Determination of Thermotolerant Yeast Population in Dairy Products

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Abstract

Thermotolerant yeasts constitute a critical indicator for the effective management of product quality, food safety, and production processes in the dairy industry. This study aims to investigate the presence of thermotolerant yeasts in diverse dairy products within the context of Turkiye. In this study, pH and thermotolerant yeast properties of Turkish white cheese, butter, cream (Kaymak), and Tulum cheese were investigated. Thermotolerant yeast counts in butter samples ranged between 4.30 and 4.82 log CFU/g, with pH values ranging from 4.91 to 6.68. Thermotolerant yeast counts of Tulum cheese, white cheese and cream samples were <2 log CFU/g. The pH values of cream and Tulum cheese were ranged from pH 5.07-6.79 and pH 4.91-6.68, respectively. The mean pH value for white cheeses was 4.98. As a results, thermotolerant yeast counts of Tulum cheese, white cheese and cream samples were below the detectable value; however, a high number of thermotolerant yeasts were determined in butter samples. In conclusions, these findings offer valuable insights for evaluating the microbiological quality of different dairy products, aiding producers in enhancing safety and quality for consumers.

Keywords: Yeast, Thermotolerant, Cheese, Butter, Cream, Tulum.

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1. Introduction

As an ideal source of nutrition, milk is a foodstuff that supports intelligence and body development with the nutrients it contains. Drinking milk produced from raw milk is the most widely used dairy product. In addition to drinking milk, yogurt, buttermilk, cheese, ice cream and butter are other dairy products. Cheese is a dairy product produced by coagulating milk, separating the whey and processing the clot in various manners. White cheese is the most widely produced and most consumed type of cheese among cheese types (Demirci & Şimşek, 1997; Metin, 2005). White cheese is a risky product in terms of microbiology due to its structure and consumption without any processing. Pathogenic microorganisms can contaminate milk during cheese making and this poses a risk to public health. For the production of safe white cheese, there are some important rules that must be followed. When necessary precautions are taken, it is possible to produce hazard-free white cheese. HACCP (Hazard Analysis Critical Control Points) is the most effective method for this (Boztunç, 2000).

Despite the fact that Tulum cheese takes its name from its packaging material (Tulum), the great majority of Tulum cheeses offered for sale in the market today are in plastic drums. Storage in Tulum was preferred in the past because cans and other packaging materials were not available. Furthermore, studies indicate that the cheeses in plastic cans are superior in appearance, taste, odor and structure to those in Tulum made of goat skin (Dağdemir, 2000).

In the world, the lack of durability of butter is an important problem. Most of the butter produced cannot be kept even for a few weeks. Therefore, either many sensory defects occur or it is converted into clarified butter by salting or melting to increase its durability. This situation restricts the use of butter for breakfast (Öztürk, 2002; Sagdic et al., 2010).

Turkish cream is a dairy product specific to our culture and is not a product of the same quality in western countries (Öncü & Arun, 2013). In Turkiye, cream is used especially with desserts (Yılsay & Bayizit,

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2002). Cream is not a fermentable product and its high water content creates a very good environment for the growth of saprophytic microorganisms. In addition, since its shelf life is short and pasteurization or heat treatment is required. As a dairy product with low durability, the microbial safety of cream depends on the temperature of transportation, sales outlets and home storage. Temperature causes pathogenic microorganisms to multiply and thus threatens human health (Tosun, 2016).

Yeasts are unicellular, heterotrophic, eukaryotic microorganisms that belong to the Ascomycetes and Basidiomycetes. Among their important differences from other microorganisms are cell size, cell structure and metabolic activities (Jacques & Casaregola, 2008; Kurtzman & Fell, 1998). In general, yeasts grow well in warm, humid, sugary, salty, acidic and aerobic environments and are widely distributed in air, water, soil and organic matter. They can utilize lipids, proteins and carbohydrates (Jacques & Casaregola, 2008; Durlu Özkaya & Kuleaşan, 2000). Most of the mesophilic industrial yeasts grow at 20-30°C. At 12-15°C is the optimum temperature range for psychrophilic yeasts. They are well adapted to low temperatures and cause spoilage in frozen foods (Querol & Fleet, 2006). The thermophilic yeasts grow at 20-46°C (Deegenaars & Watson, 1998). This study aimed to determine the presence of thermotolerant yeasts in different dairy products.

2. Material and Methods

2.1. Material

For this study, 10 samples of white cheese, butter, cream and Tulum cheese were obtained from Kayseri, Tunceli, Erzincan and Elazığ provinces. Samples were taken under aseptic conditions and brought to the laboratory under suitable conditions.

2.2. pH Analysis of Samples

Ten grams of cheese, butter and cream samples were taken and 90 ml of distilled water was added. Then the samples were homogenized in Ultraturrax (IKA T18 Basic, Germany). The pH values of homogenized samples were measured with a calibrated pH meter (WTW, Inolab 720, Germany).

2.3. Microbiological Analysis of Samples

Ten g samples were taken from the samples that were brought to the laboratory under sterile conditions and they were placed in sterile stomacher bags. Then 90 ml of sterile maximum recovery diluent (MRD) solution was added and the samples were homogenized in a stomacher (Stomacher, IUL, Barcelona, Spain). Prepared butter and cream samples were kept at 45°C for 5 minutes and after homogenizing the Tulum and white cheeses, serial dilutions were prepared (Sagdic et al., 2010). From these dilutions, Dichloran Rose Bengal Chloramphenicol (DRBC) Agar medium was cultured by spreading method. The plates were incubated at 42°C for 7 days for counting thermotolerant yeasts (Arthur and Watson, 1976). After incubation, colonies were counted and the results were given as log CFU/g.

3. Results

The pH values of the butter samples are given in Table 1. It was determined that the pH values of the butter samples varied between pH 4.22-4.81. In addition, as can be seen in the table, the pH values of the butter samples were mostly pH <5. It was determined that the pH values of butter samples B6 and B8 were higher than the other samples and had pH values of 4.78 and 4.76, respectively. The sample numbered B3 was

Table 1. pH values of dairy products

Butter		*Cream*		*Tulum Cheese*		*White Cheese*	
B1	4.38±0.05	C1	6.79±0.01	T1	5.33±0.03	W1	5.08±0.02
B2	5.29±0.05	C2	5.07±0.01	T2	6.68±0.01	W2	5.24±0.01
B3	4.23±0.01	C3	6.53±0.01	T3	5.50±0.01	W3	4.99±0.01
B4	4.56±0.02	C4	6.32±0.01	T4	4.91±0.01	W4	5.07±0.01
B5	4.69±0.3	C5	6.51±0.03	T5	5.31±0.01	W5	4.80±0.04
B6	4.78±0.03	C6	6.17±0.02	T6	4.91±0.01	W6	5.05±0.01
B7	4.67±0.01	C7	6.47±0.01	T7	5.02±0.01	W7	4.77±0.01
B8	4.76±0.02	C8	6.06±0.04	T8	5.10±0.01	W8	4.70±0.32
B9	4.43±0.01	C9	6.27±0.10	T9	5.94±0.10	W9	5.28±0.01
B10	4.28±0.01	C10	6.63±0.01	T10	5.11±0.02	W10	4.85±0.01

observed to have the smallest pH value with a value of 4.23. Thermotolerant yeast counts in the butter are given in Table 2. The highest number of thermotolerant yeasts in sample B1 was 4.82 log CFU/g, while the lowest number of thermotolerant yeasts was 4.30 log CFU/g in butter sample B8.

The analysis indicated that the number of thermotolerant yeasts in all cream samples was <2 log CFU/g. Consequently, it was determined that the number of thermotolerant yeasts in the cream samples was below the detectable limits.

The pH values of the cream samples are given in the Table 1. It was determined that the pH values of the cream samples varied between pH 5.06-6.80. Particularly in the cream sample numbered C2, the pH values were determined to be pH <6. On the other hand, as can be seen in the table, the pH values of the other cream samples were found to be pH >6. The pH values of the cream samples C1 and C10 were higher than the other samples and were determined to have pH values of 6.79 and 6.63, respectively.

Thermotolerant yeast counts were <2 log CFU/g in all Tulum and white cheese samples as a result of the analysis. In conclusion, it was determined that the number of thermotolerant yeasts in Tulum and white cheese samples was below the detectable limits (Table 2).

The pH values of Tulum and white cheese samples are given in the Table 1. It was determined that the pH values of Tulum cheese samples ranged from pH 4.91-6.68. In particular, it was found that the pH values of T4 and T6 Tulum cheese samples were pH <5. On the other hand, as can be observed in the related table, the pH values of the other Tulum cheese samples were pH >5. It was observed that the pH values of T2 and T9 Tulum cheese samples were higher than the other samples and had pH values of 6.68 and 5.94, respectively. Among the white cheese samples, W1, W2, W4, W6 and W9 were pH >5 and had pH values of pH 5.08, 5.24, 5.07, 5.05, and 5.28, respectively. The other white cheese samples were found to be pH <5. Sample W8 was found to have the smallest pH value with a pH value of 4.70.

4. Discussion

Nowadays, cheese types that are produced in different ways are available to consumers through markets and neighborhood bazaars. The most consumed cheese varieties that can be consumed at any time of the day are Tulum cheeses and have an important place in nutrition. There is no standard production method for these cheeses and they may vary from region to region. Nevertheless, some of the traditional Tulum cheeses have been patented and the geographical marking system has started to be implemented (Dağdemir, 2000).

In Turkiye, butter production is mostly done uncultured, which prevents the desired flavor, standardization and aroma from being achieved in the final product (Sagdic et al., 2002). As butter is usually made from raw cream in small enterprises, it carries a health risk. However, in some enterprises, the cream is pasteurized, but since starter culture is not added, the taste and aroma are insufficient. Therefore, the taste and aroma of butter is formed by the microorganisms that are dominant in the environment (Atamer, 1993; Sagdic et al., 2002; Sagdic et al., 2010).

Different animal milks are used in the production of cream, but generally buffalo milk is preferred. Buffalo milk is preferred because of its high cream binding rate and white color. In recent years, the decrease in wetlands has led to a decrease in the number of buffalos. Therefore, cow's milk with increased dry

Table 2. Thermotolerant counts of dairy products (log CFU/g)

Butter		*Cream*		*Tulum Cheese*		*White Cheese*	
B1	4.82±0.22	C1	<2	T1	<2	W1	<2
B2	4.78±0.17	C2	<2	T2	<2	W2	<2
B3	4.64±0.03	C3	<2	T3	<2	W3	<2
B4	4.64±0.06	C4	<2	T4	<2	W4	<2
B5	4.67±0.06	C5	<2	T5	<2	W5	<2
B6	4.72±0.04	C6	<2	T6	<2	W6	<2
B7	4.63±0.05	C7	<2	T7	<2	W7	<2
B8	4.30±0.03	C8	<2	T8	<2	W8	<2
B9	4.61±0.05	C9	<2	T9	<2	W9	<2
B10	4.32±0.04	C10	<2	T10	<2	W10	<2

matter content is used instead of buffalo milk to meet the demand especially in big cities (Tosun, 2016).

In this study, no thermotolerant yeast was found in cream and Tulum and white cheeses. Thermotolerant yeast was found in butter. A research conducted on thermotolerant yeast population in Turkiye dairy products was not found in the literature. There are some researches on determination of yeast and mold population in mesophilic temperature incubation conditions (at 25°C).

In the studies carried out on this subject, the number of yeast-mold in butter samples was found to be between 2 log CFU/g and 5.86 log CFU/g (Tosun, 2016). In the studies carried out in Erzurum province, the number of yeast and molds in butter was determined between 0-112x105 CFU/g (Kurdal and Koca, 1987). In a study performed with 70 butter samples consumed in Samsun, yeast and mold counts were found to be above the standards in all of the samples (Çon and Oysun, 1990). Another study carried out in Konya showed that the average number of yeasts and molds in breakfast butter was 7.1x104 CFU/g (Yalçın et al., 1993). In the study on 35 samples to identify the quality of breakfast butter in the Elazığ province, the average yeast-mold count of the samples was found to be 9.0x106 CFU/g (Patır et al., 1995). It was studied on 20 samples of butter offered for consumption in Ağrı and the average number of yeasts and molds in the samples was 2.6x103 CFU/g (Esis, 1997). Microbiological qualities of butter made from yoghurt and cream were analyzed in Malatya and the number of yeasts and molds in cream butter was found between 1.0x103 and 7.3x106 CFU/g (Hayaloğlu and Konar, 2001).

5. Conclusions

Variations in pH values were observed among the samples. Microbiological analyses revealed discrepancies in the counts of thermotolerant yeasts across the samples. Notably, cream, Tulum, and white cheeses exhibited an absence of thermotolerant yeasts, with counts falling below detectable limits (<2 log CFU/g). Contrarily, butter samples demonstrated the presence of thermotolerant yeasts.

These results indicate significant microbiological differences among the samples. The absence of thermotolerant yeast below the detectable limits in cream, Tulum, and white cheeses suggests that these products may be safer in terms of this particular characteristic. On the other hand, the presence of thermotolerant yeast in butter implies that the production or storage conditions of this product may be more conducive to yeast growth. These findings provide valuable insights for the assessment of the microbiological quality of various dairy products. Such information can assist producers in understanding potential improvements to make their products safer and enhance quality for consumers.

Declaration of Competing Interest

The authors declare that they have no financial or non-financial competing interests.

Author's Contributions

F. Ayer, F. Aygül Karadeniz, S. Yıldızhan, M. M. Polat: *Definition, Data Collection, Investigation Conceptualization, Methodology*.

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References

Arthur, H. & Watson, K. (1976). Thermal adaptation in yeast: growth temperatures, membrane lipid, and cytochrome composition of psychrophilic, mesophilic, and thermophilic yeasts. Journal of Bacteriology, 128, 56–68.

Boztunç, T. (2000). Bir Beyaz Peynir İşletmesinde HACCP Uygulaması. MSc Thesis. İstanbul Teknik University, Şstanbul, Turkiye.

Çon, A. & Oysun, G. (1990). Samsun il merkezinde tüketime sunulan tereyağların bazı nitelikleri üzerinde bir araştırma. 19 Mayıs Üniversitesi Ziraat Fakültesi Araştırma Yıllığı, 80-82.

Dağdemir, V. (2000). Erzincan İlinde Tulum Peynirinin İmalat Maliyeti ve Pazarlama Marjının Belirlenmesi Üzerine Bir Araştırma. Turkish Journal of Agriculture and Forestry, 24, 57–61.

Deegenaars, M. L. & Watson, K. (1998). Heat Shock response in the Thermophile Enteric Yeast Arxiozyma telluris. Applied and Environmental Microbiology, 64 (8), 3063-3065.

Demirci, M. & Şimşek, O. (1997). Süt İşleme Teknolojisi. İstanbul: Hasad Yayıncılık.

Durlu Özkaya, F. & Kuleaşan, H. (2000). Gıda Mikrobiyolojisi ve Uygulamaları. Ankara: Sim Matbaası.

Esis, İ. (1997). Ağrı Piyasasında Satışa Sunulan Tereyağların Fiziksel, Kimyasal ve Mikrobiyolojik Özellikleri Üzerine Bir Araştırma. MSc Thesis, Trakya University, Tekirdağ.

Hayaloğlu, A. A. & Konar, A. (2001). Malatya yöresinde yoğurttan ve kremadan üretilen tereyağlarının mikrobiyolojik kalitesi üzerinde karşılaştırmalı bir araştırma. Gıda, 26(6), 429-435.

Jacques, N. & Casaregola, S. (2008). Safety assessment of dairy microorganism. The hemiascomycetes yeasts. International Journal of Food Microbiology, 166, 331-326.

Kurdal, E. & Koca, F. (1987). Erzurum il merkezinde tüketime sunulan kahvaltılık tereyağlarının kimyasal ve mikrobiyolojik özellikleri üzerinde bir araştırma. Gıda, 12(4), 299-304.

Kurtzman, C. P. & Fell J. W. (1998). The Yeasts, A Taxonomic Study. (pp.57-300). Amsterdam North-Holland: Elsevier.

Metin, M. (2005). Süt Bileşimi ve İşlenmesi. Süt Teknolojisi. İzmir: Ege University.

Öncü, N. A. & Arun, Ö. Ö. (2013). Raf Ömrü Boyunca Sıcaklık Değişimine Maruz Kalan Kaymaklarda Listeria monocytogenes'in Gelişim Potansiyelinin Araştırılması. 5. Veteriner Gıda Hijyeni Kongresi, 03-06 April 2013, Antalya, Turkiye

Öztürk, S. (2002). Farklı Sıcaklılarda Muhafaza Edilen Tereyağının Raf Ömrü Üzerine Çeşitli Antioksidanların Etkisi. PhD Thesis, Atatürk University, Erzurum, Turkiye.

Patır, B., Güven, A. & Saltan, S. (1995). Elazığ'da tüketime sunulan kahvaltılık tereyağlarının kalitesi üzerinde araştırmalar. Veteriner Bilimleri Dergisi, 11(1), 77-81.

Querol, A., & Fleet, G. (2006). Yeast in Food and Beverages. Berlin: Springer.

Tosun, F. (2016). Ekzopolisakkarit Üreten Laktik Kültürlerinin Tereyağı ve Kaymağın Kalite Özellikleri Üzerine Etkisi. PhD Thesis, Erciyes University, Kayseri, Turkiye.

Sagdic, O., Arici M. & Simşek O. (2002). Selection of starters for a traditional Turkish yayik butter made from yoghurt. Food Microbiology, 19, 303–312.

Sagdic, O., Ozturk I., Bayram O., Kesmen Z. & Yilmaz M. T. (2010). Characterization of butter spoiling yeasts and their inhibition by some spices. Journal of Food Science, 75, 597-603.

Yalçın S., Tekinşen O.C., Doğruer Y. & Gürbüz, Ü., (1993). Konya'da tüketime sunulan tereyağlarının kalitesi. Selçuk Üniversitesi Veteriner Fakültesi Dergisi, 9(2), 20-21.

Yılsay, T.Ö. & Bayizit, A. A. (2002). Bursa İlinde Tüketilen Kaymakların Mikrobiyolojik Özellikleri ve Bazı Patojen Bakterilerin Aranması. Uludağ Üniversitesi Ziraat Fakültesi Dergisi, 16, 77-86.