Journal of Animal and Veterinary Advances 10 (9): 1171-1176, 2011
ISSN: 1680-5593

Effects of Ripening Period on Textural and Sensory Properties of Capper Cheeses

Oktay Yerlikaya and Cem Karagozlu
Department of Dairy Technology,
Faculty of Agriculture, Ege University, 35100 Bornova, Izmir, Turkey

Abstract: In this study, the effect of caper berries addition on the some textural and sensory properties of white cheese was investigated. Three batches of white cheese were produced: one without caper addition the test (K), another with addition of whole grain caper was (T) and the 3rd with minced caper was (P). Caper berries were added to vat two different ways as grain and minced after cutting at a level of 8 g 100 g^{-1} of curd weight. According to the results obtained from statistical analyses when compared to control sample, a significant difference was obtained by add caper to white cheese for hardness, adhesiveness, cohesiveness, gumminess, springiness and chewiness ($p<0.05$). When sensory characteristics including body and texture, appearance, taste and odour were evaluated as totally, total sensory scores of add caper as grain and minced decreased after 30th day of storage. Generally, the data obtained from the study showed that add to caper to white cheese while it was reduced to some quality characteristics and some properties had improved.

Key words: Cheese, ripening, caper, texture, sensory properties, Turkey

INTRODUCTION

Capparies is called capers (*Capparis* L.) of the Capparaceae family are the fruit of a shrub, a perennial plant having medicinal and aromatic properties and grown wildly at various regions of the world were profited for several purposes since ancient times (Ozcan *et al*., 2004). Cappers species were used in traditional medicine as a capers and caper berries have gained importance in the food industry and international trade but manufacturing processes are expensive due to the lack of extensive farming of *Capparis* sp. (production often relies on wild growing plants), the seasonal availability of the raw materials and the absence of large enough processing industries (Pulido *et al*., 2007). The commercially valuable parts of caper are the immature flower buds which are pickled in vinegar or preserved granular salt (Dursun and Dursun, 2005). Capers are one of the plant sources high in flavonoid compounds rutin (or rutoside) and quercetin. Both these compounds are powerful anti-oxidants. Research studies suggest that quercetin has anti-bacterial, anti-carcinogenic, analgesic and anti-inflammatory properties (Sher and Alyemeni, 2010).

White cheese is the most popular traditional Turkish cheese which has also been manufactured on an industrial scale for a long time. Turkish white cheese is a soft or semi-hard cheese that contains 20-25% milk fat with a salty and acidic taste. It is a major foodstuff of the Turkish diet. In cheese production various kinds of herbs are added to cheese curd produced from raw or pasteurised milk. After production, the cheese is ripened for 3 months (Tarakci and Kucukoner, 2008). In this study, caper was decided to be used in order to give white cheese (the most commonly produced and consumed cheese type in Turkey) different flavours and aromas and to create new choices for the consumers due to its nutritional features. The aim of this study was to compare the effect of grain caper and minced caper on the textural and sensory characteristics of industrially produced capper cheeses.

MATERIALS AND METHODS

Raw cow's milk supplied from Ege University, Menemen Practise and Research Farm of Faculty of Agriculture (Izmir, Turkey). The mean composition of raw cow's milk used in making cheese with caper was total solids 12.70±0.69 g/100 g, fat 4.5±0.42 g/100 g, lactose 3.65±0.35 g/100 g, total nitrogen 0.68±0.02 g/100 g and acidity as lactic acid 0.18±0.01 g/100 g. Rennet of animal (calf) origin was obtained from Mayasan Gida Sanayi ve Ticaret A.S. (Istanbul, Turkey) and used to coagulate milk in liquid form (coagulating power 1:8000). Calcium chloride was obtained commercially from Horasan Kimya (Ankara). Cheese starter culture, *Lactococcus lactis* subsp. *lactis* and *Lactococcus lactis* subsp. *cremoris* (1:1) were obtained from Danisco Co. (France). Freeze-dried

Corresponding Author: Oktay Yerlikaya, Department of Dairy Technology, Faculty of Agriculture, Ege University, 35100 Bornova, Izmir, Turkey

concentrated cultures were activated by growing at 37°C overnight in de Mann, Ragosa, Sharpe (MRS) broth (Fluka Chemie GmbH, Buchs, Switzerland) and this procedure was repeated twice. Activated cultures were grown overnight at 37°C in heat-treated (110°C for 15 min) 12 g 100 mL^{-1} reconstituted skim milk before the addition into the cheese vats. Canned caper berries were obtained from Susitas A.S. (Cigli, Izmir) and added to the cheese vat after cutting. Level of caper in pickled from was 8% of curd weight, acidity 1%, pH 3.5, salt 10% and control cheese contained no caper. The experiment was carried out in thrice.

Cheese-making and sampling: Cheese with caper production was carried out in a pilot plant of Dairy Technology Department of Ege University, Izmir, Turkey. Raw milk was first filtered, pasteurized at 72°C for 2 min. and cooled to 32°C. Starter culture was added at a level of 0.5 g 100 mL^{-1} and $CaCl_2$ at a level of 0.2 g L^{-1} cheese milk. Then it was coagulated by using calf rennet. After coagulation, the curd was cut into 1 cm^2 cubes. After the removal of whey and divided into 3 equal groups. One of them was used as control group without caper. Capers at level of 8% of curd weight were added to two different ways as fruit and sliced and mixed well. The curd was weighed and cut in blocks of a size of 7×7×7 cm^3. Fresh cheeses were soaked in brine of 16% salt for 3 h. The brined blocks were dry salted and taken out and left for 12 h uncovered on a cheese table at ambient temperature.

Cheeses were put into cans with 12% brine and transferred to cold rooms (4-5°C) and ripened for 90 days at this temperature. From each batch, samples were taken out on day 1, 30, 60, 90 of ripening. Textural and sensory properties were analyzed.

Textural analysis: Texture Profile Analysis (TPA) of the cheeses was determined in terms of hardness, adhesiveness, cohesiveness and springiness using a two-bite test (Bourne, 1978; Al-Otaibi and Wilbey, 2006). Cubes (20 mm) from each cheese were cut and covered with an airtight plastic wrap to avoid loss of moisture and allowed to equilibrate to the assay temperature of 15°C. Each cube was compressed to 80% of its original height using a Texture Analyzer TA-XT Plus (Vienna Court, England) with a 50 kg load cell and a test speed of 1 mm sec^{-1}. Texture analysis values were the mean of the three replicates tested on each sampling time.

Sensory analyses: Organoleptic assessment of the cheeses during the ripening period was carried out by a seven member panel of the Department's staff, selected on the basis of interest and experience in sensory evaluation of white cheese products. Panellists assessed the cheese samples according to scheme by the (IDF, 1987) guide for the sensory evaluation of cheese. Samples of white-brined cheese were placed on white plates coded with three-digit random numbers.

The samples were tempered at ambient temperature (18±2°C) for 1 h and then presented to the panellists in a random order for testing. Water was provided for mouth-washing between samples. The parameters investigated in sensory evaluation were body/texture (0-5), appearance (0-5), flavour (0-5), odour (0-5) and overall appearance (0-3).

Statistical analysis: Analyses were done in triplicate. Data were analyzed using the general linear model procedure of the SPSS Win 9.0 program (SPSS Inc., Chicago, IL). Analysis of variance for each set of data was conducted and Duncan's multiple range tests was used to compare the means when the effect was significant ($p<0.05$). In addition, statistical significance was given in terms of p-values with differences at the 95% confidence interval ($p<0.05$) as being considered statistically significant.

RESULTS

Texture profile analysis of cheeses: In the study, the experimental cheese sample (control) without caper addition was labeled K; the sample with addition of whole grain caper was T and the one with minced caper was P. Texture profile which plays an important role in defining and determining the quality of cheese is also accepted as the primary attribute in preference and consumption of cheese. When the studies concerning the texture profiles of cheeses are examined it is seen that they mostly focus on 6 different textural properties as hardness, adhesiveness, cohesiveness, gumminess, springiness and chewiness values and changes in the period of storage for the cheeses produced in the research are shown in Table 1.

Hardness is defined in sensorial terms as the force required to compress a food between teeth or between tongue and palate. It is the peak force of the first compression. As a result of the statistical evaluation, the change in hardness values of control and whole-grain-caper white cheese samples in storage period is found to be statistically significant ($p<0.05$). Hardness values decreased in all cheese samples. In a comparison between the products, whole-grain-caper cheese is

Table 1: Changes in texture parameters of capper cheeses during ripening (n = 3±SD)

	Storage days				
Parameters	1	30	60	90	Means of storage
H (kg)					
K	1.81±0.07^{a}	1.73±0.02^{b}	1.71±0.05^{b}	1.08±0,01^{b}	1.58±0.05^{X}
T	2.21±0.08^{a}	2.20±0.15^{a}	1.04±0.17^{b}	0.94±0.03^{b}	1.60±0.65^{X}
P	1.36±0.01^{b}	1.73±0.01^{a}	1.20±0.01^{b}	0.56±0.01^{c}	0.96±0.35^{Y}
A (kg)					
K	13.77±0.29^{d}	16.24±2.49^{c}	22.57±0.09^{b}	67.58±6.89^{a}	30.04±2.55^{Y}
T	25.67±0.05^{cd}	30.04±7.13^{c}	42.32±3.84^{b}	67.58±6.89^{a}	34.40±21.75^{X}
P	20.00±0.33^{a}	16.24±2.49^{ab}	12.92±0.87^{c}	17.24±0.18^{b}	16.34±2.57^{Z}
C					
K	0.44±0.01^{c}	0.71±0.07^{aY}	0.59±0.04^{b}	0.28±0.05^{d}	0.51±0.26^{Y}
T	0.53±0.01^{a}	0.47±0.04^{a}	0.14±0.02^{c}	0.29±0.01^{b}	0.36±0.16^{X}
P	0.68±0.17^{a}	0.57±0.22^{bc}	0.25±0.04^{bc}	0.15±0.01^{c}	0.41±0.26^{Z}
G (kg)					
K	1.36±0.07^{b}	1.23±0.12^{a}	1.02±0.04^{b}	0.30±0.08^{a}	0.97±0.44^{X}
T	1.10±0.16^{a}	1.04±0.15^{a}	0.27±0.02^{c}	0.15±0.00^{b}	0.64±0.47^{Y}
P	0.90±0.01^{c}	0.68±0.27^{bc}	0.43±0.07^{ab}	0.08±0.01^{a}	0.52±0.34^{Y}
S					
K	0.91±0.01^{a}	0.95±0.06^{aX}	0.71±0.01^{a}	0.82±0.00^{b}	0.82±0.08^{X}
T	0.87±0.01^{b}	0.85±0.00^{b}	0.83±0.01^{a}	0.80±0.03^{ab}	0.84±0.03^{Y}
P	0.94±0.04^{c}	0.85±0.01^{b}	0.59±0.02^{a}	0.87±0.00^{b}	0.81±0.14^{Z}
Cw (kg)					
K	1.14±0.02^{a}	1.04±0.01^{a}	0.72±0.01^{b}	0.25±0.06^{c}	0.78±0.37^{X}
T	0.88±0.11^{a}	0.88±0.13^{a}	0.23±0.02^{b}	0.12±0.00^{b}	0.53±0.39^{Y}
P	0.52±0.01^{a}	0.36±0.06^{b}	0.39±0.14^{b}	0.07±0.01^{c}	0.34±0.19^{Z}

K: control; T: whole grain caper cheese; P: minced caper cheese; Means with different letters within same row ($^{a-d}$) or column ($^{X-Z}$) are significant at p<0.05; H: Hardness; A: Adhesiveness; C: Cohesiveness; G: Gumminess; S: Springiness; Cw: Chewiness

observed to have the highest value of hardness, followed by control and minced caper cheese. It is observed that hardness values decreased significantly in the last days of storage. This result is seen in sensory mass/texture scores of the cheese samples (Table 2).

While the difference between the average hardness values of control and whole-grain-caper cheese samples is not statistically significant (p>0.05), the difference between control and minced cheese samples is found to be significant (p<0.05). The results obtained are found to be lower than the hardness values identified in the studies of Gwartney *et al.* (2002), Topcu and Saldamli (2006), Arguello *et al.* (2007) and Akalin and Karaman (2010). This is considered to result from the type of cheese and caper addition to cheese.

Adhesiveness is defined as a force required to pull food away from palate with tongue (Truong *et al.*, 2002). This value is the negative area for the force in the first compression. Koca and Metin (2004) stated that there is negative correlation between hardness and adhesiveness. The change in adhesiveness values of cheese samples in storage period and the differences between average adhesiveness values of cheese types are found to be statistically significant (p<0.05). It is observed that adhesiveness values of cheese samples increased in the period of storage. In a comparison between the samples, whole-grain-caper cheese is observed to have the highest

Table 2: Changes in sensory properties of cheeses during ripening (n = 3±SD)

	Storage days				
Parameters	1	30	60	90	Means of storage
Body/texture					
T	4.75^{a}	4.75^{a}	4.13^{b}	4.13^{b}	4.44±0.15^{X}
P	4.63^{a}	4.63^{a}	3.75^{b}	3.75^{b}	4.19±0.22^{Y}
Appearance					
T	4.25^{a}	4.25^{a}	4.25^{b}	4.00^{c}	4.19±0.19^{X}
P	4.38^{a}	4.25^{a}	3.75^{b}	3.50^{c}	3.97±0.44^{Y}
Flavour					
T	3.75^{a}	3.63^{ab}	3.63^{ab}	3.50^{b}	3.63±0.72^{X}
P	3.75^{a}	3.50^{b}	3.38^{c}	3.13^{d}	3.44±0.05^{X}
Odour					
T	4.25^{a}	4.12^{b}	4.00^{c}	3.88^{d}	4.06±1.10^{X}
P	4.25^{a}	4.00^{b}	3.88^{c}	3.63^{d}	3.94±0.88^{X}
Overall appearance					
T	2.13^{a}	1.94^{b}	1.86^{c}	1.75^{d}	1.92±0.11^{X}
P	2.25^{a}	2.14^{b}	1.63^{c}	1.57^{d}	1.90±0.05^{X}

T: whole grain caper cheese; P: minced caper cheese; Means with different letters within same row ($^{a-d}$) or column ($^{X-Z}$) are significant at p<0.05

value of adhesiveness followed by control and minced caper cheese. The results are found to be higher than the adhesiveness values obtained in a research conducted by Akalin and Karaman (2010) on full-fat cheeses. Adhesiveness values increased in the control and whole-grain-caper cheese samples while they slightly decreased in minced caper cheeses. Adhesiveness value increased in the period of storage in the researches conducted by Awad *et al.* (2005), Topcu and Saldamli (2006), Akalin and

Karaman (2010) and Bryant *et al.* (1995) noted that the reason for this increase is that proteins are broken along with ripening in the storage period and higher amount of water is retained over time. Cohesiveness is defined as the degree of deformation of food sample before it fractures in the mouth. The change in cohesiveness values of cheese samples in storage period and the differences between average cohesiveness values of cheese types are found to be statistically significant ($p<0.05$).

It is observed that cohesiveness values of cheese samples first increased and then decreased in the period of storage. The results are found to be lower than the cohesiveness values obtained in a research conducted by Mehenktas and Metin on full-fat cheeses while they are found to be higher than the cohesiveness values obtained by Gwartney *et al.* (2002), Ozer *et al.* (2003), Topcu and Saldamli (2006), Arguello *et al.* (2007) and Karagul-Yuceer *et al.* (2007). This difference is considered to result from the different types of cheese used in the aforementioned researches.

Gumminess is the force or the number of times required to disintegrate a semi-solid food product to a state ready for swallowing. It is analytically defined as Hardness x Cohesiveness. While gumminess values decreased in all samples in the period of storage, the decrease in gumminess values of control and whole-grain-caper cheese samples in the period of storage is found to be statistically significant ($p<0.05$).

The difference between the caper-added cheese samples is found to be insignificant in terms of affecting the gumminess value ($p>0.05$). The gumminess values obtained in the research are found to be lower than the values obtained in the studies of Topcu and Saldamli (2006) and Akalin and Karaman (2010) and the results of these researches also reflected decrease in gumminess values in the period of storage in parallel with the results of the research.

Springiness is defined as the rate at which deformed food goes back to its undeformed condition in the course of chewing (Truong *et al.*, 2002). It is analytically defined as the height that the food recovers during the time that elapses between the end of the first bite and the start of the second bite (Bourne, 1978). The change in springiness values of control and caper white cheese samples in storage period and the differences between average spreadability values of samples are found to be statistically significant ($p<0.05$). The results are found to be in parallel with those of Akalin and Karaman (2010) parallel and lower than those of Gwartney *et al.* (2002), Topcu and Saldamli (2006) and Karagul-Yuceer *et al.* (2007).

In the research conducted by Ozer *et al.* (2003) on Urfa cheese and in the research conducted by Akalin and Karaman (2010) on white cheese, the springiness values are found to decrease slightly in the period of storage in parallel with the findings. The number of times required to chew a food product to a swallowable state is termed as chewiness. It is analytically defined as gumminess x springiness (Bourne, 1978). While chewiness values decreased in all samples in the period of storage, the change in chewiness values of control and whole-grain-caper white cheese samples in the period of storage is found to be statistically significant ($p<0.05$). The difference between the average chewiness values of control, whole-grain-caper and minced caper cheese samples is also found to be statistically significant ($p<0.05$). Hardness value is effective in the estimation of chewiness values of cheeses. In the research, decreased hardness value has also decreased chewiness value. Therefore, the factors affecting hardness values of the cheeses also affect their chewiness property.

Sensory evaluations: In the research, caper cheeses and white cheese are not compared in terms of sensory properties because the purpose of caper cheese production is to create a different taste and flavour as mentioned in the objective of the study. Therefore, whole-grain-caper cheese and minced caper cheese is compared with respect to their sensory properties. The scores given to the cheeses produced with respect to mass and texture are shown in Table 2. The samples are evaluated over a 5-point scale. It is observed that the samples are hard in mass and texture and it is seen that some of the caper grains are separated from the whole-grain-caper cheese texture when they are cut. However, it was not evaluated negatively by the panelists.

The scores given to whole-grain-caper cheese and minced caper cheese declined in the period of storage. This decline is found to be statistically important after the 30th day ($p<0.05$). When whole-grain-caper cheese and minced caper cheese is compared, whole-grain-caper cheese is seen to receive higher scores. Decline in scores is caused by ripening-based textural softening of cheese. Dry matter rate in cheeses which are ripened in salt, decreases over the period of storage. The reason for this is attributed to the transfer of water-soluble protein and peptides to salt solution. Furthermore, peptide bonds of an α_{s1}-casein are broken during ripening and the new ionic groups form bonds with water in salt solution and proteins have increased ability to absorb water during storage at low temperature which can reduce the amount of dry matter in cheese (Kesenkas and Akbulut, 2008) thus leads to softening in the mass and texture of cheese.

Textural difference between types of cheese is found to be statistically significant ($p<0.05$). These results are in parallel with the findings from texture analysis. The appearance of a food is influenced by how it reflects, absorbs or transmits light which in turn is related to the physical structure and chemical nature of the food (Rudan *et al*., 1998). The opacity and whiteness of cheese is manifestation of light scattering (Pastorino *et al*., 2002). In the samples which are given 5 full scores in appearance evaluations, it is found out that whole-grain-caper cheese is admired more than the minced one (Table 1). One reason for this is that addition of minced capers in cheese type P leads to a nonhomogenous color distribution.

The change in the appearance scores for cheese samples after the 30th day is found to be statistically significant ($p<0.05$). In average values, whole-grain-caper product is given higher scores and the difference is found to be statistically significant ($p<0.05$). According to the panelists' comments, whole-grain-caper product seems better with capers seemingly more bright. The difference between the average flavor scores of minced caper and whole-grain-caper samples is found to be statistically insignificant ($p>0.05$) (Table 1). It may be because cheese has unripe flavor on the 1st day. In the subsequent days of storage, the scores of cheese samples were decreased, leading to less differentiation in terms of minced caper and whole-grain-caper products. This decrease in cheese samples over the period of storage is found to be statistically significant ($p<0.05$). Panelists evaluated the flavor of samples as unique and the caper aroma and salt to be much. The difference between the average odor scores of minced caper and whole-grain-caper samples is found to be statistically insignificant ($p>0.05$). The scores are the same on the 1st day of storage. The change in odor values of the samples over the period of storage is found to be statistically significant ($p<0.05$). While there is no difference statistically between two types of caper cheese, panelists made comments that odor of capers was felt more in minced caper cheese samples, particularly after the 60th day of storage. Other than that a slightly sourish odor is felt in cheese samples.

In addition to the mass and texture, appearance, flavor and odor properties in the scale, the panelists are asked to evaluate the overall impression in a 3 point scale (Table 2). There is not a significant difference in average values between two products ($p>0.05$). The change over the period of storage is found to be significant ($p<0.05$). Panelists rated all cheese samples above 2 points in the 1st 30 days of storage and any of the samples was not rated unfavourable.

DISCUSSION

Food texture profile and cheese texture profile analysis within this scope is associated with the quality of food and an important parameter directly influencing consumer preference. Food textural properties change and vary depending on the product type and storage conditions. Texture profile which plays an important role in defining and determining the quality of cheese is also accepted as the primary attribute in preference and consumption of cheese. In the texture profile analysis conducted, certain textural problems have arisen due to addition of caper to cheeses.

In all cheese samples, hardness values decreased over the period of storage. In a comparison between the products, whole-grain-caper cheese is observed to have the highest value of hardness followed by control and minced caper cheese. It is observed that hardness values decreased significantly in the last days of storage. Increasing water in the mass of cheese causes decrease in hardness of cheese. Adhesiveness is defined as a force required to pull food away from palate with tongue. In the research, the change in adhesiveness values of cheese samples in storage period and the differences between average adhesiveness values of cheese types are found to be statistically significant as well as the statistical significance of cohesiveness which is the degree of deformation of food sample before it fractures in the mouth, gumminess which is the force or the number of times required to disintegrate a semi-solid food product to a state ready for swallowing, springiness which is the rate at which deformed food goes back to its undeformed condition in the course of chewing and chewiness which is the number of times required to chew a food product to a swallowable state ($p<0.05$).

Control sample is not included in the sensory analysis where results of whole-grain-caper cheese and minced caper cheese samples are evaluated. In the comparison evaluating the factors of mass and texture, appearance, flavor and odor, it is found that whole-grain-caper cheese samples get higher scores than minced caper cheese samples. However as panelists also mentioned in their comments, certain unfavourable aspects appear in sensory properties in later stages of storage, i.e., ripening therefore it is concluded that it would be more appropriate for this kind of cheese to be consumed fresh. Still, whole-grain-caper cheeses received 1.75 points and minced caper cheeses received 1.57 points in a 3 point scale even at the 90th day of storage which indicates liking above 50%.

CONCLUSION

In the study, minced and whole grain caper cheeses are liked from a textural and sensory perspective. In addition, production of less salty and less acidic caper in pickled caper which will be used in caper cheese production will improve the sensory properties of cheeses further. On the other hand, the amount of caper and the kind of milk (cow and ewe milk or cow, ewe and goat milk, etc.,) used in the cheese curd at the production phase may be changed to be offered to liking of consumers. With the addition of caper which is known for its functionality, consumers will be offered a kind of cheese with enhanced functionality which will lead to an alternative product in dairy products market.

ACKNOWLEDGEMENTS

This research was supported by Turkish Scientific Research Council (TUBITAK) (Project Number: TOVAG 107 O 305) and Ege University Scientific Research Fund (Project Number: 2008-ZRF-042).

REFERENCES

Akalin, S. and D. Karaman, 2010. Influence of packaging conditions on the textural and sensory characteristics, microstructure and colour of industrially produced Turkish white cheese during ripening. J. Texture Stud., 41: 549-562.

Al-Otaibi, M.M. and R.A. Wilbey, 2006. Effect of chymosin reduction and salt substitution on the properties of white salted cheese. Int. Dairy J., 16: 903-909.

Arguello, A., M. Fresno, M.E. Ruiz, N. Castro and S. Alvarez, 2007. Effects of smoking on surface colour and texture of traditional goat cheeses. J. Anim. Vet. Adv., 6: 310-313.

Awad, S., A.N. Hassan and K. Muthukumarappan, 2005. Application of exopolysaccharide-producing cultures in reduced-fat cheddar cheese: Texture and melting properties. J. Dairy Sci., 88: 4204-4213.

Bourne, M.C., 1978. Texture profile analysis. Food Technol., 33: 62-66.

Bryant, A., Z. Ustunol and J. Steffe, 1995. Texture of cheddar cheese as influenced by fat reduction. J. Food Sci., 60: 1216-1219.

Dursun, E. and I. Dursun, 2005. Some physical propeties of caper seed. Biosyst. Eng., 92: 237-245.

Gwartney, E.A., E.A. Foegeding and D.K. Larick, 2002. The texture of commercial full-fat and reduced-fat cheese. J. Food Sci., 67: 812-816.

IDF, 1987. Sensory Evaluation of Dairy Products. International Dairy Federation, Brussels.

Karagul-Yuceer, Y., M. Isleten and C. Uysal-Pala, 2007. Sensory characteristics of ezine cheese. J. Sens. Stud., 22: 49-65.

Kesenkas, H. and N. Akbulut, 2008. Yeasts as ripening adjunct cultures in Turkish white brined cheese production. Turk. J. Vet. Anim. Sci., 32: 327-333.

Koca, N. and M. Metin, 2004. Textural, melting and sensory properties of low-fat fresh kashar cheeses product by using fat replacers. Int. Dairy J., 14: 365-373.

Ozcan, M., H. Haciseferogullari and F. Demir, 2004. Some physico-mechanic and chemical properties of capers (*Capparis ovata* Desf. var. *canescens* (coss.) heywood) flower buds. J. Food Eng., 65: 151-155.

Ozer, B.H., R.K. Robinson and A.S. Grandison, 2003. Textural and microstructural properties of Urfa cheese (A white-brined Turkish cheese). Int. J. Dairy Technol., 56: 171-176.

Pastorino, A.J., R.I. Dave, C.J. Oberg and D.J. McMohan, 2002. Temperature effect on structure-opacity relationship of nonfat Mozzarella cheese. J. Dairy Sci., 85: 2106-2113.

Pulido, R.P., N.B. Omar, H. Abriouel, R.L. Lopez, M.M. Canamero, J.P. Guyot and A. Galvez, 2007. Characterization of lactobacilli isolated from caper berry fermentations. J. Appllied Microbiol., 102: 583-590.

Rudan, M.A., D.M. Barbano, R.M. Guo and P.S. Kindstebt, 1998. Effect of the modification of fat particle size by homogenization on composition, proteolysis, functionality and appearance of reduced fat mozzarella cheese. J. Dairy Sci., 81: 2065-2076.

Sher, H. and M.N. Alyemeni, 2010. Ethnobotanical and pharmaceutical evaluation of *Capparis spinosa* L., validity of local folk and Unani system of medicine. J. Med. Plants Res., 4: 1751-1756.

Tarakci, Z. and E. Kucukoner, 2008. Comparatives of basic nutrients, mineral and heavy metal contents of some herby dairy products. Int. J. Food Sci. Tech., 43: 216-219.

Topcu, A. and I. Saldamli, 2006. Proteolytical, chemical, textural and sensorial changes during the ripening of Turkish white cheese made of pasteurized cows milk. Int. J. Food Prop., 9: 665-678.

Truong, V.D., C.R. Daubert, M.A. Drake and S.R. Bexter, 2002. Vane eheometry for textural characterization of cheddar Cheese. J. Food Sci., 47: 631-636.