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# Bacteriological Assessment of Some Food Meals Served in Egyptian Hotels

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**ABSTRACT:**

Meat and meat products are among the food categories most frequently involved in food-borne diseases. Hence, a total of 120 ready to eat meals (RTE) RTE random meat steak, beef burger, chicken Piccata, and fish Filet (30 of each) were collected to assess their quality. As a hygienic indicator, aerobic bacterial count (APC), Coliforms count (CC) and *Staph. aureus* were investigated, and the results showed that $1.5\times10^4 \pm 3.96\times10^3$; $1.76\times10^2 \pm 2.9\times10$ and $8.35\times10 \pm 1.4\times10$ for Meat Steak, $3.6\times10^4 \pm 1.5\times10^4$; $2.72\times10^2 \pm 5.8\times10$ and $1.09\times10^2 \pm 2.46\times10$ for Beef burger, $1.559\times10^4 \pm 6.42\times10^3$; $2.99\times10^2 \pm 6.89\times10$ and $1.06\times10^2 \pm 2.7\times10$ for Chicken piccata and $5.48\times10^4 \pm 2.3\times10^4$; $7.3\times10^2 \pm 1.42\times10^2$ and $2.5\times10^2 \pm 6.99\times10$ for Fish Fillet, respectively. *E. coli* also was investigated revealing that 26 (21.6%) of the examined samples were unsuitable for human consumption represented by 4(13.3%), 11(36.6%), 3(10%) and 8(26.6%) of the examined meat steak, beef burger, chicken Piccata and fish Filet samples were rejected because they contaminated with *E. coli*, respectively. According to the findings of the serological identification of the *E. coli* isolates, the strains of EPEC were the most common, followed by EHEC, ETEC, and EIEC. Therefore, strict hygienic practices must be followed when receiving, preparing, storing, and handling every food item in order to maintain the health of the consumer and provide wholesome meat meals.

**Keywords:** Microbial count**,** beef burger, meat steak, chicken Piccata, fish Filet, *E. coli*.

## INTRODUCTION

Meat is the most significant component of our diet and provides an excellent supply of high-quality proteins since it includes all of the amino acids that are necessary for human survival. However, the high moisture content, high percent of nitrogenous substances, abundant supply of minerals, glycogen, and their optimal pH for most microbes, so it is regarded as a good culture medium for the growth of many organisms (Wyness, 2016).

One of the dietary categories most frequently linked to pathogen-caused foodborne illness is meat and meat products. Since microorganisms are found in animals, in their environments, and on their bodies, it is inevitable that meat and meat products will become contaminated by them. In the fight to maintain low levels of contamination and guarantee the microbiological safety

and quality of the products along the whole meat chain, from farm to table, meat processors and producers encounter numerous obstacles (Terrell and Hernandez-Jover, 2023).

There are many dangerous microbes in water, soil, animals, and people. These germs can spread to meat dishes and result in food-borne illnesses. Also present on utensils, clothes, hands, and cutting boards. Dangerous bacteria are present in raw food, particularly in poultry, meat, and their juices, and they can spread to other foods during preparation and storage (Hanson et al., 2011).

Total coliform and aerobic plate counts are two criteria for microbial contamination and hygienic standards during meat preparation (Hamed et al., 2015). They are used as an indicator of the bacterial population because it is unable to different between different kinds of bacteria. Aerobic plate counts can also be used to determine the expiration date and quality of food. Total coliform has demonstrated the ability to detect the presence of fecal materials (Shaltout et al., 2019).

Food poisoning, food deterioration and intoxications are the main causes of food-borne outbreaks (FBOs), which are caused by microbial contaminations and their toxins. A rough estimate of 92 million Africans acquires illnesses from eating tainted food each year, leading to 137,000 fatalities. Moreover, in many of these nations on this continent, food safety does not appear to be a big concern (Nagingo et al., 2022).

The most important bacterial pathogens in cattle that cause foodborne diseases are Salmonellae, coagulase positive bacteria, and *E. coli*. *Escherichia coli* is generally a commensal, non-pathogenic microorganism, certain strains have acquired pathogenic and/or toxigenic virulence traits that render them hazardous to both animals and people. It is now recognized as a hazardous food-borne pathogen that connected to several disease outbreaks caused by contaminated meat products (Croxen et al., 2013; Ezzat et al., 2014).

Staphylococciare present on the skin and in the nose of about 25% of both humans and animals. In healthy individuals, Staphylococcitypically does not result in disease, but it has the capacity to produce toxins that can result in food poisoning (CDC, 2018). Maintaining proper personal hygiene is crucial for food handlers in order to create a safe work environment and stop the spread of foodborne illnesses (ISO, 2017).

So, this study was aimed mainly to evaluate the level of hygiene in Egyptian hotels through determination of aerobic plate, Coliforms, *Staph. aureus* counts as well as isolation of *E. coli.*

## MATERIAL AND METHODS

### ***Samples collection***

Sample collection was carried out over an eighteen-month period from February 2022 to July 2023. A total of 120 arbitrary samples of meat steak, beef burger, chicken piccata, and fish fillet (30 of each) were gathered from different Egyptian hostels.

Approximately 100g was the weight of each sample. The samples were immediately transferred in aseptic packages and transported, under sterile conditions in an insulated ice box, to the Laboratory.

### ***Samples preparation (ISO, 2008)***

After preparing 25g of each sample and adding 225 ml of sterile peptone water (0.1%) aseptically on top, the mixture was well homogenized for 1-2 minutes at 2000 rpm using a sterile

blender. This allowed for the preparation of ten-fold serial dilutions.

***Bacteriological examinations***

**I. *Aerobic plate count (APC)* (ISO, 2013)**

Using the pour-plate method, 1 ml of the previously made serial dilution was cultivated in APC agar and incubated for 48 hours at 37 °C. The number of plates with between 30 and 300 colonies was counted. APC equals the dilution factor (cfu/g) multiplied by the median number of duplicate plates.

**II. *Coliform count (CC)* (ISO, 2006)**

Using pour-plate method, 1 milliliter of the previously made serial dilution was cultivated in Violet Red Bile (VRB) agar and incubated for 24 hours at 37 °C. Record counts of suspected colonies.

**III. Identification and Isolation of *Escherichia coli* (ISO, 2006)**

Samples were cultured on the MacConkey agar plate for 24 hrs. The typical rose-pink colony of *E. coli* appeared on MacConkey agar medium, then the suspected colony cultured on EMB media the typical colony gave the characteristic green metallic sheen. The isolates were further identified based on the biochemical tests and the serology using O and H antigens according to Kok et al. (1996) by using rapid diagnostic *E. coli* antisera sets for diagnosis of the Enteropathogenic types. Slide agglutination tests were performed with the diagnostic sera to identify the O-antigen.

**IV. *Staphylococcus aureus* count (ISO. 2003)**

Over Baird-Parker agar plates, 0.1 ml of the previously made serial dilution was spread on the plates and were incubated at 35±2 °C for 24-48 hours. Suspected colonies in positive samples were recorded.

**Statistical analysis**

Data were presented as the mean ± standard deviation. Means were compared using ANOVA using statistical package for Social Sciences (SPSS) version 23.0 (IBM Crop., Armonk, NY), and analysis of variance at 95% significance (P = 0.05).

## RESULTS

Results in Table 1. For aerobic plate count (APC), coliform count (CC) and *Staph aureus* count revealed that the samples of beef burgers and fish fillets had the greatest bacterial counts.

**Table 1.** Mean values of APC, CC and *Staph. aureus* count (CFU/g) of examined samples (n=30).

| Meal samples | Aerobic plate count | Coliform count | *Staphylococcus aureus* count |
|---|---|---|---|
| Meat Steak | $1.5\times10^4 \pm 3.96\times10^3$ | $1.76\times10^2 \pm 2.9\times10$ | $8.35\times10 \pm 1.4\times10$ |
| Beef burger | $3.6\times10^4 \pm 1.5\times10^4$ | $2.72\times10^2 \pm 5.8\times10$ | $1.09\times10^2 \pm 2.46\times10$ |
| Chicken piccata | $1.56\times10^4 \pm 6.42\times10^3$ | $2.99\times10^2 \pm 6.89\times10$ | $1.06\times10^2 \pm 2.7\times10$ |
| Fish Fillet | $5.48\times10^4 \pm 2.3\times10^4$ | $7.3\times10^2 \pm 1.42\times10^2$ | $2.5\times10^2 \pm 6.99\times10$ |

**Table 2.** Incidence of aerobic bacterial count (APC), Coliforms count (CC), *E. coli* and *Staph. aureus* isolated from the examined meat samples (n=30).

| Mealsamples | Aerobic plate count | | Coliform count | | *E. coli* | | *Staph. Aureus* | |
|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % |
| Meat Steak | 1 | 3.3 | 0 | 0 | 4 | 13.3 | 0 | 0 |
| Beef burger | 2 | 6.6 | 2 | 6.6 | 11 | 36.6 | 0 | 0 |
| Chicken piccata | 1 | 3.3 | 3 | 10 | 3 | 10 | 0 | 0 |
| Fish Fillet | 4 | 13.3 | 6 | 20 | 8 | 26.6 | 3 | 10 |

Table 2. recorded the results of fish fillet samples that revealed the highest prevalence of *E. coli* and *S. aureus* (16.6 and 10%, respectively); additionally, 6.6% of the tested beef burger samples had *E. coli*, but the most examined samples of meat steak were free of harmful bacteria.

**Table 3.** Incidence and serotyping of *E. coli* isolated from examined samples (n=30)**.**

| **Strain characteristics** | **Meat steak** | | **Beef burger** | | **Chicken piccata** | | **Fish fillet** | | **Meals** |
|---|---|---|---|---|---|---|---|---|---|
| | % | No. | % | No. | % | No. | % | No. | **E. coli strains** |
| **EPEC** | - | - | - | - | 3.3 | 1 | - | - | **O17: H18** |
| **EHEC** | 3.3 | 1 | - | - | - | - | 6. 7 | 2 | **O26: H11** |
| **EPEC** | - | - | 3.3 | 1 | - | - | 3.3 | 1 | **O55: H7** |
| **EPEC** | - | - | 6. 7 | 2 | - | - | 3.3 | 1 | **O86** |
| **EHEC** | - | - | - | - | 6.7 | 2 | - | - | **O91: H21** |
| **EHEC** | - | - | - | - | - | - | 10 | 3 | **O111: H2** |
| **EPEC** | - | - | - | - | - | - | - | - | **O114: H4** |
| **ETEC** | 6.7 | 2 | 3.3 | 1 | - | - | - | - | **O125: H21** |
| **ETEC** | - | - | 13.3 | 4 | - | - | 3.3 | 1 | **O128: H2** |
| **EPEC** | 3.3 | 1 | 10 | 3 | - | - | - | - | **O146: H21** |
| **EIEC** | - | - | - | - | - | - | - | - | **O159** |
| **Total** | 13.3 | 4 | 36.6 | 11 | 10 | 3 | 26.6 | 8 | **26 (21.6%)** |

Table 3. illustrated the findings of the serological identification of the *E. coli* isolates, the EPEC strains (O17: H18, O55:H7, O86, O114:H4 and O146:H21) were the most prevalent, followed by EHEC (O26:H11, O91: H21, O111:H2), ETEC (O125:H21 and O128:H2), and EIEC (O159). The recorded results, 26 (21.6%) of the examined samples were deemed unfit for consumption; represented by, 4 (13.3%), 11 (36.6%), 3 (10%), and 8 (26.6%) of meat steak, beef burger, chicken Piccata and fish

fillet that were rejected due to the presence of *E. coli*, respectively.

## DISCUSSION

Safety of food is a complicated topic, and meat and other animal proteins are typically considered high-risk commodities due to the presence of pathogens, natural poisons and other potential contamination (Vågsholm et al., 2020).

Table 1. revealed the results of the aerobic plate count (APC), Coliform count (CC) and *Staph. aureus.* The APC results obtained from the various meal samples under examination were consistent with those reported by Hassanien et al. (2015) ($7.34x10^4$ CFU/g in burger samples) and Hassan (2015) ($5.07x10^4$ cfu/g in chicken piccata samples), while greater results were mentioned by Salem et al. (2019) ($1.37\times10^6$ for Meat Steak samples), and Sameeh et al. (2022) ($18.5 \times 10^7$ for burger samples); but lower than those recorded by Setha et al. (2022) ($7.41x10^2$ for beef burger samples) and Elbarbary et al. (2023) ($2.7 \times 10^2$) and Saelens and Houf (2024) (4.6 cfu/g) for Fish fillet samples.

The high APC reflects the unhygienic way that meat is cooked, prepared and served. Regarding CC, they were higher than those reported by Hassan et al. (2015) ($1.06\times10^4$) and Salem et al. (2019) ($4.54\times10^4$) in meat steak samples and Hassanien et al. (2015) ($1.73x10^3$ CFU/g in Beef burger samples); while lower than those collected by Edris et al. (2017) (2.19 CFU/g in Fish Fillet samples), and Incili et al. (2023) failed to detect coliform in meat steak samples.

The fish fillet samples had the highest coliform level, which suggested unsanitary handling and preparation circumstances combined with low-quality fish fillet. Contaminated water, contaminated hands, cutting boards, or blades are also thought to be major sources of coliforms in the meat processing industry (Saad et al., 2020).

The main cause of the development and multiplication of these organisms is the food storage especially at room temperature for a few hours. From the many phases of handling and preparation to serving till consumption, contamination happened. The danger of excessive contamination rose when these dishes were made in kitchens with plenty of individuals and staff members handling them (Rane, 2011).

The results recorded in Table 2. revealed the incidence of *E.coli* and *S. aureus* in examined meal samples were less than reported by Salem et al. (2019) (*E.coli* found in 32% of Chicken piccata samples) and Shaltot et al. (2015) (*S. aureus* mean was $2.76\times10^3$ CFU/g in Beef burger samples); while lower *E.coli* results were reported by Khairy et al. (2021), Shaltot et al. (2015), and Allewy (2015) (20%, 10%, and 22% respectively). And Beef burger lower samples were obtained by Mitiku et al. (2022) (21.21% in Fish fillet samples) and Hassan (2015) (5% In Chicken piccata samples).

Moreover Table 3. showed the findings of the serological identification of the *E. coli* isolates, with the EPEC strains (O17: H18, O55:H7, O86, O114:H4 and O146:H21) being the most notable; followed by EHEC (O26:H11, O91: H21 and O111:H2) and finally with ETEC (O125:H21 and O128:H2), and EIEC (O159). 26 (21.6%) of the examined samples so these samples deemed unfit for human consumption; represented by, 4 (13.3%), 11 (36.6%), 3 (10%), and 8 (26.6%) of meat steak, beef burger, chicken Piccata, and fish fillet samples

were rejected due to the presence of *E. coli*, respectively.

This result may differ significantly or significantly from others due to the high scale of serological typing. When pathogenic *E. Coli* strains are exposed to humans, it can cause hemolytic uremic syndrome, hemorrhagic colitis and gastroenteritis (Pavithra and Ghosh, 2013).

*S. aureus* may be present in raw meat or on the hands of people handling food. Food handlers can contaminate food through their mouths, noses, and skin, thus good hygiene is crucial. Avoiding cross-contamination and keeping food at the right temperature (refrigerated or heated) will stop the organism from multiplying and producing heat-stable enterotoxins (Tegegne and Phyo, 2017).

*Staphylococcus aureus* can be isolated from meat that had been received and late-served. This finding could be explained by the fact that cocci are typically more heat resistant than rods, making them useful as targets for mild thermal treatments. It could also be related to poor hand hygiene, as these infections happen when people handle cooked food who have the pathogen on their skin or in their nails. (Rattanasena and Somboon, 2010).

## CONCLUSION

According to the results, handling and processing of meat and chicken meat products took place in an unsanitary and unhygienic environment; improper cooking and storage methods also seemed to have a significant impact on the quantity and quality of bacteria present in cooked meat meals; the areas around food surfaces that come into close contact with one another, such as cutting boards and food handlers, represent the most important points for cross-contamination between raw and cooked meat. Therefore, it is important to follow stringent hygiene guidelines when receiving, preparing, storing, and handling each food item to ensure that meat meals are nutritious, and that customers' health is maintained.

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