

Microbiological Quality of Chocolate Cake at Retail Outlet Storage in the Perspective of Halalan-Toyyiban

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ABSTRACT

Apart from non-Halal sources, foods that are hazardous to health are also considered as haram in Islamic perspective. Among the types of hazards in food safety, microbiological is the most commonly occurring hazards compared to physical and chemical hazards. Many factors contribute to the microbiological hazards such as personal and production hygiene also storage conditions of the food product. The aim of this research is to study the microbiological quality of chocolate cakes during storage in meeting the halalan-toyyiban requirements. In this study, the cake samples were stored at two different storage conditions which are room and chill temperatures in order to simulate the common retail outlet conditions. The microbiological quality of chocolate cakes was monitored by analyzing the total plate count (TPC) and yeast and mold count (Y&M). Results obtained in this study revealed that chocolate cakes stored at room temperature spoiled about 3.5 times faster than storage at chill temperature. At room temperature storage, the cakes become moldy on the 8th day with the highest TPC of 6.05 log₁₀ CFU and Y&M count of 6.21 log₁₀ CFU. Chocolate cake stored at chilled temperatures achieved highest TPC of 4.88 log₁₀ CFU and Y&M count of 4.80 log₁₀ CFU on the 28th day of storage. Rapid growth of microorganisms was observed at the initial stage of chill storage from day 0 to day 8 followed by a gradual decline for both TPC and Y&M up to day 28 of storage. This study shows that proper storage temperature is a critical factor in ensuring the biological safety of cakes product during storage at retail outlets.

KEYWORDS: Microbiological Quality, Halalan-Toyyiban, Chocolate Cake, Total Plate Count, Yeast and Mold Count.

INTRODUCTION

Nowadays, food safety issues are getting more stringent as it affects the safety and health of human. Besides that, consumers are also getting more concerned about halal food, since; food safety and halal go together. As Allah swt says in the Qur'an: "O mankind! Eat of that which is lawful and good on the earth" [Surah Al Baqarah, 2:172] "They ask you (O Muhammad SAW) what is lawful for them (as food). Therefore, halal and toyyiban is important to human, Muslims and non-Muslims alike. According to [6], many non-Muslims have already chosen to consume halal food products due to the perception that halal food products is a healthier choice because halal means permissible according to Shariah while toyyiban is wholesome which include safety, cleanliness, nutritious, quality and authentic. Halal food in the contemporary food industry means that the food produced is of high quality and safe for consumption. It conforms to the international standards of food safety as stipulated in the Hazard Analysis Critical Control Point (HACCP) and of course it should also be permitted under Shariah [15]. The issues towards halal become viral throughout the world. Moreover, the basic reasons for the prohibition of things are due to impurity and harmfulness hence basically halal requirements are in accordance with the conventional quality standards (ISO, HACCP, Codex, GHP, GMP, etc.) [11]. An incident was reported recently for a halal certificate of a cake company in Malaysia which was revoked over hygiene issue. The Malaysian Islamic Development Department (JAKIM) decided to revoke the halal certificate because there has been a violation to the Malaysia Halal Certification Procedures Manual that involves serious cleanliness issues [14]. It means that halal and toyyiban is all about hygiene and safety which must comply with the existing regulatory requirements that includes food safety and food hygiene requirements as prescribed under the Food Act 1983, Food Regulations 1985, Hazard Analysis and Critical Control Points (HACCP) requirements.

Qur'anic guidance dictates that all foods are halal (lawful and permissible) except those specifically mentioned as haram (unlawful or prohibited) according to Shariah law, while technical aspect or toyyiban was according to scientific evidence that will ensure the food are free from any hazardous materials or contaminant and safe to be consumed [15]. The technical aspect may include food analysis such as by analytical methods like gas chromatography mass spectroscopy analysis, microscopic determinations, molecular biological approaches,

chemical testing and also microbiological testing [15]. Present study focussed on the microbiological testing on food as it is also important to ensure safety of food. According to [9], food safety consists of three types of hazards which are microbiological, physical and chemical hazards. Thus, food safety is also the concept that food will not be injurious to the consumer at the point of consumption, when it is prepared and or eaten according to its intended use [2]. However, microbiological hazards is the critical toyyiban factor to affect the consumer due to the production of bacteria and toxin that may cause cases of food poisoning.

Chocolate cake is one type of ready-to-eat foods that are very popular all over the world. However, it is categorized as a type of cake that provide an excellent growth medium for many kinds of microorganisms, as it provides rich nutrients for microorganisms, high in moisture content and has a neutral pH [19]. This type of ready to eat cake product is not shelf stable and pose a potential public health risk if subjected to temperature abuse at any stage of their production, storage, distribution and marketing as well as their production under unhygienic conditions. In [8] reported the unsatisfactory value for microbiological quality of various ready-to-eat foods were greater than 6 log₁₀ CFU for aerobic plate count while acceptable values are within 5 log₁₀ CFU to 6 log₁₀CFU. The Institute of Food Science and Technology (IFST) has also drawn up the generalized microbiological specification for cakes and pastries, which stated the maximum acceptable levels of yeast is 5 log₁₀ CFU and molds is 4 log₁₀ CFU [3]. Furthermore, according to good manufacturing practice (GMP) guidelines indicates the level expected immediately following production of food, for cakes and pastries for yeast and molds is 2 log₁₀ CFU [3]. In addition, in [7] stated that the microbiological quality of ready to eat foods ≥ 5 log₁₀ CFU was considered unsatisfactory level for TPC while < 4 log₁₀ CFU was considered satisfactory level.

In addition, the storage temperature of chocolate cakes at the end of food supply chain which are in the retail outlets become important as it may affect the microbiological stability of the cake. However, most cakes are normally laid out on shelves at room temperature rather than being stored in refrigerators. Undesirable microbial growth in cakes and other bakery products may occur, which resulting in spoilage especially when stored at room temperature [10]. Temperature storage of the product is the main factor that contributes to the shelf life of the food which ensures the safety of the product upon consumption. According to [12], chilled cakes in particular fresh creams filled ones, normally have a shelf life of one to two days and are merchandised in refrigerated display cabinets while frozen cakes usually have a shelf life of many months whilst in the freezer but only one to two days at ambient temperature once thawed. In a cold chain, the shelf life, quality and safety of perishable foods throughout the supply chain is greatly impacted by environmental factors especially temperature. Furthermore, temperature is also the most efficient means to control microbial growth. In addition, some of the major contaminants present in the filled baked products is mold and yeast that contributed to the overall microbial load of the bakery products. These contaminants also play major role in the spoilage of the baked products due to inadequate preparatory steps like cooling, slicing and transport[17]. Therefore, the aim of this research was to study the microbiological quality of chocolate cake stored at two different storage conditions at retail outlets which were room and chilled temperatures in meeting the halalan-toyyiban requirements.

METHODOLOGY

Materials

Chocolate cakes were purchased from a cake factory in Shah Alam, Selangor, Malaysia and transported to the laboratory as soon as they were processed. All samples were stored at room (25±1°C) and chilled temperatures (3 ± 1°C) prior to further analysis.

Determination of Total Plate Count

The microbiological analysis was carried out according to [5]. Total plate count (TPC) was determined at 0, 2, 4, 6 and 8 days of storage at room temperature and also at 0, 4, 8, 12, 16, 20, 24, 28, 32 and 36 days of storage at chill temperature. Sample (25 g) was aseptically weighed and placed in a stomacher bag containing 250 mL of sterile 0.1% peptone diluent agitated for 120 s after closing the bag. A 1-mL aliquot was serially diluted in 9 mL sterile buffered peptone water (Difco, Detroit, MI, USA) and then 0.1 mL was placed on plate count agar (Difco, Detroit). The plates were incubated at 37±1°C for 48 h and then any colonies seen were counted. All analysis was conducted in duplicates. Number of CFU was counted and reported as log CFU/g.

Determination of Yeast and Mold Count

Y&M counts were determined by spreading plating method at 0, 2, 4, 6 and 8 days of storage at room temperature while at 0, 4, 8, 12, 16, 20, 24, 28, 32 and 36 days of storage at chill temperature according to [5]. Sample (25 g) was aseptically weighed and placed in a stomacher bag containing 250 mL of sterile 0.1% peptone diluent agitated for 120 s after closing the bag. A 1-mL aliquot was serially diluted into 9 mL sterile buffered peptone water (Difco, Detroit, MI, USA) and then 0.1 mL was placed on plate count agar (Difco, Detroit). The plates were incubated upside down at 25°C for 5-7 days. Number of CFU were counted and reported as log CFU/g. All analysis was conducted in duplicates.

Statistical Analysis

Data were analyzed using Microsoft Excel and using Statistical Analysis System (SAS) 9.0 software. Values were expressed as means \pm standard deviations.

FINDINGS AND DISCUSSION

In this study, different duration of storage was used for microbial observation at room and chill temperature. This is based on the observation of microbial growth whereby molds have started to grow on the 6th day of storage, therefore the analysis was discontinued on day 8 at room temperature storage. While at chill temperature, the duration of storage was extended to 36 days. The results of TPC and Y&M count of chocolate cakes during storage at room temperature is presented in Figure 1. The chocolate cakes stored at room temperature were seen to be moldy on the 8th day of storage. Based on this study, TPC and Y&M count increased during storage period of 8 days at room temperature. This happened because the room temperature ($25^{\circ}\text{C} \pm 2^{\circ}\text{C}$) is the optimum temperature that allows growth of microorganism and this temperature also falls below the danger zone temperature which is $4.4\text{--}60^{\circ}\text{C}$. Leaving food out too long at room temperature can cause bacteria to grow to dangerous levels that can cause illness because the bacteria grow most rapidly in danger zone temperature, which doubling in number in as little as 20 minutes [21]. Furthermore, it is also due to the presence of oxygen which allows growth of aerobic microorganisms [10]. Another study showed that Y&M started to grow on the 10th day of cakes stored at ambient temperature [13]. Upon storage at room temperature, highest TPC was $6.05 \log_{10}$ CFU on the 8th day of storage while yeast and mold were $6.21 \log_{10}$ CFU on the 8th day of storage. The TPC of above $4 \log_{10}$ CFU is considered as the unsatisfactory level was observed in this study after day 4 of storage at room temperature.

The microbial count for chill storage of chocolate cakes is as shown in Figure 2 and the highest count of TPC was $4.88 \log_{10}$ CFU, while for yeast and mold was 4.80 on the 28th day of storage. After that, it started to decrease on the 36th day of storage which was $3.00 \log_{10}$ CFU for TPC and $3.39 \log_{10}$ CFU for Y&M. Normally, the chocolate cake manufacturers kept their product at chill temperature for a maximum of 30 days to ensure the product is safe for consumption. However, from this study it was found that the cakes were still acceptable in term of the microbial count since it is below the unsatisfactory level. Holding at refrigeration temperatures will delay microbial growth in cakes and refrigeration slows down the chemical and biological processes in foods and the accompanying deterioration and the loss of quality [22]. In [16] stated the recommended storage times for maintaining good quality of pound cakes at room temperature were between 3 to 5 days and 6 months if stored in the freezer. In [18, 20] studied the effect of storage on the microbiological quality of bakery flavored ice cream, where a progressive reduction in the standard plate count (SPC) of all samples was observed. The declined in the microbial count during storage could be due to ice crystal formation that damaged the cell wall of microorganisms leading to lysis of cell [4]. Besides, when the cake dries up the yeast growing will probably decrease but molds were able to grow even in dried substrate. Hence, molds still were viable and can rejuvenate into new molds when condition is conducive. As reported by [21], molds form spores which, when dry, floated in the air and find suitable conditions where they can start the growth cycle again. Besides, most molds prefer warmer temperatures, however they can also grow at refrigerated temperatures. In addition, the depletion of nutrients will slow down the growth of bacteria [1].

Therefore, the results of the present study showed that the chocolate cake stored at room temperature might not be safe to consume on the 8th day of storage onwards as the results of TPC and Y&M were greater than the permitted level.

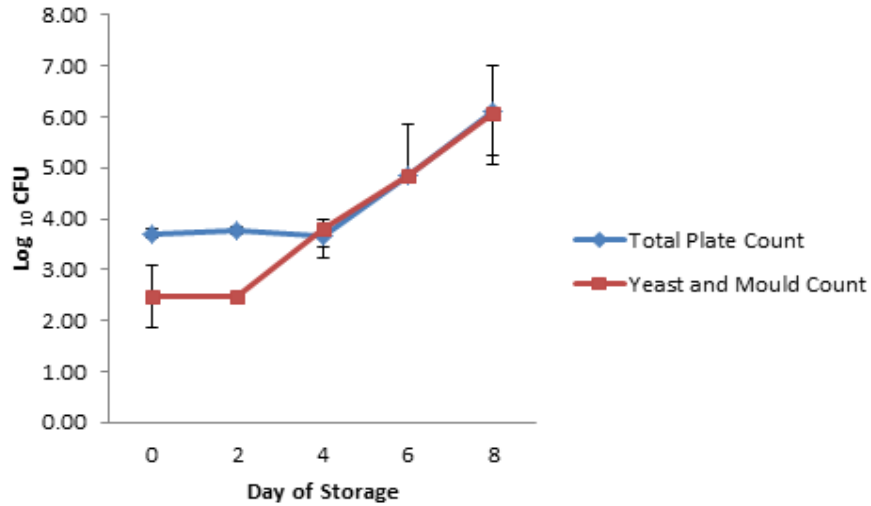


Figure 1: Microbial count of chocolate cake storage at room temperature

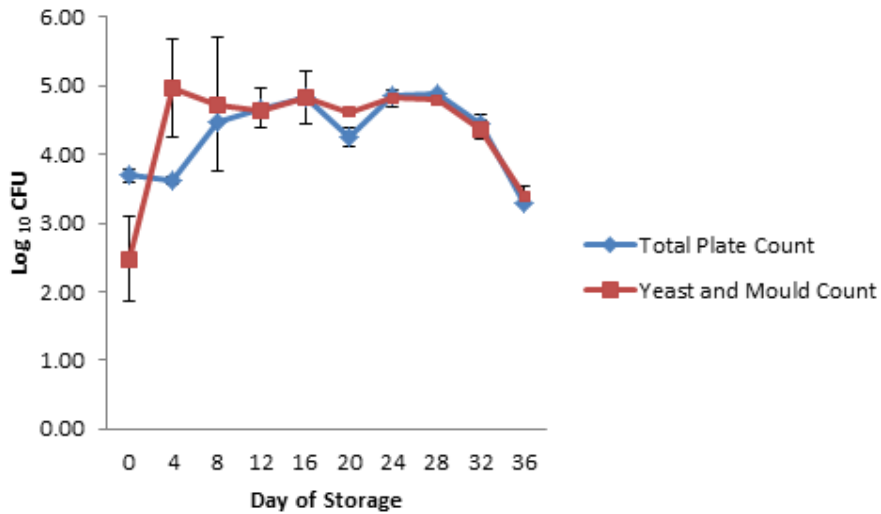


Figure 2: Microbial count of chocolate cake storage at chilled temperature

CONCLUSION AND RECOMMENDATIONS

The present study concluded that in meeting the halalan-toyyiban requirements, the chocolate cakes stored at room temperature at retail outlets are suggested to be consumed within 4 days of storage period. Whereas, chocolate cakes stored at chilled temperature were still acceptable and safe to be consumed until 36 days of storage. Hence, it can be concluded that the proper storage temperature of cakes is very important to ensure the safety of the consumers upon consumption of this product.

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