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QUALITY PARAMETERS IN KAYMAK PRESERVED AT DIFFERENT TEMPERATURES

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ABSTRACT

Kaymak is a high-fat dairy product produced from buffalo or cow's milk. Due to the high oil content, it can easily deteriorate under improper conditions. Therefore, the storage temperature is quite important for kaymak. In this study, which was conducted for this reason, some quality parameters were studied in kaymak samples stored in two different temperature degrees (A:4±2°C; B:25±2°C). According to the results of the analysis, total aerobic mesophilic bacteria and yeast/mold during storage increased to the level of 2.00 log cfu/g in group A; 3 log cfu/g in group B. The levels of proteolytic and lipolytic bacteria were found to have increased to 2 log cfu/g in both groups. While the PH values of the samples were 6.03 at the beginning, they decreased to 5.78 in group A and 5.67 in group B. Peroxide and malondialdehyde (MDA) values increased more in group B than in group A. While the L* value, which is the color parameters decreased in both groups, a* and b* values increased. In the organoleptic properties of kaymak samples were found acceptable until the 15th day in group A, 7th day in group B. Consequently, the production and storing conditions in producing an easily-perished product, kaymak, should be ensured optimally from the quality of raw materials.

1.Introduction

Kaymak is a taste unique to Turkey. Today, this taste takes its place in breakfasts and desserts. Kaymak is described as a cream that contains at least 60% milk fat by weight. "Afyon Kaymağı" is defined as a dairy product produced by boiling buffalo milk at 92°C for at least 2 minutes and cooling it by following its technique (TFC, 2003). Milk fat is the raw material of kaymak. Milk fat acts as a raw material in various dairy products and is effective on the nutritional value, taste-aroma, and physical properties of the product (Akalin et al., 2006; Kocaeli, 2009). Milk fat, which is a good source of energy, contains fat-soluble vitamins such as A, D, E, and K, essential fatty acids such as linoleic and arachidonic acids, medium-chain fatty acids, and especially conjugated linoleic acid (KLA) in its structure (Akalin et al., 2005; Anli & Gürsel, 2013). KLA, which is included in milk fat, is known to have effects such as reducing blood lipids, increasing metabolic rate, reducing the amount of body fat, strengthening immunity, reducing inflammation, increasing bone growth and muscle mass, and antiatherosclerotic and anticarcinogenic effects (Kurban & Mehmetoğlu, 2006; Seçkin & Baladura, 2011).

Kaymak can be exposed to microbial contamination in the production, storage, and marketing stages. The number and type of microorganisms of the product affect raw

materials, hygienic conditions at the production stage, storage conditions and the sensory quality of the product (Yilsay & Bayizit, 2002). Apart from these, the shelf life of kaymak differs from other milk fat-based products due to its excess moisture content. Additionally, the absence of a fermentation stage in kaymak production is also effective in the short shelf life of kaymak (Akalin et al., 2006). The shelf life of kaymak, a non-fermented product, is an average of one week, while the shelf life of other products is reported as 6-8 months (Sserunjogi et al., 1998).

This study researched the microbiological, physicochemical, and sensory properties of Afyon Kaymağı maintained at different temperatures during storage were investigated and revealed its shelf life.

2. Materials and methods

2.1. Materials

2.1.1. Samples of Kaymak

Kaymak samples were produced by using buffalo milk. Table 1 shows the values of raw buffalo milk which was used in the production of Kaymak. In kaymak production, buffalo milk was filtered first and taken into special containers, and it was subjected to heat treatment at 85ºC. After heat treatment, it was rested for 3-4 hours and left for 18 hours at 4ºC. After this stage, the layer of kaymak formed on the milk was cut and taken into special containers.

The kaymak samples produced were packaged in their original packaging (about 90-100 g) and divided into two groups. One group (A) was retained at 4C±2 ºC and the other group (B) at 25±2 ºC. From all samples, samples were taken for analysis on the 0^{th}, 3^{rd}, 7^{th}, 12^{th}, and 15^{th} days. Five kaymak samples (n:5) were analyzed for each analysis.

Table 1. Characteristics of Buffalo Milk Used in Kaymak Production

pH	Fat (%)	Protein (%)	Lactose (%)	SNF (%)	SCC (ml)	TBC (cfu/ml)
6.74±0,02	7.23±0,09	4.31±0,31	5.07±0,31	10.08±0,35	149,000±1000	760,000±1000

SNF: solids nonfat, SCC: somatic cell count, TBC: total bacteria count

2.2. Methods

2.2.1. Analysis of Buffalo Milk

Chemical properties of milk (Fat, protein, lactose, and SNF) were identified with Milk Analyzer MID - Infrared (MIRIS), Somatic Cell number was identified with Somatic Cell Counter (Chemometec SCC 100).

2.2.2. Color Measurement

L*, a*, b* values of kaymak samples were performed by using Hunter-Lab ColorFlex (A60-1010-615 Model Colorimeter, HunterLab, Reston, VA). Before measurements, the spectrocolormeter was calibrated with white and black reference colors. Hunter l*, a*, b * values were obtained with three different readings.

2.2.3. Water activity (a_w) measurement

The water activity (a_w) of kaymak samples was determined by using the Novasina brand (LabMASTER NEO, Switzerland) water activity measurement device.

2.2.4. pH measurement

The pH measurement of the samples was determined by using the Inolab brand (pH-7110, WTW, Germany) pH meter. The pH meter was calibrated with standard solutions 4.00 and 7.00 before measurement.

2.2.5. Microbiological analyses

The 10 grams of samples were added to 90 ml sterile peptone water with Tween80 and samples were homogenized for analysis. Then, serial dilutions were prepared from 1:10 diluted sample and sowing was done instead of the medium. In the samples, total aerobic mesophilic bacteria count (ISO, 2003),

proteolytic bacteria (Frank et. al., 1985), lipolytic bacteria (Smith & Alford, 1984), and yeast/mold count (ISO, 2008) were applied.

2.2.6. Number of peroxides

The number of peroxides in kaymak samples was determined according to the spectrophotometric method reported by Downey (1975).

2.2.7. Malondialdehyde (MDA)

Malondi-aldehyde (MDA) level in kaymak samples was determined according to the spectrophotometric method reported by Draper and Hadley (1990).

2.2.8. Sensory Analysis

Sensory analysis of kaymak samples was performed by evaluating the look, color, taste/flavor, and general liking of the samples by 10 volunteer expert panelists. The panelists made the evaluations by using the hedonic scale in the score range 1-3 (very bad - unacceptable), 4-5 (medium), 6-7 (good), 8-9 (very good).

2.2.9. Statistical analysis

The results of five kaymak samples (n:5) were evaluated for each analysis. In the results of the analysis, the difference between the kaymak samples which emerged during storage was determined by ANOVA, and the difference between the groups was determined by using the independent t-test.

3. Results and discussion

Table 2 shows the results of microbiological analysis determined during the storing process in the study. While the total number of aerobic mesophilic bacteria increased by approximately 2.00 log cfu/g during storage in group A, it increased by 3.00 log cfu/g in group B. In kaymak samples, the differences between the groups on the same days were found significant after the 3rd day ($p<0.05$). Çakmakçı and Hayaloğlu (2011) reported the total number of mesophilic bacteria in Ispir kaymak samples as 4.02 log cfu/g. An increase in proteolytic and lipolytic bacterial levels of 2.00 log cfu/g during storage was detected in both groups; differences were found between the two groups at the same time ($p<0.05$). In kaymak samples, while yeast/mold levels were found to increase by 2.00 log cfu/g in group A during storage; in group B, an increase of 3.00 log cfu/g was found. At high temperature (25±2^{o}C), as expected in the stored samples, the bacteria number was found higher than the samples stored at 4^{o}C. In a study, the average number of yeast/mold in kaymak samples was reported as 3.06 log cfu/g (Çakmakçı & Hayaloğlu, 2011). Microbiological differences between products can occur depending on the quality of the milk used in production, production, and storage conditions.

While the pH value in kaymak samples at the beginning of the storing was 6.03±0.07, it decreased by 5.78 in group A, and 5.67 in group B (Table 3). The differences between the two groups between the 3rd, 7th, 12th days were found significant ($p<0.05$). Akalın et al. (2006) reported the pH value in kaymak samples between 6.20-7.20, Çakmakçı and Hayaloğlu (2011) reported pH values in Ispir Kaymak between 6.50-6.76 in their studies. Additionally, Dereli and Şevik (2011) reported the pH value in kaymak samples, which were stored using a different packaging method, as 6.95 at the beginning, they reported it to be 5.84 on the 14th day. The pH values we obtained were found to be low compared to the results of other researchers. These differences may depend on factors ranging from raw material quality of products to production conditions. Additionally, increases in lactic acid bacteria levels due to microbial contamination levels and retention of cream can be effective. The water activity of the samples decreased during storage ($p<0.05$). While the water activity value decreased to 0.942 in group A; it decreased to 0.924 in group B ($P<0.05$) (Table 3).

Peroxide and MDA values, which are criteria for deterioration in kaymak, which is a product with a high oil content (60%), increased during storage in both groups (Table 3). Increases in group B were higher compared to group A, and the differences between the two groups were found significant starting from the 3rd day ($p<0.05$). The fact that group B was stored at high temperature compared to Group A was evaluated as the main factor. In other

studies, Dereli and Sevik (2011) reported that the peroxide value in kaymak samples increased from 0.11 to 0.25 from the beginning of storage to the end. Similarly, the study by Çön et al. (2000) found that the peroxide value increased (12,64 meq O2/kg) in the kaymak samples packed by vacuum at 18th day. However, Akalin et al. (2009) did not determine the peroxide value in the kaymak samples they collected. Lipid oxidation is a major quality problem during the processing or storage of fats and fat-containing foods (Yang et al., 2002; Lampi et al., 1997). Differences between these characteristics can be caused by production and storage conditions, as well as due to long-term storage of products in unsuitable conditions.

Table 2. Result of microbial Analysis of Kaymak Samples during Storage (n:5)

Groups	Days	TAMB	Proteolitic Bacteria	Lipolitic Bacteria	Yeast/Mold
A	**0**	5.56 ± 0.24^{c}	4.67 ± 0.19^{d}	4.62 ± 0.07^{c}	2.07 ± 0.21^{d}
	3	$5.60\pm0.30^{c\text{-}x}$	$5.16\pm0.09^{c\text{-}x}$	$4.83\pm0.21^{c\text{-}x}$	3.13 ± 0.50^{c}
	7	$5.72\pm0.22^{c\text{-}x}$	$5.34\pm0.04^{bc\text{-}x}$	$5.60\pm0.30^{a\text{-}x}$	$3.76\pm0.15^{b\text{-}x}$
	12	$5.64\pm0.05^{b\text{-}x}$	$5.44\pm0.08^{b\text{-}x}$	$5.24\pm0.03^{b\text{-}x}$	$4.24\pm0.03^{a\text{-}x}$
	15	$6.86\pm0.07^{a\text{-}x}$	$6.00\pm0.05^{a\text{-}x}$	$5.35\pm0.05^{ab\text{-}x}$	$4.47\pm0.10^{a\text{-}x}$
B	**0**	5.56 ± 0.24^{d}	4.67 ± 0.19^{d}	4.62 ± 0.07^{a}	2.07 ± 0.21^{d}
	3	$5.15\pm0.14^{c\text{-}y}$	$5.50\pm0.10^{c\text{-}y}$	$5.24\pm0.03^{b\text{-}y}$	3.30 ± 0.04^{c}
	7	$5.39\pm0.06^{c\text{-}y}$	$5.82\pm0.19^{b\text{-}y}$	$6.48\pm0.11^{a\text{-}y}$	$4.46\pm0.28^{b\text{-}y}$
	12	$6.04\pm0.13^{b\text{-}y}$	$5.92\pm0.15^{b\text{-}y}$	$6.05\pm0.13^{c\text{-}y}$	$4.50\pm0.06^{b\text{-}y}$
	15	$7.20\pm0.06^{a\text{-}y}$	$6.22\pm0.03^{a\text{-}y}$	$6.21\pm0.04^{b\text{-}y}$	$5.07\pm0.04^{a\text{-}y}$

a–e Means in each column period in same group with different letters were significantly affected by storage ($p < 0.05$); x-y Means in each column in different between Kaymak groups were significantly at similar period ($p < 0.05$); A: 4°C±2, B: 25°C±2, TAMB: total aerobic mesophilic bacteria

Table 3. Result of Physico-Chemical Analysis of Kaymak Samples during Storage (n:5)

Groups	Days	pH	a_w	Peroxide	MDA
A	**0**	6.03 ± 0.07^{a}	0.952 ± 0.004^{a}	0.0718 ± 0.004^{e}	16.56 ± 0.44^{e}
	3	$6.04\pm0.05^{a\text{-}x}$	0.943 ± 0.003^{b}	$0.0936\pm0.002^{d\text{-}x}$	$19.33\pm1.70^{d\text{-}x}$
	7	$6.09\pm0.02^{a\text{-}x}$	$0.954\pm0.001^{a\text{-}x}$	$0.1408\pm0.004^{c\text{-}x}$	$31.42\pm0.86^{c\text{-}x}$
	12	$5.85\pm0.05^{b\text{-}x}$	$0.943\pm0.001^{b\text{-}x}$	$0.3201\pm0.005^{b\text{-}x}$	$40.60\pm2.08^{b\text{-}x}$
	15	5.78 ± 0.02^{b}	$0.942\pm0.002^{b\text{-}x}$	$0.3917\pm0.008^{a\text{-}x}$	$47.36\pm0.61^{a\text{-}x}$
B	**0**	6.03 ± 0.07^{a}	0.952 ± 0.004^{b}	0.0718 ± 0.0039^{e}	16.56 ± 0.44^{e}
	3	$5.88\pm0.06^{b\text{-}y}$	0.948 ± 0.002^{b}	$0.1282\pm0.0064^{d\text{-}y}$	$47.33\pm0.36^{d\text{-}y}$
	7	$5.85\pm0.04^{b\text{-}y}$	$0.962\pm0.002^{a\text{-}y}$	$0.1850\pm0.0027^{c\text{-}y}$	$64.99\pm0.75^{c\text{-}y}$
	12	$5.62\pm0.04^{c\text{-}y}$	$0.928\pm0.002^{c\text{-}y}$	$0.3780\pm0.0038^{b\text{-}y}$	$101.32\pm1.37^{b\text{-}y}$
	15	5.67 ± 0.06^{c}	$0.924\pm0.002^{c\text{-}y}$	$0.4502\pm0.0092^{a\text{-}y}$	$109.83\pm0.91^{a\text{-}y}$

a–e Means in each column period in same group with different letters were significantly affected by storage ($p < 0.05$); x-y Means in each column in different between Kaymak groups were significantly at similar period ($p < 0.05$); A: 4°C±2, B: 25°C±2

L*, a*, b* values in both groups varied during storage (Table 4). In both groups, while the L* value decreased, the values of a* and b* increased. Significant differences were found between L*, a*, b* values in both groups ($p<0.05$). Although L* values in groups A and B decreased compared to the beginning, the decrease in group B samples was greater ($p<0.05$). The a* and b* values of sample doubled, especially in group B. A decrease in the L* value between products and an increase in the values of a* and b* can be due to a change in the quality of products depending on the difference in storage temperature.

Table 4. Result of Color Analysis of Kaymak Samples during Storage (n:5)

Groups	Days	L	a	b
A	0	98.74 ± 0.13^{a}	-1.20 ± 0.05^{b}	6.62 ± 0.07^{c}
	3	$96.96\pm0.25^{b\text{-}x}$	$-1.42\pm0.03^{d\text{-}x}$	$7.21\pm0.03^{b\text{-}x}$
	7	96.52 ± 0.24^{c}	$-1.34\pm0.02^{c\text{-}x}$	$7.33\pm0.02^{ab\text{-}x}$
	12	$96.46\pm0.06^{c\text{-}x}$	$-1.30\pm0.07^{c\text{-}x}$	$7.43\pm0.27^{ab\text{-}x}$
	15	$96.12\pm0.07^{d\text{-}x}$	$-1.10\pm0.02^{a\text{-}x}$	$7.55\pm0.03^{a\text{-}x}$
B	0	98.74 ± 0.13^{a}	-1.20 ± 0.05^{b}	6.62 ± 0.07^{e}
	3	$96.36\pm0.27^{b\text{-}y}$	$-1.25\pm0.03^{b\text{-}y}$	$7.77\pm0.14^{d\text{-}y}$
	7	96.49 ± 0.19^{b}	$-1.23\pm0.04^{b\text{-}y}$	$9.51\pm0.03^{c\text{-}y}$
	12	$95.88\pm0.12^{c\text{-}y}$	$-0.58\pm0.02^{a\text{-}y}$	$13.21\pm0.03^{b\text{-}y}$
	15	$95.10\pm0.02^{d\text{-}y}$	$-0.56\pm0.02^{a\text{-}y}$	$13.65\pm0.08^{a\text{-}y}$

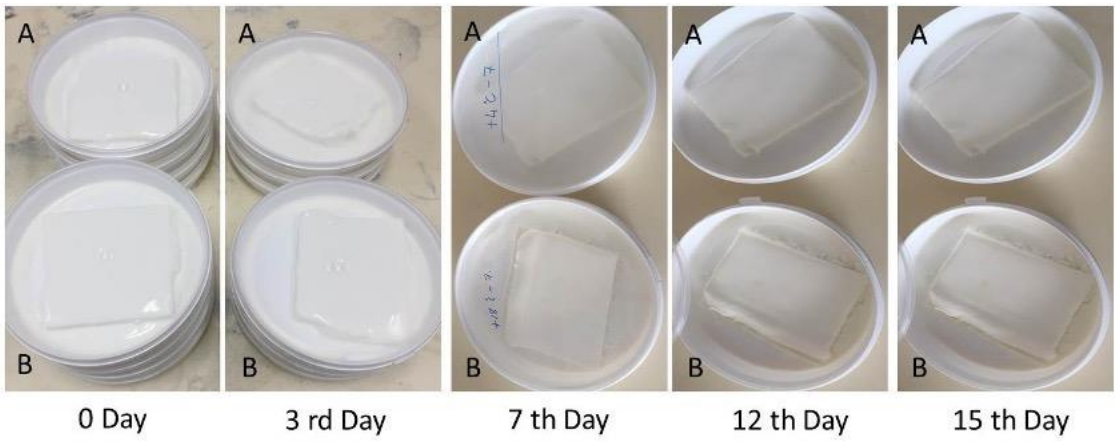
a–d Means in each column period in same group with different letters were significantly affected by storage ($p < 0.05$); x-y Means in each column in different between Kaymak groups were significantly at similar period ($p < 0.05$); A: 4ºC±2, B: 25ºC±2

Table 5. Result of Organoleptic Analysis of Kaymak Samples during Storage (n:5)

Groups	Days	Appearance	Color	Aroma	General
A	0	8.50 ± 0.55^{a}	8.83 ± 0.41^{a}	8.67 ± 0.52^{a}	8.67 ± 0.52^{a}
	3	$8.50\pm0.55^{a\text{-}x}$	$8.67\pm0.52^{a\text{-}x}$	$8.50\pm0.55^{a\text{-}x}$	$8.50\pm0.55^{a\text{-}x}$
	7	$7.83\pm0.41^{b\text{-}x}$	$7.83\pm0.41^{b\text{-}x}$	6.83 ± 0.41^{b}	$7.67\pm0.52^{b\text{-}x}$
	12	$7.33\pm0.52^{b\text{-}x}$	$6.83\pm0.75^{c\text{-}x}$	$6.67\pm0.52^{b\text{-}x}$	$6.83\pm0.41^{c\text{-}x}$
	15	$5.67\pm0.52^{c\text{-}x}$	$4.83\pm0.41^{d\text{-}x}$	$4.33\pm0.52^{c\text{-}x}$	$4.67\pm0.52^{d\text{-}x}$
B	0	8.50 ± 0.55^{a}	8.83 ± 0.41^{a}	8.67 ± 0.52^{a}	8.67 ± 0.52^{a}
	3	$6.67\pm0.52^{b\text{-}y}$	$6.67\pm0.52^{b\text{-}y}$	$6.50\pm0.55^{b\text{-}y}$	$6.83\pm0.41^{b\text{-}y}$
	7	$6.17\pm0.41^{b\text{-}y}$	$6.33\pm0.52^{b\text{-}y}$	6.17 ± 0.75^{b}	$6.33\pm0.52^{b\text{-}y}$
	12	$4.67\pm0.52^{c\text{-}y}$	$4.67\pm0.52^{c\text{-}y}$	$3.17\pm0.41^{c\text{-}y}$	$3.50\pm0.55^{c\text{-}y}$
	15	$3.33\pm0.52^{d\text{-}y}$	$2.67\pm0.52^{d\text{-}y}$	$1.17\pm0.41^{d\text{-}y}$	$1.17\pm0.41^{d\text{-}y}$

a–d Means in each column period in same group with different letters were significantly affected by storage ($p < 0.05$); x-y Means in each column in different between Kaymak groups were significantly at similar period ($p < 0.05$); A: 4ºC±2, B: 25ºC±2

When the organoleptic properties of kaymak samples were examined in both groups, differences depending on time and between groups were found (Table 5, $p<0.05$). Additionally, while the general scores of the products were acceptable until the 15th day, they were found unacceptable after the 7th day in group B. Images of kaymak samples are shown at during the experimental period days (Picture 1).



A: 4ºC±2, B: 25ºC±2

Picture 1. Kaymak samples at during the experimental period

4. Conclusions

The study examined the quality properties of kaymaks stored at different temperatures. As a result, it is seen that high temperature can have negative effects when storing kaymaks with a high oil ratio. But in a production to be carried out under appropriate and hygienic conditions, it was found that the products could have a 7-day shelf life when the is storage made at 25ºC±2, and 15-day shelf life at 4ºC±2 without affecting the consumer preferences and until the days specified (7-15). Therefore, the production and storage conditions starting from the quality of the raw material must be ensured optimally in kaymak, which is an easily perishable product. In order to extend the shelf life of cream, studies should continue with different natural antioxidant and antimicrobial compounds. In addition, the use of quality raw materials should be the first priority in obtaining quality products.

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