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Two-Year Monitoring of Staphylococcus aureus Contamination in Traditional Shahroud Kebab and Ice Cream and Its Consequences on Public Health

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Abstract

Background: *Staphylococcus aureus is a common enterotoxin-producing bacteria that can grow in food products such as kebabs and ice cream and cause food poisoning.*
Methods: *Using standard food sampling methods, over the course of two years from 2022 to 2024, samples of kebab and ice cream were collected from all traditional ice cream and traditional kebab stores in Shahrood, with a total number of 252 samples, and the amount of Staphylococcus aureus in these samples was examined according to the standard method of the Food Control Department.*
Results: *In terms of examining the contamination of the samples examined with Staphylococcus aureus bacteria, 37 cases (14.7%) were identified as positive out of a total of 252 samples. To examine the seasonal relationship and sample type, the chi-square test and logistic regression were used. The results showed that there was no significant relationship between the type of sample and the result of contamination with Staphylococcus aureus (P-value>0.05). The results of the logistic regression analysis also showed that the type of sample had no effect on the result of contamination.*
Conclusions: *The results of the present study show that the health index of kubideh kebab and chicken kebab, as well as ice cream in Shahroud city, is at a suitable level compared to other studies, which is attributed to the observance of hygiene in this area.*

Keywords: Ready to eat food, Staphylococcus aureus, Kebab, Ice cream, Shahroud.
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Introduction

Monitoring and controlling food quality plays a vital role in maintaining public health [1]. Whether raw or cooked, these materials can be a source of transmission of pathogens [2–6]. Ensuring the safety of these materials not only prevents the occurrence of foodborne diseases, but also helps to improve the quality of nutrition and promote public health [7–9]. Continuous and careful examination of food at all stages of production, distribution and consumption is essential to prevent microbial and chemical contamination [10]. Raw and cooked foods are susceptible to contamination with pathogens due to different preparation and distribution processes. These agents include bacteria, viruses and fungi [1,8,10,11]. The presence of these pathogens in food can lead to problems such as food poisoning, digestive disorders and even the spread of infectious diseases in the community [1,7,8,10,11]. Cooked foods, in particular, that are stored or distributed at inappropriate temperatures provide an ideal environment for the growth of pathogenic microorganisms [9,10,12,13].

With changing lifestyles and increasing demand for ready-to-eat and take-away foods, the consumption of these types of foods has increased dramatically [9,14]. This trend is accompanied by an increase in food-borne illnesses, emphasizing the importance of monitoring the safety of these products. Actions such as strict control during production and distribution, and raising public awareness about the risks of consuming contaminated foods are effective strategies in this regard [8,9,14]. Implementing such interventions can prevent foodborne epidemics and play an important role in ensuring public health [8]. Foodborne illnesses are a major public health challenge worldwide [6].

The World Health Organization (WHO) reports that approximately 420,000 people die each year from foodborne illness and nearly 600 million people develop foodborne illnesses [15–17]. These deaths are mainly due to illnesses associated with the consumption of food contaminated with bacteria, viruses, toxins, and parasites. The WHO notes that approximately 40% of deaths from foodborne illness are among children under 5 years of age [15–17]. Foodborne illnesses can cause symptoms such as diarrhea, vomiting, fever, and in more severe cases, dangerous infections [15,16].

These global statistics clearly highlight the importance of observing food safety and maintaining public health. In developing countries such as Iran, observing hygiene principles in the process of food production and distribution and improving public education can play an effective role in reducing this statistic. Raw foods such as ice cream and cooked foods such as kebabs are susceptible to microbial contamination due to specific preparation, storage, and distribution processes [5,8,14]. In Iran, food-related diseases are also a significant challenge for the public health system [14]. According to official reports, the high prevalence of food poisoning caused by contaminated take-out foods highlights

the need for continuous monitoring and surveillance in this field [3,14].

Food poisoning is more prevalent, especially during the warmer seasons, due to increased bacterial growth and consumption of contaminated foods [18]. In recent years, the rate of food poisoning in Iran has increased significantly. According to reports, between 4,000 and 10,000 hospital admissions due to food poisoning are recorded annually, of which about 4.6% are due to staphylococcal toxin poisoning [3,19], and the highest number of cases were reported in rural areas [19].

Food hygiene plays a key role in the prevention and control of foodborne illnesses [19]. Implementing hygiene standards during the production, storage, and distribution stages of food can prevent the growth of pathogens and their transmission to the consumer [15]. Effective strategies for reducing foodborne illnesses include training employees involved in the production and supply chain, adhering to food safety principles, and increasing public awareness of potential risks [16]. Continuous monitoring of the hygiene of food preparation and supply environments and the use of accurate monitoring systems can have a significant impact on reducing the spread of these diseases and improving community health [18].

Food contamination with Staphylococcus aureus usually occurs due to factors such as contact with contaminated hands, storage at inappropriate temperatures, or lack of hygiene during preparation and distribution [20]. Temperature control, personal and environmental hygiene, and continuous monitoring of food quality are preventive measures. Personal and environmental hygiene, thorough hand and tool washing, storage of food at appropriate temperatures (less than 5°C or more than 60°C), and reduction of food storage time are the main strategies for preventing contamination [3,6,19,20]. The prevalence of staphylococcus in ready-to-eat foods in Iran, India, Pakistan, China, and Afghanistan has been reported to be about 15.42%, 15%, 28.57%, 2.1%, and 13.33%, respectively [9,21–24]. In European countries, the prevalence of this bacterium in ready-to-eat foods has also been reported to be 15.7% [25].

Materials and Methods

The present study is a descriptive-cross-sectional study conducted in Shahroud city. In this study, 252 food samples including ice cream, Kubideh kebab and chicken kebab were examined for contamination with Staphylococcus aureus in 2022 and 2023 using the available sampling method. The samples were stored in different seasons and for two consecutive years according to FDA guidelines and tested in the shortest possible time. The maximum time interval between sampling and testing was 1-6 hours. Among the samples taken, 33 ice cream samples, 193 Kubideh kebab samples and 26 chicken kebab samples were tested. The tests to measure Staphylococcus aureus on food samples were performed by the Food Standard Laboratory of the Food and Drug Administration of Shahroud University of Medical Sciences. The results obtained were analyzed using appropriate statistical tests such as the Chi-square test and SPSS version 22 software.

Results

Figure 1 summarizes the contamination status of the samples studied. Of the 252 samples taken, 13.10% were traditional ice cream, 76.60% were Kubideh kebabs, and 10.31% were chicken kebabs.

Table 1 shows the status of staphylococcus in the samples. This table shows what percentage of samples tested positive and what percentage tested negative.

Table 2 and Figure 2 show the level of staphylococcal contamination in kebab and ice cream samples in the sampling years and in different seasons.

To investigate the relationship between season and the results of the Staphylococcus aureus infection test in the present study, the chi-square test was used (Table 3).

Logistic regression analysis was used to control for confounding variables such as season and sample type (Table 4).

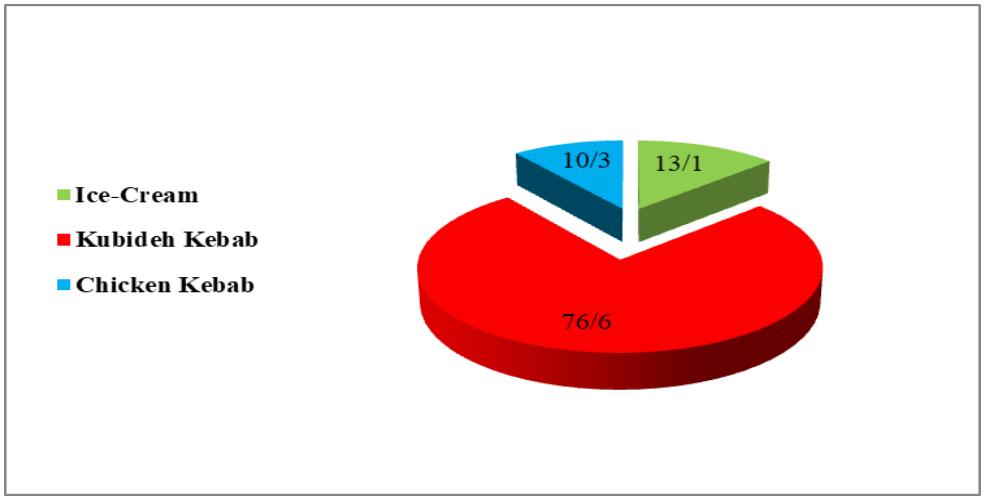

Figure 1. Percentage of sample types tested over two years 2022 and 2023

Table 1. Results of contamination of the studied samples with Staphylococcus aureus

Sample	Result	Percent
Ice-cream	Positive	27.3
	Negative	72.7
Kubideh kebab	Positive	12.4
	Negative	87.6
Chicken kebab	Positive	15.4
	Negative	84.6

Table 2. Frequency of samples examined for staphylococcal contamination by year

Sample	Year	Percent
Ice-cream	2022	54.5
	2023	45.5
Kubideh kebab	2022	71.5
	2023	28.5
Chicken kebab	2022	65.4
	2023	34.6

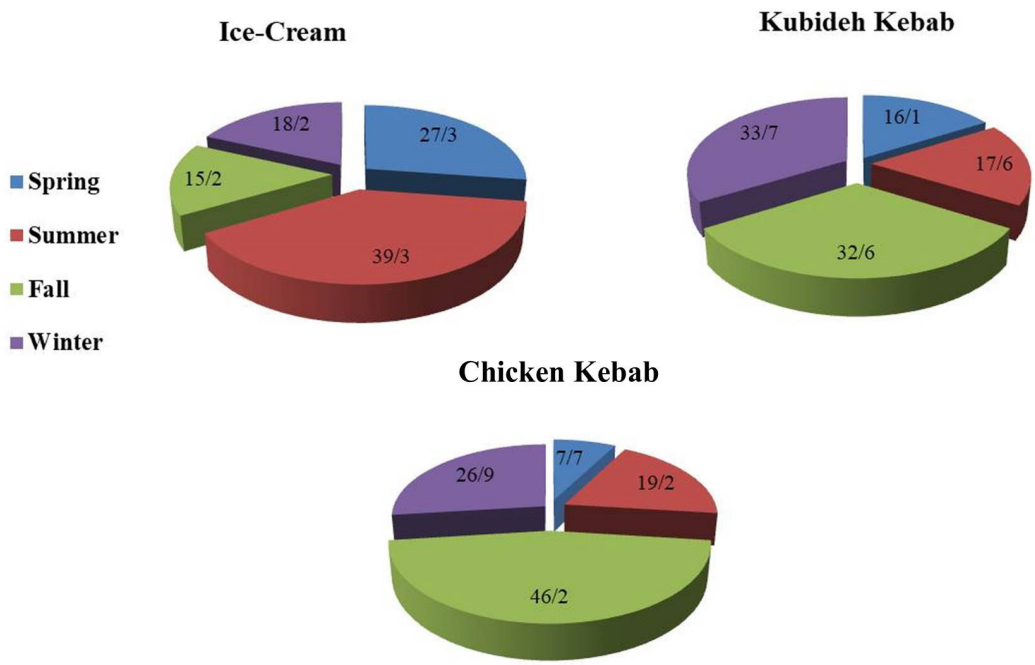

Figure 2. Frequency of samples examined for staphylococcal contamination by season

Table 3. The relationship between season and the outcome of Staphylococcus aureus infection

Sample	Season	P-value
Ice-cream	Spring Summer Fall Winter	0.58
Kubideh kebab	Spring Summer Fall Winter	0.07

Chicken kebab	Spring Summer Fall Winter	0.24

Table 4. Logistic regression analysis to examine the effect of season and sample type

	Beta	Standard error	P-value
Total of samples	-0.605	0.381	0.112

Discussion

Staphylococcus aureus was isolated in 27% of ice cream samples, 12% of Kubideh kebab samples, and 15% of chicken kebab samples, respectively. The total number of samples collected was 252, which included ice cream, Kubideh kebab, and chicken kebab. These three types of food are among the most widely consumed traditional foods prepared outside the home (Figure 1).

Of the 252 meat products studied, the largest number of samples was related to Kubideh kebab. In a search for similar studies conducted on the investigation of Staphylococcus in food, it was found that most studies have focused on the investigation of this bacteria in various types of kebabs [8–10,12,14,22,25,26], and studies have also been conducted on dairy products, including milk, cheese, and some ice creams [1,2,11,13,26].

Of the 252 samples examined, 37 (14.7%) were positive for Staphylococcus aureus contamination, with details for each type of sample provided in Table 1. The results showed that the kubideh kebab samples had the lowest level of contamination (12.4%) and the traditional ice cream samples had the highest level of contamination (27.3%). These findings are consistent with the results of studies conducted in other parts of Iran and the world [9,13,14,18,26–30]. In these studies, there were also reports of the presence of Staphylococcus aureus in samples of ready-to-cook processed meats and ready-to-cook kebabs, and higher levels of contamination were reported in some types of traditional and homemade kebabs [8–10,14,20].

In the study, the largest number of samples was collected in 2022 with a frequency of 173 cases (68.7%) and in the fall with a frequency of 80 cases (31.7%) (Table 2 and Figure 2). Probably one of the reasons why the number of samples in the fall is higher than in other seasons is the wider prevalence of food poisoning and referrals to medical centers with symptoms similar to food poisoning in the fall.

The results of the chi-square test showed that there was no statistically significant relationship between the type of samples studied and the result of Staphylococcus aureus infection (Table 3).

The results of Logistic regression analysis showed that the odds ratio was less than 1 and the calculated p-value was not significant (Table 4). These findings indicate that season and sample type do not have a significant effect on the result of the Staphylococcus aureus infection test (Table 4).

Review of previous studies and comparison with the results of the present study showed that season has not been identified as a variable affecting the level of Staphylococcus aureus contamination in other studies [5,8–10,12,14,19,25,31]. Although it may be intuitively expected that the level of contamination would increase in warmer seasons such as spring and summer, statistical analyses did not confirm this assumption. Also, examining the effect of the type of food on the level of Staphylococcus aureus contamination showed that this variable was also not statistically significant. It may seem that the level of contamination in ice cream is higher because it is not cooked, or that in kebabs it is higher because it is prepared traditionally and there is direct contact with the hands of the preparers, but the results showed that the type of food and the level of Staphylococcus present in them were not significant. One possible reason for this could be the training provided by the responsible institutions to food preparation and distribution staff to minimize the risk to consumers during food preparation, cooking, and distribution. This has been confirmed in other studies conducted in Iran and other countries [4,5,8,9,14,22,24,25,32], and only one study reported that the level of contamination in homemade hamburgers was significantly higher than other types of kebabs [22].

Conclusion: One of the most important actions that environmental and food health departments can provide to employees of preparation and distribution units to improve food safety is to observe basic hygiene principles, especially frequent hand washing and wearing masks and hats while preparing, cooking, and distributing food. The results of the present study, which is the result of information collected over two years from the Deputy of Food and Drug Administration of Shahroud University of Medical Sciences, show that the health index of kubideh kebab and chicken kebab, as well as ice cream in Shahroud city, is at a suitable level compared to other studies, which is attributed to the observance of hygiene in this area.

Ethical Considerations

The present study was registered at the Environmental and Occupational Health Research Center of Shahroud University of Medical Sciences with ethics code IR.SHMU.REC.1402.187.

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Conflict of Interest

The authors of the article have no conflict of interest in any part of the article.

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