

## Bacterial contamination evaluation of some Red velvet cakes

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### Abstract

Cakes are important and highly diversified bakery products to meet the challenges of the market. Because of their ingredients, cakes have a high potential of contamination with microorganisms. In this study, solutions were analyzed to increase the validity period, respectively to reduce the costs. The purpose of the research was to evaluate the bacterial contamination degree of some Red velvet assortments, having in the composition of their tops besides the basic ingredients, additions of beetroot powder or juice that provide approximately the same intense shade of red color as the food dyes. The determination of the total number of germs, the presence of enterobacteria, as well as of coagulase-positive staphylococci were carried out at the moment when they were ready for consumption and after a period of refrigeration of seven days. The results showed that the samples were contaminated with these germs, but the infection falls within the standards. The control of the primary contaminants, the addition of some natural compounds with antimicrobial properties, as well as the compliance of the hygiene standards are essential for the promotion of some quality desserts.

**Keywords:** cakes, hygiene, microorganisms, refrigeration

### 1. Introduction

Microbial alteration is the major problem of pastry-confectionery products because of the ingredients they contain which can include microorganisms that by consumption affect the health of the consumer. The negative aspects of microbial growth determine the loss of some nutritional and sensory characteristics, the deterioration of the products and implicitly the appearance of losses. As reported by Guynot et al., 2005 [5] losses due to microbial damage range from 1% to 5%, depending on the season, the type of product and the method of processing. Ambient temperatures, product pH values between 5.4 and 7.5 and water activity in the range of 0.75-0.98 favor the alteration of bakery products with yeasts, molds and spore-forming bacteria [2].

Cakes will always attract the attention of consumers, whether they are of different colors or shapes, or have interesting decorations. The confectionery product "Red Velvet" is especially noted and appreciated due to the appearance of the red countertop and the pleasant organoleptic

properties. The countertop has a soft consistency, and the slightly sour and refreshing taste of the cream blends perfectly with the slightly sweet taste of the countertop. The cake has in its composition accessible ingredients, resulting in a healthy dessert, without the addition of preservatives, additives and artificial sweeteners. Of course, the recipe of the product can be improved to every one's liking, adding to the composition different flavors, essences or fruits. Beetroot (*Beta vulgaris*) due to its strong purple-red color, in addition to the many health benefits it has, is also used as a food colorant [14]. Previous results have suggested that beetroot can be considered a good material to improve the quality characteristics of the confectionery products, their sensory properties, as well as shelf life [12].

The objective of this search was to make the cake "Red Velvet" using natural dyes in comparison to synthetic ones, as well as to evaluate the degree of microbial contamination both in the initial phase after preparation (I) and after a refrigeration period of seven days (II). The production of the red velvet cakes was carried out using natural dyes, namely (1)

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beetroot extract and (2) beetroot powder, respectively (3) red food coloring and one sample was commercially purchased (4).

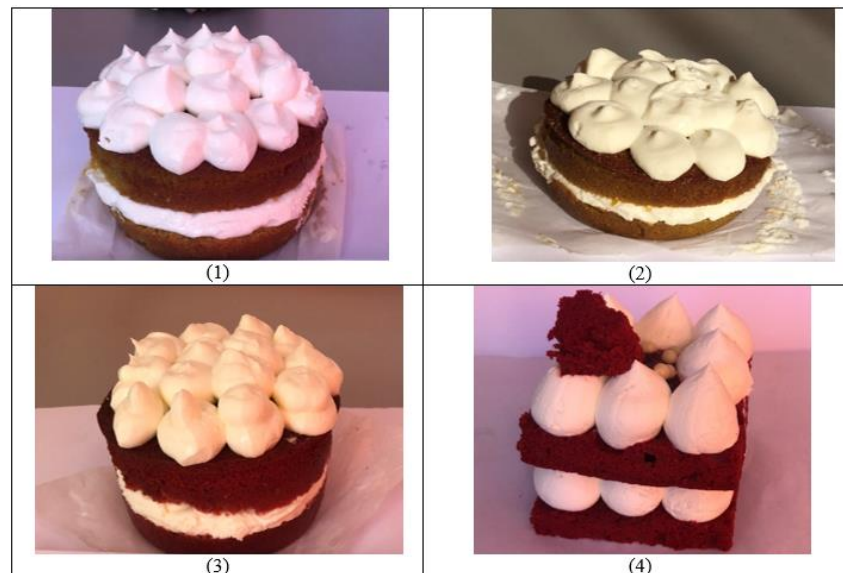
## 2. Materials and method

### Preparation of Cake Samples

The classic recipe for preparing Red velvet includes the ingredients necessary for the preparation of the countertop (flour, eggs, sugar, milk, butter, vanilla, vinegar, baking soda, cocoa, salt powder) as well as those specific to the cream (powdered sugar, whipped cream, cream cheese). First, the dough is obtained by mixing the liquid ingredients with the ingredients in the powder form, until very thing is incorporated well and a fairly consistent paste results.

At the end, the red dye is added (in the form of powder or liquid) to the desired color intensity. Everything is passed in a pan and baked in the oven for 45 minutes at a temperature of 180 °C. After baking the dough, it should not be syrupy because it retains moisture, but left to cool, cut in to two equal parts and filled with cream. In parallel, the cream cheese must be mixed with the liquid whipped cream and the powdered sugar until a fine paste is obtained. Then, it was stored in the refrigerator for about two hours before the initial microbiological analysis was carried out.

Aspects of the red velvet samples prepared with the addition of natural dye from red beetroot and synthetic food coloring, as well as the commercially purchased sample can be seen in Figure 1.



**Figure 1.** Aspects of the Red Velvet cakes with (1) beetroot extract; (2) beetroot powder; (3) red food colouring; (4) commercial sample

**Table 1.** Culture media and incubation conditions used for bacterial examination

| Examined bacteria                      | Cultivation media | Incubation conditions |          |
|--|-------------------|-----------------------|----------|
|  |                   | Temperature (°C)      | Time (h) |
| The total bacteria count (TBC)         | Nutrient agar     | 30                    | 72       |
| Enterobacteriaceae count (EC)          | VRBG agar         | 37                    | 48       |
| Coagulase-positive staphylococci (CPS) | Baird Parker agar | 37                    | 72       |

### Bacterial Examination

From each homogenized sample, 10 g were taken and suspended in 90 ml of sterile physiological serum, being prepared also the appropriate dilution series. Then, 1 ml of each dilution was put in two Petri dishes over which the appropriate culture medium was poured, being well mixed, then left to

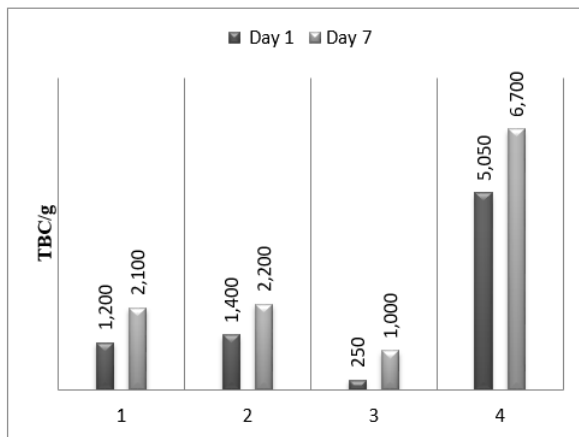
solidify. The Petri dishes were then incubated for a while at the appropriate temperature (Table 1).

The plate culture method was used to determine the total number of germs, and also for counting enterobacteria and coagulase-positive staphylococci [8, 9, 10] both on fresh cakes and after a refrigeration period of 7 days.

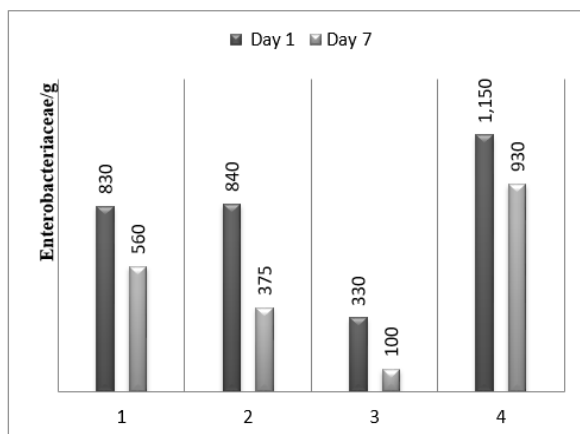
### 3.Results and discussions

Following this study the results showed a contamination of the cake samples, but without exceeding the maximum accepted values in the fresh state. After keeping under refrigeration conditions for a period of 7 days, a slight increase in the colonies of bacteria, respectively coagulase-positive staphylococci and a reduction in the number of enterobacteria, is observed.

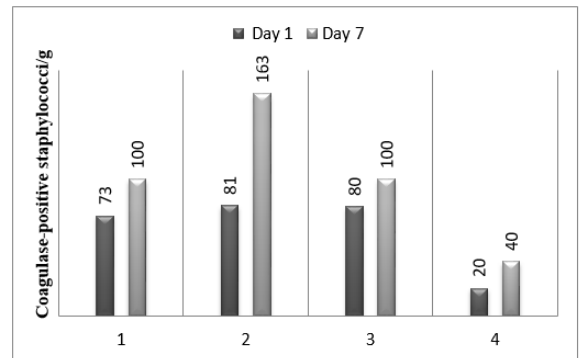
The number of the Red Velvet samples analyzed, as well as the total bacteria count, *Enterobacteriaceae* and coagulase-positive staphylococci (*Staphylococcus aureus* and other species) in the two stages were represented in figures 2, 3, 4.



**Figure 2.** The total bacteria count of Red Velvet cakes with (1) beetroot extract; (2) beetroot powder; (3) red food colouring; (4) commercial sample.



**Figure 3.** Enterobacteriaceae count of Red Velvet cakes with (1) beetroot extract; (2) beetroot powder; (3) red food colouring; (4) commercial sample.



**Figure 4.** Coagulase-positive staphylococci of Red Velvet cakes with (1) beetroot extract; (2) beetroot powder; (3) red food colouring; (4) commercial sample

The presence of microorganisms in food products is dependent on the nature of the food and the method of processing, which can subsequently allow the growth of the microbiota of alteration or pathogens. Some bacteria are due to raw materials and spores remanence, other bacteria are introduced into the food after the cooking stage or survive inadequate cooking [7].

The chemical composition and the high content of water and sugar make the cakes as favorable environments for the growth and multiplication of various microorganisms [6]. Studies from different parts of the world show that *Enterobacteriaceae* infections are the most common [4], but in general cakes are infected with several types of microorganisms [11]. The 7-day refrigeration period shows a multiplication of colonies for bacteria and coagulase-positive staphylococci, instead *Enterobacteriaceae* are reduced. Because, even under refrigeration conditions, staphylococci multiply, the initial contamination of the products should be taken in to account, being a pathogen responsible for serious food toxins. In other studies on the dynamics of staphylococci multiplication at different temperatures, the shelf life of cookies was identified based on the initial levels of *S. aureus* contamination [13]. The initial contamination degree is due to the quality of the raw materials, the processing methods, the degree of hygiene and the health of the working staff. It is known that many of the outbreaks of food poisoning with staphylococcus resulted from foods prepared by manipulators with infections [3]. This emphasizes the importance of ensuring food safety management and control of the pathogens growth conditions.

The addition of natural dyes shows an improvement in the microbiological characteristics of the product; the liquid red beetroot extract has a higher preservative effect than that of the powder form. Many efforts are being made to use natural bio-dyes such as those from beetroot (betalain), because their incorporation in food improves their physical and sensory properties, and also inhibits the growth of bacteria [1]. However, the synthetic preservatives have the highest preservation capacity, and are distinguished both by the intensity of the color and by the higher antimicrobial effect.

#### 4. Conclusion

Cakes, as nutrient-rich foods, can be contaminated with pathogens during production, handling, packaging, refrigeration and distribution, becoming a potential risk to the consumer if good hygiene practices are not respected.

Beetroot is an interesting ingredient for bakery production being valuable by its mineral content, antioxidant effect and natural pigments.

In the red velvet cakes, the most obvious antimicrobial effect was observed in the case of the liquid extract of red beetroot, compared to the one in the form of powder. Bacterial proliferation depends mostly, on the initial degree of contamination of the product, even in conditions of storage at refrigeration temperatures.

Therefore, in confectionery products, the idea of replacing synthetic dyes with those extracted from beetroot can be acceptable without negatively affecting the microbiological quality of the product.

**Conflict of Interest.** Author has declared that no competing interests exist.

**Compliance with Ethics Requirements.** Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

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