The effect of seasons on the health and microbial contamination of creamy pastries in Isfahan

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(Received: September 5, 2017; Accepted: November 25, 2017)

Abstract

Food quality control after production is considered very essential for the consumers' health. Among the foods, creamy pastries are much more important because of their high demand and consumption, high humidity and the possibility of secondary contamination. In this research, therefore, the microbial quality of creamy pastries was evaluated in order to enhance public health, reduce the complications of food-borne diseases and treatment costs. In this cross-sectional study, creamy pastries samples were randomly collected in summer and winter. Then, some food poisoning bacteria mold and yeast, and enterobacteriacea were evaluated in samples according to the Iranian national standards methods. Finally, the data were statistically analyzed using SPSS version 16 (T- test). In the samples under study, the lowest and highest levels of contamination were related to salmonella (0%) and yeast (48%) respectively. 38% of the sweets were emerged as non-consumable due to enterobacteriacea and 8% for *Escherichia coli*. The percentage of mold and *Staphylococcus aureus* was 18% and 40%, respectively. Among the microbes under study, the effects of the season were only statistically significant in relation to *Escherichia coli* in summer and *Staphylococcus aureus* in winter. As the findings revealed, there should be more effort to apply the principles of personal and environmental hygiene, along with paying more attention to the safety of the raw materials, and increasing food handlers' awareness and more supervision in the food supply centers.

Key words*:* food poisoning, creamy pastries, microbial contamination, season

Introduction

Today, consumers' sensitivity and awareness in relation to food has greatly increased, and people want to eat high quality healthy food. The health of the food can be investigated in terms of microbial, physical and chemical properties. Microbial contamination of food is important for food-borne diseases, a decrease in food preservation, corrosion and food smell and taste changes. Of the most common threats to human health are diseases caused by the consumption of contaminated water and food, annually leading to food poisoning in the form of gastrointestinal disorders such as nausea, vomiting, diarrhea, abdominal pain and even death all over the world, causing pain and suffering, waste of time and high medical costs. However, these diseases are easily prevented through following hygiene practices in the production, distribution and maintenance of foodstuffs. Therefore, today, given the importance of preventing diseases, it is important to study the causes of food-borne illnesses as well as the ways in which microorganisms enter and survive in food products. In this respect, a lot of studies have been conducted (Kjeldgaard et al., 2010; Kérouanton et al., 2014).

[DOR: 20.1001.1.2717378.2017.1.3.5.5]

Faramarzi and his colleagues (2012) investigated the microbial contamination of protein substances, salads, dairy products, and sweets supplied in west of Tehran. Their findings showed that in the case of contamination with chlorophylls, sweets (13.46%) and protein products (1.73%), *Escherichia coli* in salads (58.33%) and in dairy products (84.9%), *S.aureus* in sweets (4.81%) and in salads (0%), *Bacillus cereus* in sweets (4.18%) and in dairy products (0.39%) were the most contaminated and the healthiest foods, respectively. Accordingly, an important group of foods that their quality control has an important place in the society as due to their production and high consumption rate are confectionery products (Faramarzi et al., 2012; Nikniaz et al., 2011).

The purpose of this study is to investigate the microbial contamination of creamy pastries with regard to their increasing risk factors. Moreover, it is an attempt to study the causes which leads to the food poisoning and microbial spoilage in order to increase the public awareness, prevent illnesses, and reduce personal and social damages, as well as to contribute effectively in the implementation of controlling and monitoring programs to increase health indicators in the society. The studies also show that these management programs can be efficient in reducing food poisoning (Kjeldgaard et al., 2010).

Methods

A. Chemicals and culture media

All chemicals and culture media used in the test have been prepared and used from Merck (Germany).

B. Sample collection

The present research is a cross-sectional study using random sampling. 70 samples, creamy pastries were collected from first class confectioneries in Isfahan in equal numbers in summer and winter. The samples were transferred to the laboratory under appropriate and sterile conditions ($4^{\circ}C$) and were put under necessary tests.

C. Determination of microbial contamination

For this purpose, using sterile ringer solution proper dilutions were prepared from the samples. Then, according to the instructions of the Institute of Standards and Industrial Research of Iran, enrichment media, proprietary and confirmatory chemical testing were used for isolation and enumeration of each microbe. Incubation was carried out at appropriate temperature, time and conditions. Accordingly, the samples were first pre-enriched with sterile buffered peptone water (BPW) followed by incubation for 24 hours at $37^{\circ}C$ and enrichment media of tetrationate and selenite broth for salmonella detection. In the next step, linear culture was performed on Salmonella-Shigella media at 37 ° C for 24 hours. Suspected colonies were then transferred to differentiation culture media such as triple sugar agar, indole, lysine and urea. Baird Parker agar media (BPA) and catalase and coagulase tests were used to detect *S.aureus* (Institute of Standards and Industrial Research of Iran, 2001; 2002).

Plate count agar, Violet red bile glucose agar, Yeast extract chloramphenicol agar were used at temperatures 30 ° C, 37 ° C and 25 ° C for general counts, enterobacteriacea and yeast, respectively (Institute of Standards and Industrial Research of Iran, 2001; 1999).

[DOR: 20.1001.1.2717378.2017.1.3.5.5]

According to the Institute of Standards and Industrial Research of Iran (2001), for detection of *Escherichia coli*, the production of gas in Brilliant Green Broth at 44.5 $^{\circ}C$, Kovacs reagent, a differential media as EMB (Eosin methylene blue) and IMVIC tests were applied.

Finally, the number of microbes was counted and recorded on the basis of cfu/g and the results were compared to the national standards of creamy pastries and samples with higher levels of contamination were declared unusable. Also, SPSS software and T-test were used to examine the results and to compare the effects of season.

Results

According to Table 1, the highest level of creamy pastry contamination in all samples were first due to yeast and then *S.aureus* coagulase-positive bacteria, followed by contamination by enterobacteriacea, mold and *E.coli*. Salmonella was reported as zero in all samples.

As shown in Chart 1, the level of contamination for all microbes was higher in the summer than the winter except for yeast and *S.aureus* bacteria. However, the effect of season was statistically significant ($P < 0.05$ only on *Escherichia coli* and *S.aureus*. That is, in summer, the conditions were more suitable for *E. coli* contamination and in winter for *S.aureus*.

Chart 1: The effect of season on percentage of microbial contamination of creamy pastries

Microbial Types Permissible Limit Cfu/g	Contamination Percentage in All samples	Comparing Contamination Levels in Seasons (p-value)	Mean and Standard Deviation in Winter	Mean and Standard Deviation in Summer
salmonella 0/25g	0%	-	-	-
S.aureus 0/0.1g	40%	0.03*	2260.20±30.91	1680.21 ± 17.43
Enterobacteriaceae 10^2/g	38%	0.26	2671.91 ± 35.88	2684.13 ± 29.31
E.coli 0/g	80%	0.03*	11.61 ± 1.1	19.91 ±6.03
Mold 3×10^3/g	18%	0.14	6997.12 ± 49.45	7008.23 ± 59.32
Yeast 10^3/g	48%	0.78	7965.00 ± 65.4	7953.65 ± 54.91

Discussion

Food poisoning is one of the most common illnesses, strongly threatening human health, especially in vulnerable groups such as the elderly, pregnant women, children and those with defective immune system. There are numerous reports of diseases and food poisoning caused by food microbial contaminations around the world. In developed countries in which the record of diseases, and the number of patients and deaths is constantly monitored, there are numerous and exact statistics on the incidence of food-borne microbial contamination and the source of infection (Saranraj and Geetha, 2012; Kopper, 2010).

There are also numerous reports of food-borne diseases in Iran that highlight the importance of investigating and evaluating the causes of food-borne poisoning in order to prevent and mitigate them. The existence of different environmental conditions (temperature and humidity), variations in people's sensitivity, awareness level of workers, and management issues have led to conducting cross-sectional studies in different cities. Cities such as Isfahan that is a great tourist attraction for foreigners are of particular importance for this type of research. Since tourists are more susceptible to infections due to the lack of exposure to some of the existing microbial strains and the lack of high acquired resistance, they are more likely to show much more severe symptoms if food poisoning occurs. Consequently, in these conditions, more social and economic consequences are emerged. Among disease causing foods, confectionary products as ready-made foods are of particular importance. Due to their components, these materials are important sources of carbohydrates, proteins, and some vitamins and minerals, highly consumed due to their desirable flavor and taste. On the other hand, these products containing different ingredients (milk, egg, sugar, cream, cocoa powder, fruit), workers' hand contamination, and supply instruments and conditions, storage and transportation can be suitable substrate for many microbes guaranteeing their survival and growth (Nikniaz, 2011).

Therefore, it was found necessary to study one of the most popular foods based on Iran's standard methods. The results also revealed a considerable level of contamination in creamy pastries in Isfahan. In this study, among the food poisoning bacteria the bacterial contamination of *S.aureus* was higher in creamy sweets than the others, which can be due to high resistance to environmental conditions, especially the growth power in low moisture. However, its origin can be unpasteurized dairy products, workers' hand contamination, and acnes (Landgraf and Destro, 2013; Kérouanton, 2007). Concerning this bacterium, the contamination level of Isfahan creamy pastries was 40% which appeared to be less than what conducted in Zahedan by Shadan on creamy pastries (60.5%), and more than the contamination found in sweets in Mashhad (10.5%), Shahrekord (10%) and Lordegan (6%). Given the source as *S.aureus*, it can be argued that this difference is likely due to the use of contaminated cream, the lack of food handler's compliance to personal hygiene and possibly high temperature compared to the three cold cities (Khezri et al., 2007; Pishgar et al., 2004). Sultandallal and Nikniaz declared the contamination level of sweets in south of Tehran, west of Mazandaran and Tabriz as 12%, 34.67% and 31.2%, respectively (Nikniaz et al., 2011; Khezri, 2007; Ahmadbozorgy and Sabzemeidany, 2012).

Salmonella and *E.coli* bacteria are of great importance among the food poisoning causes. The prevalence of food poisoning with salmonella caused by chocolate and sweets was reported in the United States and Canada in 1973, in the United Kingdom in 1982, in Norway and Finland in 1987, and in Germany in 2001. In 2004 in England, *E.coli* and salmonella were isolated from confectionary products by Baylis(2004), stating that the contamination level of each of these products and the survival of bacteria in them depended on the temperature of the maintenance medium and the moisture content of product (Kačániová . and Juhaniaková, 2011; Baylis et al, 2004). According to Iran's standards, the existence of these two in foods is very important and should be zero. Fortunately in the present study, the least amount of contamination was related to them (0%, 8%), indicating the use of healthy primary ingredients such as eggs, dairy products, as well as observing personal health issues by workers while using the toilet. However,

E. coli infection was reported 49.3% in Mazandaran, 48.8% in Tabriz and 26% in Mashhad (Nikniaz et al., 2011; Khezri et al., 2007; Ahmadbozorgy and Sabzemeidany, 2012).

Among the microorganisms, yeasts can cause organoleptic changes such as alcoholic fermentation, gas production and color changes in sweets, and ultimately their corrosion and non-consumption. In this research, yeast caused the highest level of contamination in sweets, but the quality of microbial contamination of pastry in Isfahan was modest in terms of yeast compared to the study by Sultan- Dalal in south of Tehran (33%) and Nick-Niyaz in Tabriz (70%) (Nikniaz et al., 2011; Soltandalal et al., 2011). In most studies, yeast infection levels are reported higher than molds, which can be related to infected raw materials and appropriate environmental conditions for their growth.

The mold can easily be spread through the air, the raw materials and workers' clothing, reducing foods preservation and causing economic losses. The degrees as 5%, 9% and 9.24% in south of Tehran, Mashhad and Damghan, respectively, indicate better hygiene and the use of appropriate packaging in sweets production than contamination level as 18%, 27.5% in Isfahan and Tabriz (Nikniaz et al., 2011; Khezri et al., 2007; Soltandalal et al, 2011; Baylis et al., 2004).

The contamination level of Isfahan sweets to Enterobacteriaceae (a gram-negative bacteria) was found to be 38%, 40% sweets in south of Tehran and 43.46% Gorgan sweets. These bacteria are transmitted to sweets through the use of contaminated containers, improper storage temperature of dairy products, and inadequate personal hygiene by workers (Shadan et al., 2005; Shabani et al., 2014).

As the findings revealed, in this study the degree of non-consumability of samples in summer was more than winter, which is regarded reasonable due to the higher temperature in the warm season with better growth conditions for most microbes. Of these microbes, however, only *E. coli* showed statistically significant contamination level in summer, which could be related to the more prevalence of microbial diarrhea in workers and the contaminated raw materials such as cream. Due to this contamination, the proper use of cold chain in the maintenance of raw materials and products until sale can reduce the problem of temperature rise in summer. However, the percentage of yeast infection and *S.aureus* was higher in winter though statistically significant difference was found for *S.aureus* alone, which can be attributed to an outbreak of respiratory diseases such as colds and the spread of bacteria through sneezing and coughing due to inadequate personal hygiene by workers. The study by Shabani and his colleagues demonstrated a higher prevalence of this bacterium in the winter (Shabani et al., 2014).

Conclusion

According to the findings in this study, it can be stated that the evaluation and control of microbial contamination of creamy sweets is essential. However, in order to prevent and reduce the contamination of this food product special attention should be paid to the food handlers' health and hygiene and the production environment, management issues and regular monitoring of production centers. Meanwhile, increasing workers' awareness about microbial agents, their hazards and the ways to prevent food poisoning will be more effective. Of course, it seems necessary to raise awareness, as well as to create an appropriate attitude and insight that result in the implementation of learned information (Zareie et al, 2014; Balzaretti and, Marzano, 2013).

[DOR: 20.1001.1.2717378.2017.1.3.5.5]

References

Ahmadbozorgy, N., Sabzemeidany, A. (2012). Investigation of microbial contamination of fresh sweets sent to the West Block of Mazandaran provicine in 2012, Journal of Food Processing and Production, 3: 49-55. (In Persian)

Bahmanunia, S., Nadery, S., Hosseinpour, B. (2013). Evaluation of microbial contamination of pastries in Lordegan. 21nd Food science and technology, Shiraz. (In Persian)

Balzaretti, C.M., Marzano, M.A. (2013). Prevention of travel–related food borne diseases: Microbiological risk assessment of food handlers and ready- to-eat foods in northern Italy airport restaurants. Food Control, 29: 202-207.

Baylis, S., MacPhee, A.J., Robinson, R. (2004). Betts Survival of *Escherichia coli* O157:H7, O111:H− and O26:H11 in artificially contaminated chocolate and confectionery products. International Journal Food Microbiology, 96: 35-48.

Faramarzi, T., Jonidi jafari, A., Dehghani, S., Mirzabeygi, M.I., Naseh, M.I., Rahbar Arasteh, H. (2012). A Survey of Bacterial Contamination of Food Supply in the West of Tehran. Journal of Fasa University of Medical Sciences, 2: 2008-11. (In Persian)

Institute of standards &Industrial Research of Iran. Microbiologic characteristic of sweets products. (1993). umber 2393. (In Persian)

Institute of standards & Industrial research of Iran. (1999). Microbiology of food & animal feeling stuffs methods for the detection & enumeration of mold and yeast. Number 998. (In Persian)

Institute of standards & Industrial research of Iran. (2001). Microbiology of food & animal feeling stuffs methods for the detection & enumeration of Enterobacteria.1.1st, Revision. (In Persian)

Institute of standards &Industrial research of Iran. Microbiology of food and animal feeding stuffs -Detection and enumeration of presumptive *E.coli* -Most probable number technique. (2001), Number 2946. (In Persian)

Institute of standards &Industrial research of Iran. (2001). Microbiology of food and animal feeding stuffs-Horizontal method for the enumeration of positive Staphylococci –coagulas Working principles for general methods in food microbiology laboratories. Number 6806-3. (In Persian)

Institute of standards &Industrial research of Iran. (2002). Microbiology of food and animal feeding stuffs- Horizontal method for the detection of salmonella. Number 1810. (In Persian)

Kačániová, M. and Juhaniaková, L. (2011). Microorganisms in confectionery products. Journal of Microbiology & Biotechnology Food Science, 1: 57-69.

Kérouanton, A., Hennekinne, J.A., Letertre, C. (2007). Characterization of *Staphylococcus aureus* strains associated with food poisoning outbreaks in France. International Journal of Food Microbiology, 115: 369-375.

Kérouanton, A., Hennekinne ,J.A., Letertre, C. (2014). Food Safety Management. Chapter 23 - Hygiene in Primary Production, 559-621.

Kjeldgaard, K.J., Stormly, M.L., Leisner, J.J. (2010). Relation between microbial levels of ready-to-eat foods and the monitoring of compliance with HACCP-based own control programs in small Danish food outlets. Food Control, 21: 1453-7.

Khezri, H., Safamanesh, S., Gorgani, M. (2007). The survey of microbial contamination in dried and creamy sweets. Food and Drug Deputy of Mashhad University of Medical Sciences, 8: 64-70. (In Persian)

Kopper, G., Mirecki, S., Kljujev, I.S. (2010). Knowledge, attitude and practice of Taif University students on food poisoning. Food Control, 21: 55-60.

Landgraf, M., Destro, M.T. (2013). Food borne Infections and Intoxications. Chapter 28 - Staphylococcal Food Poisoning. Fourth Edition, 389-400.

Nikniaz, Z., Mahdavi, R., Jalilzadeh, H., Vahed Jabbari, M. (2011). Evaluation of microbial contamination in cream filled pastries Distributed in Tabriz Confectionaries. Journal of Food Technology & Nutrition, 8: 66-71. (In Persian)

Pishgar, A., Jazaery, R., Khalily, M. (2004). The survey of microbial quality in kinds ice cream and cookies Distributed in Shahrekord Confectionaries. Research journal of Ahvaz Health University, 132. (In Persian)

Saranraj, P. and Geetha, M. (2012). Microbial Spoilage of Bakery Products and Its Control by Preservatives. REVIEW ARTICLE. International Journal of Pharmaceutical & Biological Archives, 3: 38-48.

Shabani, Sh., Sadeghi, M., Jalali, H. (2014). Microbial Contamination of Pastry Cream Supplied in Gorgan. Journal of laboratory science, 8: 62-7. (In Persian)

Shadan, M., Khoshaby, F., Shahraky, M. (2005). The survey of microbial condition in cream filled pastries of Zahedan confectionery. Research journal of Ahvaz Health University, 84. (In Persian)

Soltandalal, M.M., Fazelyfard, P., Tabatabaey-befroei, A. (2011). Determining of microbial contamination pastries in present unit in south of Tehran. Zyst Fanavary microbiology of Islamic Azad University, 2: 7-12. (In Persian)

Tasehinia, H.R., Arfanian, N., Kalate, M., Mehri, N. (2014). Determination of microbial contamination for entrobacteriacae and mold in cookies and pastries in Damghan confectionary, National Conference on Environmental Health, Tehran. (In Persian)

Zareie, S., Ehrampoush, M.H., Mazloomi, S.M. (2014). Evaluation of Microbial Quality of Sausage Slicers at Food Retail Food Stores in Shiraz, Iran. Scientific & research journal of Yazd Health university. 3: 54-63.

[DOR: 20.1001.1.2717378.2017.1.3.5.5]