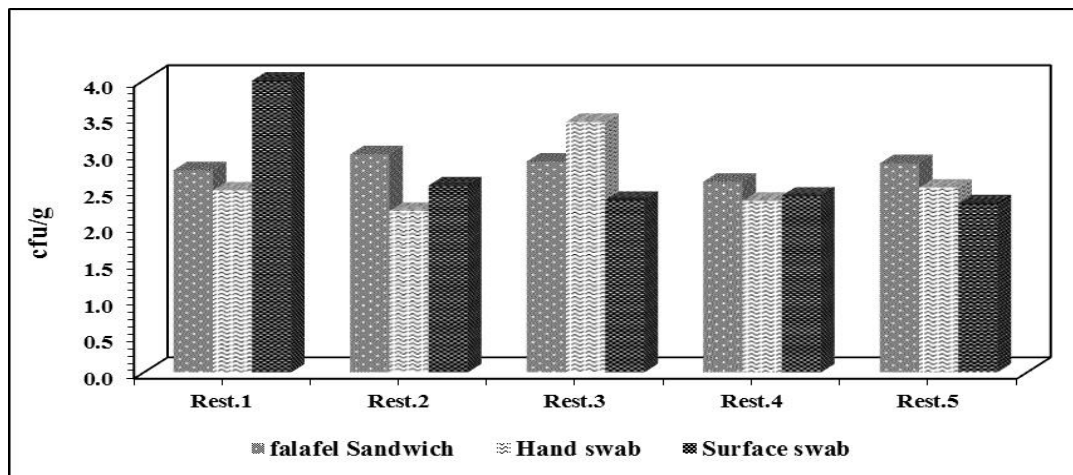

(a)   **(b)**   **(c)**   **(d)**   **(e)**   **(f)**

Figure (4): Salmonella of falafel sandwiches, hand swabs and surface swabs collected from 5 restaurants. Salmonella count in (f)   Hand swab (b, a, d, e) Falafel sandwich   (c) Surface swab

Microbiological evaluation of the applied part at domestic:

The data in the figure (5) showed significant differences in total bacterial count among the average of falafel sandwich, hand swab and surface swab. The highest total bacterial count in falafel sandwich was 2.14 cfu/g, and the lowest total bacterial count was found in hand swab (1.14 cfu/g). New South Wales (NSW) Food Authority (2012) Indicated that the total bacterial count in fully cooked ready-to-eat foods (falafel sandwiches) should not exceed 5 cfu/ g. Thus, all tested samples did not exceed the permissible limit. This may be due to hand washing, and surface disinfection before preparing food. These results are in agreement with Dodrill *et al.* (2011), who stated that Effective hand washing, and surface sanitization will help avoid any negative impacts from these organisms may have. Therefore, samples had the lowest microbial count after application of GMP, decreased by 100% compared to the previous one after applying the HACCP system. This is consistent with Kassem *et al.* (2004). The data in the same figure revealed differences in *Staphylococcus aureus* count among the average of falafel sandwich, hand swab and surface swab. The reason for the decrease in the *Staphylococcus aureus* count may be due to good hand washing, surface cleaning and the application of GMP because the fact that *Staphylococcus* species are resident flora of human skin and hence easily contaminate surfaces on touch could be the cause of their prevalence in all hand swabs and easy-contact surfaces (Oranusi and Olorunfemi, 2011; Oranusi and Braide, 2012). *Escherichia Coli* and *Salmonella* were not detected in all samples tested. This result was also consistent with the presence of Agency (2009) which indicated that RTE should be free of *Salmonella.* The absence of these organisms in the RTE food and swabs samples tested indicates that hygienic standards and practices were followed during the production of this food product (Jay, 2005). Additionally, according to Antwi-Agyei and Maalekuu (2014), heating meals with good hygienic practice (GHP) could help reduce the microbial load to a harmless level.
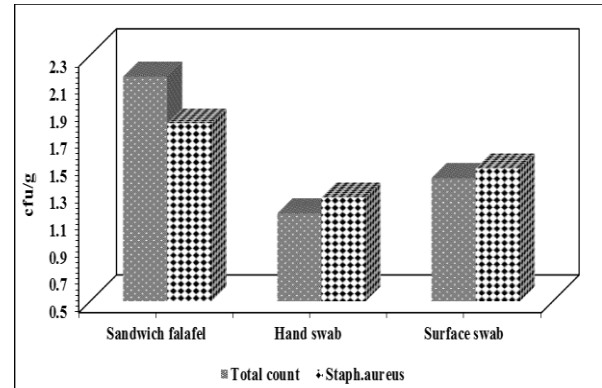

Figure (5): Microbiological evaluation of the applied part at domestic

CONCLUSION

Because fried foods are sold in Egyptian restaurants and street vendors, they are sensitive to microbiological deterioration, so the world health organization defined the HACCP program for the prevention of foodborne diseases about 20 years ago because it increases food safety. The application of the HACCP system in the process of frying foods greatly helped to reduce the microbial load by following the Good Manufacturing Practice (GMP) and the Good Health Affairs Practice (GHP) (following food safety requirements such as washing and drying hands, cleaning and disinfecting surfaces).

REFERENCES

A.P.H.A. (1976). American Public Health Association of Methods for the Microbiological Examination of Foods. Speck, M. L. ed., Washington, D. C., USA.

Agency, H.P. (2009). Guidelines for assessing the microbiological safety of ready-to-eat foods placed on the market, pp. *1-34.*

Ahmed, A. G. A (2022). Antimicrobial and Antioxidant Activities of Phytate and Phenolic Compounds in Some Meat Products. MCS. Dept. Food science and nutrition. Faculty of Agriculture. Sohag University. Sohag. Egypt.

Ajao, A. T., & Atere, T. G. (2009). Bacteriological assessment and hygienic standard of food canteens in Kawar State Polytechnic, Ilorin, Nigeria. African Scientist Journal, *3(10), 173-180.*

Al Mamun, M., Rahman, S. M. M., & Turin, T. C. (2013a). Microbiological quality of selected street food items vended by school-based street food vendors in Dhaka, Bangladesh. International Journal of Food Microbiology,166(3), 413–418.

Al Mamun, M., Rahman, S. M. M., & Turin, T. C. (2013b). Knowledge and awareness of children's food safety among school-based street food vendors in Dhaka, Bangladesh. Foodborne Pathogens and Disease 10 (4), 323-330.

Amusan, E., Oramadike, C. E., Abraham-Olukayode, A. O., & Adejonwo, O. A. (2010). Internet Journal of Food Safety. Internet Journal of Food Safety, *12, 122-126.*

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

Antwi-Agyei, P. & Maalekuu, B. K. (2014). Determination of microbial contamination in meat and fish products sold in the Kumasi metropolis (A Case Study of Kumasi central market and the Bantama market). Merit Research Journal of Agricultural Science and Soil Sciences, 2(3), 38-46.

Assefa, T., Tasew, H., Wondafrash, B., & Beker, J. (2015). Contamination of bacteria and associated factors among food handlers working in the student cafeterias of Jemma University Main Campus, Jemma, South West Ethiopia. Alternative & Integrative Medicine.

Awad-Allah, M. A. A., & Mostafa, U. E. (2008). microbiological quality of the most consumption fast foods available in Qena′ s restaurants. Journal of Food and Dairy Sciences, *33(5), 3505-3516.*

Ayalew, H., Berhanu, A., Sibhat, B., & Serda, B. (2015). Microbiological assessment of meat contact surfaces at abattoir and retail houses in Jigjig town, Somali National Regional State of Ethiopia. ISABB Journal of Food and Agricultural Sciences, *5(3), 21-26.*

Bichai, F., Payment, P., & Barbeau, B. (2008). Protection of waterborne pathogens by higher organisms in drinking water: a review. Canadian journal of microbiology, *54(7), 509-524.*

Burt, B. M., Volel, C., & Finkel, M. (2016). Safety of vendor-prepared foods: evaluation of 10 processing mobile food vendors in Manhattan. Public Health Reports, *118, 470-476.*

Campos, A. K. C., Cardonha, Â. M. S., Pinheiro, L. B. G., Ferreira, N. R., de Azevedo, P. R. M., & Stamford, T. L. M. (2009). Assessment of personal hygiene and practices of food handlers in municipal public schools of Natal, Brazil. Food Control, *20(9), 807-810.*

Difco-Manual, (1984). Dehydrated culture media and reagents microbiological and clinical laboratory procedures, Pod-Deco-Lab-Detroit's Michigan, USA.

Dodrill, L., Schmidt, W. P., Cobb, E., Donachie, P., Curtis, V., & De Barra, M. (2011). Male commuters in north and south England: risk factors for the presence of fecal bacteria on hands. BMC Public Health, *11(1), 1-6.*

Easa, S. M. H. (2010). The microbial quality of fast food and traditional fast food. Nature and Science, *8(10), 117-133.*

El-Gazaly F. M. and F. M. Ahmed (2003). Chemical composition and microbiological studies on some popular foods served by small food shops and street vendors in El-Minya city, Egypt. Home Economics Journal. *19: 1-18.*

FAO, (1979). Manuals of food-quality controls, 4, microbiological analysis. Food and Agriculture Organization of the United Nations. Rome, PP.C9-12 and DI-33.

FSA (Food Standard Agency) (2015). E. coli O157 Control of Cross-contamination. United Kingdom.

Gillespie, I., Little, C., & Mitchell, R. (2000). Microbiological examination of cold ready-to-eat sliced meats from catering establishments in the United Kingdom. Journal of Applied Microbiology, *88(3), 467-474.*

Gomez, K. A., & A. A. Gomez (1984). Statistical procedures for agricultural research. John wiley & sons.

Jay, M.J. (2005). Modern Food Microbiology 4th ed. Chapman and Hall, New York.p.187.

Käferstein, F. K. (2003). Food safety, the fourth pillar in the strategy to prevent infant diarrhea.

Bulletin of the World Health Organization, *81, 842-843.*

Kassem M.M., EI-Syaed A.H., Afifi E.A. and Abo Elmakarem W. (2004). Effect of good manufacturing practices "GMP" on food safety. Bull. Nat. Nutr. Inst. of the Arab Republic of Egypt, *3, 210-227.*

Kusumaningrum, H. D., Riboldi, G., Hazeleger, W. C., & Beumer, R. R. (2003). Survival of foodborne pathogens on stainless steel surfaces and cross-contamination to foods. International Journal of Food Microbiology, *85(3), 227-236.*

Lambrechts, A. A., Human, I. S., Doughari, J. H., & Lues, J. F. R. (2014). Bacterial contamination of the hands of food handlers as indicator of hand washing efficacy in some convenient food industries in South Africa. Pakistan Journal of Medical Sciences, *30(4), 755.*

Losito, P., Visciano, P., Genualdo, M., Satalino, R., Migailo, M., Ostuni, A., & Cardone, G. (2017). Evaluation of hygienic conditions of food contact surfaces in retail outlets: Six years of monitoring. LWT, *77, 67-71.*

Mahmoud, E. A., (2013). Studies on improvement shelf-life and safety of minced beef with some spices on their volatile oils. Ph. D. Dept. food science and technology. Faculty of Agriculture. Al-Azhar University. Assiut. Egypt.

Mohamedin, A., Michel, M., & Tolba, M. (2015). Assessment of the microbiological quality of public restaurants and street vended ready-to-eat "kochari" meals. International Journal of Applied Sciences and Biotechnology, *3(3), 452-458.*

New South Wales (NSW) Food Authority (2012). Microbiological Quality Guide for Ready-To-Eat Foods: A Guide to Interpreting Microbiological Results. Accessed 22 May 2012.

Odu, N. N., & Akano, U. M. (2012). The microbiological assessment of ready-to-eat-food (Shawarma) in Port Harcourt City, Nigeria. Nat Sci, 10(8), 1-8.

Oranusi S and Braide, W. A. (2012). Study of microbial safety of ready-to-eat foods vended on highways: Onitsha-Owerri, South east

Nigeria, International Research Journal of Microbiology, *3(2): 066-071.*

Oranusi, S. & Olorunfemi, O. J. (2011). Microbiological safety evaluation of street vended ready-to-eat fruits sold in Ota. Ogun state, Nigeria, International Journal of Research in Biological Sciences, *1 (3): 22-26.*

Osimani, A., Aquilanti, L., Tavoletti, S., & Clementi, F. (2013). Evaluation of the HACCP system in a university canteen: Microbiological monitoring and internal auditing as verification tools. International Journal of Environmental Research and Public Health, *10(4), 1572-1585.*

Ravishankar, S., Zhu, L., & Jaroni, D. (2010). Assessing the cross contamination and transfer rates of Salmonella enterica from chicken to lettuce under different food-handling scenarios. Food Microbiology, *27(6), 791-794.*

Salem Z.A. (2004). Microbial quality of some ready to eat foods and beverages distributed in the local market of Tanta (Gharbia). M. Sc. Thesis, Faculty of Home Economic, Minufia University.

SAS Institute (2008). The SAS system for Windows, release 9.2.SAS Institute, Cary, N.C. USA.

Snedecor GW, Cochran WG (1989). Statistical methods. Iowa University Press Ames.

Tomasevic, I., Kuzmanović, J., Anđelković, A., Saračević, M., Stojanović, M. M., & Djekic, I. (2016). The effects of mandatory HACCP implementation on microbiological indicators of process hygiene in meat processing and retail establishments in Serbia. Meat Science, *114(8), 54-57.*

WHO (2004). Global strategy for food safety: safer food for better health. World Health Organization, Geneva.

Yang, S., Pei, X., Wang, G., Yan, L., Hu, J., Li, Y., & Yang, D. (2016). Prevalence of food-borne pathogens in ready-to-eat meat products in seven different Chinese regions. Food Control, *65, 92-98.*

Zain, M. M., & Naing, N. N. (2002). Sociodemographic characteristics of food handlers and their knowledge, attitude, and practice towards food sanitation: a preliminary report. Southeast Asian Journal of Tropical Medicine and Public Health, *33(2), 410-417.*

تقييم المخاطر الميكروبيولوجية لبعض مطاعم الفلافل المصرية بمحافظة سوهاج

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الملخص العربي

هدفت هذه الدراسة إلى التعرف على وجود البكتيريا المسببة للأمراض في سندوتشات الفلافل، ومسحات أيدي متداولي الطعام، ومسحات الأسطح الملامسة للأغذية التي تم الحصول عليها من 5 مطاعم فلافل، وكذلك تطبيق اشتراطات سلامة الغذاء للسيطرة على أنواع البكتيريا المسببة للأمراض. تم جمع العينات عشوائياً وتحت ظروف محكمة من مطاعم الفلافل في محافظة سوهاج. أشارت النتائج إلى أن العدد الإجمالي للبكتيريا في جميع المطاعم تراوح من 5.09 إلى 6.63 مستعمرة / جرام في سندوتشات الفلافل، ومن 3.02 إلى 4.69 مستعمرة / جرام في مسحات اليد، ومن 3.24 إلى 4.37 مستعمرة / جرام في مسحات الأسطح. وتراوحت نسبة الإيشريشيا القولونية في جميع المطاعم من 3.61 إلى 4.79 مستعمرة / جرام في سندوتشات الفلافل، ومن 2.23 إلى 3.58 مستعمرة / جرام في مسحات اليد، ومن 2.17 إلى 2.80 مستعمرة / جرام في مسحات الأسطح. تم العثور على المكورات العنقودية الذهبية في جميع العينات التي تم اختبارها، حيث تراوحت من 2.02 إلى 3.74 مستعمرة / جرام في سندوتشات الفلافل، ومن 2.63 إلى 5.27 مستعمرة / جرام في مسحات اليد، ومن 2.57 إلى 4.53 مستعمرة / جرام في مسحات السطح. تم الكشف عن وجود السالمونيلا في جميع العينات التي تم اختبارها في جميع المطاعم، حيث تراوحت من 2.61 إلى 2.99 مستعمرة / جرام في سندوتشات الفلافل، ومن 2.21 إلى 3.43 مستعمرة / جرام في مسحات اليد، ومن 2.31 إلى 4.00 مستعمرة / جرام في مسحات السطح. ومن خلال تطبيق متطلبات سلامة الأغذية، كان إجمالي عدد البكتيريا منخفضًا بشكل ملحوظ وتراوح من 1.14 إلى 2.14 مستعمرة / جرام. انخفض عدد المكورات العنقودية الذهبية بشكل ملحوظ في جميع العينات، ولم يتم اكتشاف الإيشريشيا القولونية والسالمونيلا في جميع العينات التي تم اختبارها.