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Case Study of the Identification with Assessment of Bacterial Contaminants in Food and Environments in a Restaurant at Baghdad University

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Abstract: Foodborne bacterial contamination remains a significant public health concern, particularly foodborne illnesses, which are prevalent in Iraq and worldwide due to poor food handling and hygiene. The current study focused on the prevalence, presence, and types of bacterial contaminants in food served at the Student Club Restaurant at Baghdad University, as well as on kitchen utensils, hands, and hair of restaurant staff. A total of 150 samples were collected over six months (January–June 2024), including food items, utensil swabs, and staff hygiene samples. Bacterial isolation and identification were performed using standard microbiological techniques, including culture on selective media and Gram staining. The results revealed that food samples had the highest contamination rates (33.4%), followed by cooking utensils (26.6%), hands (20%), and hair (20%). The most frequently isolated bacteria were *E. coli* (33.3%) and *Staph. aureus* (16.2%). These findings highlight the roles of poor hygiene practices, inadequate food storage during cooking, and high environmental temperatures, which promote bacterial growth and food contamination. Therefore, the study highlights the urgent need for improved hygiene protocols, awareness of food safety issues among restaurant staff, and regular monitoring to ensure the health and safety of university students eating on campus.

Keywords: University, restaurant, contamination, public health, *E. coli*.

Introduction

Bacterial contamination is the most widespread disease in societies, affecting humans throughout their lives. Food poisoning is generally spread through contaminated food [1]. Therefore, hundreds of millions of cases of food poisoning occur monthly due to contaminated meals cooked in restaurants and sold in stores, which contain multiple types of bacteria [2]. Fast food from restaurants is considered the most influential and causative factor for food poisoning, leading most communities to shift to eating meals from restaurants or takeaway food stores [3]. There are some factors that increase the spread of food poisoning, including food preservation and cooking methods, as well as seasonality, such as summer, when food poisoning happens more often than in other seasons due to higher temperatures and increased bacterial proliferation, creating a favorable environment for them [4,5]. Therefore, bacterial food poisoning is defined as a group of symptoms and signs that include vomiting, diarrhea, abdominal cramps, nausea, fever, headache, and serious complications affecting the digestive, nervous, and respiratory systems. These symptoms appear after eating contaminated food and occur within 1-48 hours. Not all of these symptoms and signs will necessarily appear in every person with food poisoning, with the same severity.

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Materials and Methods

Sample Collection

Samples were collected randomly from food served to students at the Student Club at Baghdad University for the detection of bacterial load. Also, swabs were collected from the hands and hair of restaurant staff, as well as from cooking utensils. A total of 150 different samples were collected, as shown in Table 1. Samples prepared for testing were stored in special refrigerated containers until they arrived at the laboratory, after being collected in sterile laboratory tubes. The samples were collected twice weekly, and each sample contained two containers. for the period from January to June 2024.

Sample Inspection

After the samples arrived at the laboratory, the solid and semi-solid foods were isolated and emulsified to release and identify microorganisms (bacteria) from the adhering food. To be done later, Bacterial isolation was performed less than an hour after sample collection, Samples were prepared and cultured twice in duplicate. The samples were put in an incubator at room temperature, 37°C, for 48 hours. Then, the number of colonies was counted using a colony counter, after the incubation period was over, the colonies bacteria for the microscope after staining them with Gram stain to determine their affinity for this stain (+,-) with to determine their shape according Abbasi et al., (2020) [8].

Results

The results of the current study showed that the highest rate of bacterial contamination was apparent in food samples taken from restaurants, followed by samples from workers' hands and cooking utensils, respectively. while the lowest bacterial load was found in hair sample The results of the examination in this study also showed that *E. coli* bacteria recorded the highest rate, while *Bacillus sereus* (*B. cereus*) bacteria showed the lowest rate during the current research period, as shown in Table 2.

Table 1: Shows the complete percentages of the number of samples.

Sample	No. of sample	Rate
Hair	30	20 %
Cooking utensils	40	26.6 %
Hands	30	20 %
Food	50	33.4 %
Total	150	100

Table 2: Frequency ratio of isolated bacteria.

Species	food sample %	Hands sample %	Utensils sample %	Hair sample %
E. coli	32.5	33.3	34.4	66.6
Staph. aureus	23.3	30	37.9	-
Staph. albus	12.1	16.6	-	-
Strep. spp	8.13	16.6	-	33.3
B. cereus	6.5	3.3	27.5	-
B. subtilus	16.2	-	-	-

Discussion

In the current study, as shown in Table 1, the highest percentage of sufficient bacterial contamination in food served in the restaurant is consistent with [9]. There is a difference in contamination, and depends on the effect of the types and numbers of bacteria present on the food, the type and quantity of contamination by the growth of certain types, and this contamination increases according to the number of various bacterial organisms in the food [10]. Therefore, failure to maintain the cleanliness and sterilization of all equipment used in food preparation poses a significant threat of contamination with bacteria and other microorganisms [11]. Although food is essential for the life and growth of living organisms, bacteria can be a source of epidemics, especially for humans. However, important to reduce its quantity as much as possible.

Therefore, the types of food most exposed to contamination by harmful bacteria are meat and its products, as well as poultry, fish, dairy and its products. Processed, cooked, and spoiled canned foods also show signs of contamination more quickly, as do fast foods sold on the street [12], According to the World Health Organization (2015) [13], diseases transmitted through contaminated food are classified as foodborne infectious diseases and are considered serious. The most important of these diseases is brucellosis, bacillary dysentery and cholera [14].

The most common causes of food poisoning in the world and Iraq are Salmonella (enteritis) and Staphylococcus aureus bacteria [15,16] in Among the foods that were examined was the food provided by the restaurant, which is considered a daily food served to university students. Therefore, contamination and bacterial growth occur through the process of preparation and preservation at a temperature suitable for the growth of many types of bacteria for a period ranging from 10 to 24 hours [17,18]. The study results also showed that *E. coli* was one of the most isolated and identified bacteria in food throughout the research period. E.coli possesses certain special and distinctive characteristics that make important in food spoilage [19,20]. Among its nutritional properties are its ability to grow in a variety of materials, *E. coli*'s consumption of a large amount of organic matter as an energy source, and its ability to thrive in a range of environments and temperatures [21].

E. coli's is considered one of the most common aerobic bacteria in the digestive tract of humans and animals. *E. coli's* widely distributed in nature and is found in water as well as food. Escherichia coli contamination with face's is often an important indicator of water and food contamination. This is what reports published over the past ten years have indicated, indicating that the main cause of infection is through food [22,23].

While *Bacillus cereus* recorded the lowest rate among all the bacteria in the study, this is consistent with [24,25] confirmed that a few cases of food poisoning are caused by these bacteria, which produce their toxins in food. *Bacillus cereus* is common in grains and soil and is widely distributed in foods such as vegetables, dairy products, and meat. *Bacillus cereus* causes vomiting and diarrheal diseases, which are becoming more important in the industrialized world. This is inconsistent with [26], who found this bacterium ranked second among the germs they recorded in their experiment. may be due to the resistance of these bacteria to heat and unnatural conditions, making them a significant problem in food preservation methods. The increased bacterial contamination during milder weather, such as spring and early summer, may be an indicator that climate plays a significant role in the proliferation of bacteria, The US Public Health Agency has stated that two-thirds of food poisoning cases result from food served in restaurants [27]. Furthermore, basic hygiene requirements are likely to be met, as clean utensils and the absence of dirt are essential to preventing food contamination [28].

Conclusion

The current study has proven that the most common bacteria found in food is *E. coli*, while the least common bacteria is *Bacillus cereus*. Therefore, the lack of health and hygiene awareness, weak monitoring of restaurants, and the lack of regular inspections in the restaurant (student club) led to the presence of many types of bacteria in food.

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