

# MICROBIOLOGICAL CONTAMINATION OF CONFECTIONERY PRODUCTS: A CASE STUDY ON SANTIAGO AND MONCHERRY VARIETIES

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## Abstract

This study investigates the microbiological contamination of confectionery products, specifically focusing on two popular varieties, Santiago and Moncherry, sourced from a confectionery establishment in Botoșani County, Romania. Conducted over a two-year period, the research involved biannual sampling, culminating in a total of 40 samples analyzed for Enterobacteriaceae presence in strict adherence to the SR ISO 21528-2:2007 standard. The sampling protocol entailed the collection of five samples per product type during each visit, with meticulous attention to maintaining aseptic conditions during transport to preserve microbiological integrity. Analytical results consistently revealed that all samples had Enterobacteriaceae counts below the threshold of 10 colony-forming units per gram (cfu/g) or milliliter (cfu/ml), thereby demonstrating compliance with established safety standards. These findings underscore the efficacy of the quality control measures and hygiene practices implemented throughout the production, storage, and handling processes of the confectionery products. The continuous monitoring and strict adherence to rigorous hygiene standards are critical in ensuring the safety and quality of these products. This research offers significant insights into the microbiological safety of confectionery items and serves as a benchmark for future studies aimed at enhancing food safety protocols. Compliance with international safety standards confirms the effectiveness of the implemented control measures and underscores the importance of sustained efforts to protect consumer health.

**Key words:** contamination, confectionery products, food safety, microbiological control

## INTRODUCTION

Food safety is a fundamental aspect of the food industry, encompassing the prevention of microbiological, physical, and chemical hazards. Islam et al. (2013) assert that food safety ensures that consumers won't experience any harm during consumption, as long as they prepare and/or consume them as intended [2, 3].

Consumption of contaminated food or beverages can expose humans to a variety of pathogens, including bacteria, viruses, and parasites [4].

Microbiological hazards, in particular, are critical factors for consumers because they produce bacteria and toxins that can cause foodborne illnesses [5].

The confectionery industry is a vital sector within the food industry, responsible for producing a wide range of sweet products, including cakes, pastries, cookies, and other desserts. Due to the nature of the ingredients used, preparation methods, and decoration practices, confectionery products are particularly susceptible to contamination by pathogens such as *Escherichia coli*,

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*Enterobacteriaceae*, molds, and yeasts. Confectionery products commonly encounter species such as *Rhizopus spp.*, *Penicillium spp.*, and *Aspergillus spp.*. Among the most problematic bacteria are those from the genera *Bacillus* and *Staphylococcus aureus*, as well as *Enterobacter spp.* and *Salmonella spp.* [6].

Given the high consumption of these products, it is essential to implement microbiological control measures to extend their shelf life and maintain their quality [6].

Confectionery products can be tainted at any point in the production process, from using tainted raw materials to not heating the products properly before eating them to heating them again after processing while they are being stored or transported incorrectly or because they were not handled properly [7].

The microbiological profile of food products is a crucial indicator of their safety. Microbiological contamination can have serious health implications for consumers and can negatively impact a food producer's reputation. Therefore, it is essential that each batch of products undergo rigorous testing to detect the presence of pathogenic microorganisms and ensure that they fall within acceptable limits.

*Enterobacteriaceae* is a family of bacteria that includes several pathogenic species, such as *Salmonella* and *Yersinia*, which can cause severe infections in humans. Detection and enumeration of these bacteria in food products are critical for preventing foodborne illnesses. The standard SR ISO 21528-2:2007 provides specific methods for identifying and quantifying these microorganisms, thereby contributing to product safety assurance.

This study investigates the microbiological contamination of confectionery products, specifically cakes and creams, sourced from a confectionery establishment in Botoșani County. The research concentrated on two highly popular

varieties, Santiago and Moncherry, with the objective of evaluating the presence of *Enterobacteriaceae*. Assessing these products is crucial for ensuring food safety and mitigating potential public health risks.

Quality and safety are critical for these products, not only for consumer health, but also for maintaining consumer trust in producers and brands. Because they contain perishable ingredients such as eggs, dairy products, and fruits, confectionery items are susceptible to microbiological contamination, which can pose significant risks to public health.

This paper provides detailed data and analyses on microbiological contamination within the confectionery sector. The study can serve as a reference for further research and the development of better practices in quality control and food safety.

## MATERIAL AND METHOD

### *Organization of researchers*

Over a two-year period, the study conducted visits every six months (January 2023, June 2023, January 2024, and June 2024) to a confectionery shop located in Botoșani County, Romania. The primary objective of the research was to assess the microbiological contamination of two popular cake varieties, Santiago and Moncherry, which are among the most favored and consumed products of the confectionery establishment.

The Santiago variety is a cake that combines generous layers of white chocolate cream and whipped cream with a fluffy cocoa base. Its main ingredients include sugar, wheat flour, cocoa, eggs, white chocolate cream, whipped cream, and nuts. On the other hand, the Moncherry variety combines a fluffy base with delicious layers of milk chocolate cream, vanilla cream, and eggnog, complemented by cherry puree and whole cherries, which provide a fruity and fresh note, while the whipped cream adds a creamy and light texture.

We collected five samples of each cake variety during each visit, resulting in a total of 40 samples analyzed throughout the study. We obtained the samples under sterile conditions and transported them to the laboratory in a refrigerated transport unit, maintaining the temperature at a maximum of 8 °C to ensure microbiological integrity.

The microbiological tests were mostly about finding and counting *Enterobacteriaceae* according to the SR ISO 21528-2:2007 standard. This made sure that the test was accurate and in line with international food safety standards. The results provided a detailed insight into the level of contamination and highlighted the need for implementing strict quality control and hygiene measures in the production of confectionery products.

This study is critical for understanding the microbiological risks associated with confectionery products and developing effective food safety management strategies, thereby ensuring consumer protection and maintaining the quality of the products offered.

#### *Applied working methods*

##### *Collection of samples for determination of Enterobacteriaceae*

In this study, samples were collected at regular six-month intervals to ensure the representativeness and reproducibility of the results. During each sampling session, five whole cakes from the Santiago and Moncherry varieties, the most favored products of the confectionery shop, were selected. We immediately placed the samples into sterile bags, appropriately labeling each with a unique identification code to avoid any subsequent confusion.

To maintain the requisite aseptic conditions, personal protective equipment employed during sample collection included sterile lab coats, single-use gloves, caps, shoe covers, and disposable gowns. We used sterile, water- and grease-resistant

bags to guard against external contamination and maintain sample integrity until we could conduct microbiological analysis.

Sample collection followed a strict protocol that required samples to be transported to the specialized laboratory in a refrigerated transport unit with a temperature below 8 °C. We transferred the samples to the laboratory as quickly as possible to guarantee a 24-hour interval between sampling and initial analysis. We accurately recorded the exact time of sampling in the sampling log to ensure comprehensive traceability of the samples. The samples entered the workflow immediately upon arrival at the laboratory.

This meticulous management of samples was crucial for ensuring the validity and reliability of the results obtained, allowing for an accurate assessment of the microbiological contamination of Santiago and Moncherry cakes. Consequently, this rigorous protocol significantly contributed to achieving the study's objectives, providing relevant data for the enhancement of food safety and the quality of confectionery products.

##### *Determination of Enterobacteriaceae*

We performed the microbiological analysis in accordance with the SR ISO 21528-2:2007 standard - Laboratory techniques for microbiological methods - Part 2: Method for *Enterobacteriaceae* (excluding *E. coli*).

There are a lot of strict steps in the SR ISO 21528-2:2007 method for finding and counting *Enterobacteriaceae* in food products. These steps include homogenizing the samples and diluting them over and over to get representative suspensions. We then inoculate these suspensions onto Petri dishes containing VRBG agar, a selective and differential culture medium. We incubate the prepared plates at 37°C for 24-48 hours, during which suspected *Enterobacteriaceae*

colonies develop. Following the incubation period, we count the characteristic colonies, which we identify by their distinctive reddish-purple appearance, surrounded by a red precipitate halo. This standardized method ensures a precise evaluation in accordance with international food safety standards, playing a crucial role in validating the quality and safety of the analyzed food products.

We validated the microbiological analysis results by comparing them to the reference values specified in Table 1, in accordance with ORDIN No. 27 of June 6, 2011. This regulation establishes the microbiological and hygiene criteria applicable to food products, excluding those outlined in Commission Regulation (EC) No. 2,073/2005 of November 15, 2005, concerning microbiological criteria for foodstuffs. This verification ensured that the results were consistent with the prevailing normative standards, thereby guaranteeing the validity and integrity of the food safety assessment for the analyzed confectionery products.

Table 1 Logarithmic Mean Values for *Enterobacteriaceae* (cfu/g or ml) in Cakes and pastries with creams, whipped cream, and fruits, according to Ordinance No. 27 of June 6, 2011.

<i>Enterobacteriaceae</i>	Average logarithmic values
Acceptable values	< 10
Marginal values (> m dar < M)	10 – 100
Not acceptable values(> M)	> 100

## RESULTS

### *Determination of Enterobacteriaceae*

Table 2 illustrates the assessment of *Enterobacteriaceae* contamination in confectionery products, specifically the Santiago and Moncherry varieties, throughout the conducted study. The SR ISO 21528-2:2007 standard establishes 10 colony-forming units cfu/g or ml as the acceptable limit for *Enterobacteriaceae*.

Table 2. Interpretation of microbiological analysis results

Harvest period	Number of samples collected	Evidence identification code		Result	
		Santiago assortment	Moncherry assortment	Santiago assortment	Moncherry assortment
January 2023	5	20443-1.1	20452-1.1	<10 cfu/g	<10 cfu/g
		20443-1.2	20452-1.2	<10 cfu/g	<10 cfu/g
		20443-1.3	20452-1.3	<10 cfu/g	<10 cfu/g
		20443-1.4	20452-1.4	<10 cfu/g	<10 cfu/g
		20443-1.5	20452-1.5	<10 cfu/g	<10 cfu/g
June 2023	5	21588-1.1	21663-1.1	<10 cfu/g	<10 cfu/g
		21588-1.2	21663-1.2	<10 cfu/g	<10 cfu/g
		21588-1.3	21663-1.3	<10 cfu/g	<10 cfu/g
		21588-1.4	21663-1.4	<10 cfu/g	<10 cfu/g
		21588-1.5	21663-1.5	<10 cfu/g	<10 cfu/g
January 2024	5	21675-1.1	21694-1.1	<10 cfu/g	<10 cfu/g
		21675-1.2	21694-1.2	<10 cfu/g	<10 cfu/g
		21675-1.3	21694-1.3	<10 cfu/g	<10 cfu/g
		21675-1.4	21694-1.4	<10 cfu/g	<10 cfu/g
		21675-1.5	21694-1.5	<10 cfu/g	<10 cfu/g
June 2024	5	22057-1.1	22148-1.1	<10 cfu/g	<10 cfu/g
		22057-1.2	22148-1.2	<10 cfu/g	<10 cfu/g
		22057-1.3	22148-1.3	<10 cfu/g	<10 cfu/g
		22057-1.4	22148-1.4	<10 cfu/g	<10 cfu/g
		22057-1.5	22148-1.5	<10 cfu/g	<10 cfu/g

## DISCUSSIONS

According to the microbiological test, all samples of Santiago and Moncherry cakes had *Enterobacteriaceae* logarithmic mean values that were less than 10 cfu/g or ml. This finding indicates that the products consistently comply with international food safety standards (Table 2).

Adherence to these limits suggests the effective implementation of contamination control measures and hygiene practices throughout the production, storage, and handling processes. The results indicate that the manufacturing procedures are adequate for preventing microbiological contamination, thereby ensuring consumer protection and maintaining the necessary quality standards.

In conclusion, the data obtained reflect rigorous quality control and confirm the effectiveness of the food safety measures implemented by the analyzed production facility, positively impacting public health protection.

## CONCLUSIONS

The study on the microbiological contamination of confectionery products, focusing on the Santiago and Moncherry varieties, highlighted the importance of rigorous food safety monitoring in the confectionery industry. Microbiological tests based on the SR ISO 21528-2:2007 standard showed that all samples collected over the two-year research period consistently had less than 10 colony-forming units cfu/g or ml for *Enterobacteriaceae*, which means they were completely safe and in line with international food safety standards.

These results suggest that the implemented measures for quality control and hygiene in the production, storage, and handling of confectionery products are effective. Adherence to the established contamination limits reflects appropriate management of microbiological risks and contributes to consumer health protection.

In conclusion, the research underscores the critical need for continuous monitoring of microbiological contamination and the implementation of strict food safety measures to prevent public health risks. The obtained results serve as a valuable reference for continuing to improve quality control practices in the confectionery industry and provide a solid foundation for future research in the field.

## REFERENCES

1. Islam, GMR; Houque, MM Food Safety Regulation in Bangladesh, Chemical Hazard and Some Perception to Overcome the Dilemma. *International Food Research Journal* **2013**, 20 (1), 47-58.
2. International Organization for Standardization, (2005): ISO 22000:2005, Food Safety Management Systems Requirements for any organisation in the food chain. Retrieved from [iso.org/obp/ui/#iso:std:iso:22000:ed-1:v1:en](http://iso.org/obp/ui/#iso:std:iso:22000:ed-1:v1:en).
3. Diane, G; Newell, MK; Verhoef, L; Duizer, E; Aidara-Kane, A; Sprong, H; Opsteegh, M; Langelaar, M; Threfall, J; Scheutz, F; Joke van der Giessen; Kruse, H Food-borne diseases—the challenges of 20 years ago still persist while new ones continue to emerge. *International Journal of Food Microbiology* **2010**, 139, 3-15.  
doi.org/10.1016/j.ijfoodmicro.2010.01.021.
4. Chaudhari, SN; Palve, SB; Choudhari, KR; Pawar, DH; Gaikwad, SS Microbial analysis of ragi cake base stored at room temperature without added chemical preservative. *International Journal of Current Microbiology and Applied Sciences*. **2017**, 6 (12), 3519-3525. doi.org/10.20546/ijcmas.2017.612.409
5. Ballata, A; Shabani, L; Dharmo, K Impact of microbiological quality of the raw material and the technological process in the microflora of final product (confectionery products). *Journal of Hygienic Engineering and Design* **2019**, 27, 39-44.
6. Smith J.P., Daifas D.P., El-Khoury W., Koukoutsis J. & El-Khoury A., Shelf life and safety concerns of bakery products—a review. *Critical Reviews In Food Science and Nutrition* **2004**, 44(1), 19-55.  
doi.org/10.1080/10408690490263774



7. El-Kadi, SM; El-Fadaly, HA; El-Gayar, EM  
Examination of pathogenic bacteria in some cake samples. *International Journal of Microbiology and Application* **2018**, 5 (3), 56-63.
8. ISO 21528-2:2017 Microbiology of the food chain — Horizontal method for the detection and enumeration of *Enterobacteriaceae* Part 2: Colony-count technique.  
[iso.org/standard/63504.html](http://iso.org/standard/63504.html)
9. ORDIN No. 27 of June 6, 2011, which establishes microbiological and hygiene criteria applicable to food products, excluding those specified in Commission Regulation (EC) No. 2,073/2005 of November 15, 2005, concerning microbiological criteria for foodstuffs.