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Effects on Physico-chemical, Proteolysis and Antioxidant Capacity use of Capper in Model Cheeses

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Abstract

In this study, the effects of capers addition on some physico-chemical and functional properties of Model Cheese were investigated. Three batches of Model Cheese were produced: a control group with no caper addition (C), a group with whole (5%) minced caper addition (CP5) and a group with (10%) minced caper addition (CP10). Caper berries were added to the cheese after cutting at a level of 5 g and 10g per 100 g of curd weight. Changes in chemical compositions, proteolysis (ripening index), free amino acids, and antioxidant capaciy of Model Cheese samples were analysed during the ripening period for 90 days at + 4 °C. According to the results obtained from statistical analyses, when compared to control sample, there was a significant difference by adding caper to Model Cheese for lactic acid %, and antioxidant capacity ($p<0.05$). Generally, the data obtained from this study showed that adding caper to Model Cheese reduced some quality characteristics, while some properties such as physicochemical were improved.

Keywords: Model cheese, ripening, caper, proteolysis, antioxidant capacity.

1. Introduction

Capparis is called capers (Capparaceae) is a common perennial shrub in the Mediterranean regions, growing both wild and cultivated, with medicinal and aromatic properties. The roots, fruits, flower buds and leaves of caper are used in medical action. Also it is used in cosmetic and food industry. The caper fruits and plant are regarded as an important source of protein. Caper plays an important role in the human diet. They are harvested in spring before they be in flover and are usually processed in brine. The processed buds have long been used in recipes for salads, pasta, meat, sauces and garnishes to add a pungent spicy flavour and aroma to food and have gained a considerable importance in the food industry. Spain is the leading world producer of capers followed by Morocco, Italy and Turkey, respectively. More than 1000 varieties of cheese are produced around the world. In Turkey, nearly 40 different cheeses are known, but only few of them have national and economic value (Hayaloglu *et al*, 2002).

In cheese production, various kinds of herbs are added to cheese curd produced from raw or pasteurized milk. After production, the cheese is usually ripened for 3 months. The herbs commonly used in dairy products are as follows: Allium sp., Prangos sp., Silene vulgaris, Tymus sp., and Mentha sp., and these herbs are added to cheese in different ratios. In the herb added dairy products these herbs have odour, flavour and bio-preservative characteristics (Tarakci and Kucukoner, 2008). Proteolysis is the most complex biochemical process and is catalyzed by indigenous milk enzymes (i.e. plasmin, cathepsin D and other proteinases); milk coagulating enzymes (i.e. chymosin, pepsin or fungal acid proteinases) and enzymes from starter bacteria, non-starter bacteria and secondary starter bacteria (Fox and McSweeney 1996).

In this study, caper was used in order to create Model Cheese with different flavours and to offer new products with improved nutritional features to the consumers. The aim of this study was also to develop a new cheese making process through additions of caper a new food product with improved functional properties.

2. Materials and Methods

2.1 Materials

Raw cow milk supplied from a dairy plant (Malatya, Turkey) was used in Model cheese making. Calf rennet, with declared milk clotting activity of 1:16,000 (Chr. Hansen A.S., Istanbul, Turkey), which means that 1 mL rennet can coagulate 16 L of milk (or 175 IMCU), was used to coagulate milk. Cheese starters including the mixture of *Lactococcus lactis subsp. lactis* and *Lactococcus lactis subsp. cremoris* (with reference code FRC 60). The average composition characteristics of raw cow's milk used in making cheese with caper were, 11.8 ± 0.03 % total solids, 3.6±0.63 % fat, 4.28±0.21 % total protein and 0.16±0.02 % acidity as lactic acid. Canned capers were obtained from Malatya and added to the cheese curd before pressing. The added amount of caper in pickled form was 5 % and 10 % of curd weight, pH=3.48, while the control cheese contained no caper. The experiment was repeated two times and the analyses were carried out in duplicate.

2. 2. Cheese manufacture

Two cheese-making trials were performed for the manufacture of Model cheese with caper addition was carried out in the Food Engineering Department of InonuUniversity, Malatya, Turkey. The milk was heat-treated at 68 °C for 10 min and cooled to 38 °C. Starter cultures were added in amount of 1 mL per 100 mL of milk and $CaCl_2$ in amount of 20g per 100 L of milk. The milk was then coagulated by using rennet. After the removal of whey, curd was divided into three batches. One of them was used as control group without caper. Cheeses were put into vacum bag and transferred to refrigirator (4±2 °C), and ripened for 90 days at this temperature (Figure 1). In the study, the experimental cheese sample without caper addition (control) was labelled as "C"; the sample with addition of minced caper 5 % as "CP5" and the one with minced caper 10 % as "CP10". From each batch, samples were taken out on the 1, 30, 60 and 90 days of ripening. In each sample chemical composition, proteolysis, sensory and antioxidant capacity were analysed.

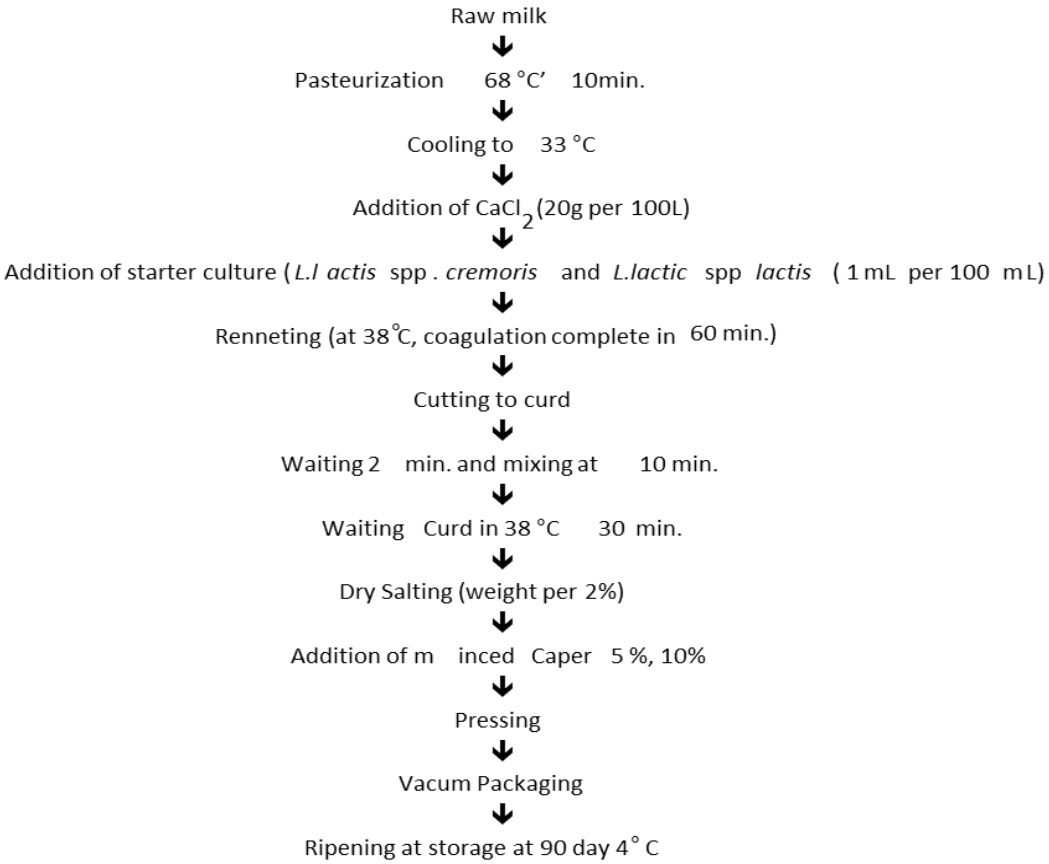

Figure1. Manufacture of Model chesese with capper

2.3. Cheese analysis

2.3.1.Gross chemical composition and proteolysis

Cheese samples were analyzed in duplicate for the pH (was measured by means of a combined electrode pH-meter (Thermo Orion, Asheville, NC, USA)., moisture, fat, total nitrogen, nitrogen fractions [water soluble nitrogen (WSN) and 12% trichloroacetic acid-soluble nitrogen (TCA-SN)] by the methods described in Hayaloglu et al. (2005). Total FAAs content of the cheeses was determined by the method described in Hayaloglu (2007).

2.3.2. Free amino acid analysis

Determination of individual free amino acids One hundred milligram of freeze-dried WSE was mixed with 20 µl 40mM methionine sulphone. The mixture was further mixed with 1 ml trichloroacetic acid (40%, w/v), and then homogenised using a vortex mixer. Afterwards, the homogenised mixture was held at 4 °C for 10 min and centrifuged at 20 000 g for 10 min. The deproteinised supernatant (25 µl) was vacuum-dried. Twenty microliters of buffer solution containing methanol, triethyleneamine and 1M sodium acetate at ratios of 2:1:2, respectively, were added to the dried samples and the mixture was re-dried under vacuum. Twenty ml of derivatising solution (prepared by mixing methanol, water, triethyleneamine and phenylthiocyanate at ratios of 7:1:1:1, respectively) was added to the dried samples. The samples were incubated at room temperature for 20 min and then vacuum-dried. One ml of dilution buffer was added to the dried samples and the diluted samples were passed through a filter paper (0·20 µm, CROMAFIL Xtra PVDF-20/25, MN GmbH, Düren, Germany). The volume of the filtrate loaded into the HPLC column (Inertsil RP C18 column, GL Science Inc, Tokyo, Japan) was 20 µl. The amino acid standard was prepared by mixing acidic, neutral and basic amino acids at ratios of 1:1:1. Methionine sulphone was used as internal standard. The eluent A consisted of 70mM sodium acetate which was adjusted to pH 6·55 with acetic acid containing acetonitrile (2.5%, v/v). The eluent B contained acetonitrile, water and methanol at ratios of 9:8:7, respectively. Na_2EDTA was added to each solvent at a level of 10 mg/ml. The results were expressed as µg/g dry WSE.

2.3.3. ABTS radical cation scavenging activity

For the ABTS assay, ABTS stock solution was prepared by reacting 7 mM ABTS with 2.45 mM potassium persulfate solution. The stock solution was left in the dark at room temperature for 16 h, and it was diluted with ethanol to reach an absorbance of 0.70 (± 0.02) at 734 nm. A 100 µL of the sample extract was mixed with 2400 µL of ABTS•+ solution, and the absorbance was measured at 734 nm after 10 min, against ethanol. The results were expressed mg/g trolox equivalent of sample by means of a curve for Trolox (1-100 ppm) (Xu et *al*, 2010).

2.3.4. Sensory analysis

Sensory evaluation of the cheeses was made at 1, 30, 60 and 90 days of ripening. Cheese samples were removed from the refrigerator, cut into pieces and placed on white plates coded with a random three-digit numbers. A total of 3 different types of cheese were presented to the panellists at one session, and two separate sessions were made for each cheese during ripening. Approximately 50 g of cheese was presented to each panellist. Before sensory evaluation at each session, cheeses were rested for about 60 min at room temperature. The samples were evaluated using criteria such as colour (scale 0-5), appearance (scale 0-5), texture (scale 0-5), taste and flavour (scale 0-5), Fruit rate (scale 0-5), Hardness (scale 0-5), Chewness (scale 0-5), Fattyness (scale 0-5), Homogeneity (scale 0-5). Water and bread were also provided to the panellists to rinse their mouths between samples. Sensory characteristics of Model cheese were evaluated by seven trained panels (from the permanent staff at the Department of Food Engineering, Inonu University, Turkey) who were familiar with the taste and texture of Model cheese.

2.3.4. Statistical analysis

Data obtained were analysed statistically using SPSS statistical package program (SPSS © v. version 9.0, SPSS Inc., Chicago, IL, USA). Duncan's Multiple Range Test was used to determine the statistically different groups. All analyses were performed in duplicate and the level of confidence was at least 95% ($P<0·05$).

3. Results and Discussions

3.1.Gross chemical composition and proteolysis

The mean values of the pH, lactic acid, fat, dry matter, salt, salt in dry matter, and fat in dry matter, WSN, 12% TCA-SN throughout the ripening of cheese samples are presented in Table 1 and Table 2.

Table 1. Compositional Properties of cheeses added capers during ripening

Compositional properties	day	C	CP5	CP10	*Ps*	*Pd*
pH	1	5.60±0.00	5.58±0.01	5.77±0.00	*	***
	30	5.11±0.01	5.05±0.01	5.28±0.01		
	60	5.00±0.02	5.15±0.08	5.15±0.09		
	90	4.79±0.03	5.05±0.00	5.11±0.01		
Acidity (Lactic acid) %	1	0.90±0.13	0.88±0.03	0.88±0.16	NS	**
	30	0.90±0.13	0.88±0.03	0.88±0.16		
	60	0.90±0.13	0.88±0.03	0.88±0.16		
	90	1.43±0.01	1.08±0.00	1.06±0.00		
Dry matter %	1	44.03±0.20	43.76±0.35	44.10±1.00	NS	***
	30	45.65±0.03	44.56±0.11	44.73±0.45		
	60	45.19±0.47	44.78±0.46	45.03±0.25		
	90	45.28±0.00	45.70±0.45	46.06±0.07		
Moisture %	1	55.97±0.20	56.24±0.35	55.91±1.00	NS	***
	30	54.35±0.03	55.45±0.11	55.27±0.45		
	60	54.81±0.47	55.23±0.46	54.97±0.25		
	90	54.72±0.00	54.31±0.45	53.94±0.07		
Fat %	1	26.50±0.71	22.00±0.00	20.50±0.71	***	**
	30	25.50±0.71	22.50±0.71	20.00±0.00		
	60	23.25±0.35	22.50±0.71	20.50±0.71		
	90	23.25±0.35	21.75±0.35	18.50±0.00		
Fat in Dry Matter %	1	60.19±1.88	50.28±0.41	46.48±0.55	***	***
	30	55.86±1.58	50.50±1.47	44.72±0.45		
	60	51.46±1.31	50.25±1.06	45.52±1.31		
	90	51.35±0.78	47.60±1.24	40.17±0.06		
Salt %	1	0.47±0.08	0.67±0.12	0.67±0.04	***	***
	30	0.59±0.00	0.81±0.01	0.85±0.05		
	60	0.61±0.04	1.18±0.03	1.44±0.05		
	90	0.66±0.02	1.18±0.02	1.47±0.05		
Salt in Dry Matter	1	1.06±0.18	1.54±0.30	1.53±0.13	***	***
	30	1.28±0.00	1.83±0.01	1.90±0.08		
	60	1.36±0.08	2.63±0.04	3.19±0.08		
	90	1.45±0.05	2.57±0.01	3.19±0.11		

C: control. CP5: 5% minced caper. CP10: 10% minced caper; *P<0.05; **P<0.01; ***P<0.001; s: sample. d: day

The use of capers significantly affected the pH, the pH levels of cheeses with caper addition were lower probably due to the acidity originating from caper brine. As presented in Table 1 there was a significant effect of storage on dry matter contents in cheese samples ($p<0.05$). Esspecially, as far as control group, caper addition had a significant effect on the dry matter contents ($p<0.05$). Dry matter contents and changes in the cheese samples during ripening are in agreement with results of other researchers (Hayaloglu, 2003; Sahingil *et al*, 2014; Yerlikaya and Karagozlu, 2014). The fat content decreased and protein content of the the all sample increased during ripening, Resulting from dry matter contents change during ripening, the composition of cheese be likely change (Kesenkas and Akbulut, 2008). Therefore, components such as protein, fat and salt were evaluated based on their ratios within the dry matter (Anonymous, 2). Salt content in a dry matter of samples increased during storage and it was higher in

samples with caper than in the control sample ($p<0.001$). It is obvious that this difference relays on the use of pickled capers. Changes in total protein amounts of control samples and samples with caper during storage was found statistically no significant ($p>0.05$).

Table 2. Proteolysis parameters of cheeses added capers during ripening

	Day	C	CP5	CP10	*Ps*	*Pd*
Crude Protein %	1	16.94±0.26	16.96±0.04	17.89±0.56	NS	NS
	30	22.42±0.09	22.88±0.31	23.57±1.37		
	60	21.07±1.31	21.03±1.02	22.92±0.82		
	90	21.98±1.07	22.96±1.02	23.12±0.95		
WSN/TN	1	12.85±0.95	10.90±0.61	9.53±0.27	NS	***
	30	10.08±0.90	11.82±0.45	11.48±0.20		
	60	22.38±2.07	21.09±0.22	20.03±0.70		
	90	25.08±1.22	24.30±0.63	21.76±1.88		
TCA/TN	1	4.59±0.07	4.26±0.16	4.12±0.07	NS	***
	30	5.09±0.50	4.81±0.01	4.91±0.11		
	60	7.10±0.34	7.43±0.92	6.92±0.31		
	90	8.28±0.75	7.80±0.11	7.25±0.29		

C: control. CP5: 5% minced caper. CP10: 10% minced caper; *P<0.05; **P<0.01; ***P<0.001; s: sample. d: day

Protein contents of sample cheeses probably increased due to additions of caper. The highest protein content was measured in the sample with 10% minced caper and it was followed by the sample with 5% minced caper and finally the control sample. According to the literature, fruit of caper contains average 22 %-27% protein (Akgül ve Özcan, 1999; Tlili *et al*, 2011). Development of proteolysis in the cheeses during ripening was monitored by measuring the variations in the concentrations of nitrogen fractions (WSN and TCA-SN). It is a well-known fact that the WSN fraction of cheese extract contains high, medium and small molecular weight peptides; free amino acids and nitrogen compounds which are produced mainly by the action of rennet and plasmin (Hayaloglu *et al*. 2005). The content of water soluble nitrogen (WSN) during ripening was statistically significant ($p<0.001$) in the control sample and in the sample with capers. Changes in ripening indexes of all cheese samples during ripening were statistically significant ($p<0.001$). It was reported similir results by Kesenkas and Akbulut, 2008; Gursoy and Kinik, 2010; Hayaloglu, 2003; Sahingil *et al*, 2014).

3.2. Free amino acid composition

The principal FAAs were Glu, Val, Tyr, Arg, Pro, Leu and Lys in all experimental cheeses with caper and the control sample and changes during storage (Table 3). The relationship between the release of amino acids and the flavour formation in cheese has been assumed by many researchers. The contents of free amino acids such as alanine, cysteine, glycine, threonine, aspartic acid and valine were high in the control sample, while the contents of arginine, glutamik acid and proline levels were high in samples with caper addition. In general, tryptophane contents in all cheese samples increased during storage. Thr content was higer with capers cheeses while Try content was the highest in the control sample (Table 3).

Table 3. Free amino acid composition (µg/gr) of cheeses added capers during ripening

	C				CP5				CP10				*P*s	*P* d
Amino acids	1	30	60	90	1	30	60	90	1	30	60	90		
Asp	3.21	5.11	6.55	9.90	2.23	1.92	2.14	2.21	0.45	1.71	1.84	2.06	*	*
Glu	1.09	1.66	1.67	1.63	1.88	3.57	7.76	15.04	1.95	3.75	7.13	17.09	NS	*
Asn	2.62	3.44	4.61	4.16	0.18	1.83	4.13	4.68	2.36	2.98	3.67	4.32	NS	**
Ser	1.21	2.46	4.59	4.17	0.16	1.10	3.75	3.09	0.33	2.43	2.20	3.23	NS	**
Gln	1.37	4.54	6.31	7.42	0.39	3.16	6.48	7.14	0.78	1.33	1.53	1.88	**	*
Gly	0.86	1.43	2.32	3.55	0.28	0.75	2.42	2.08	0.56	1.34	1.50	2.25	NS	***
His	1.28	1.57	1.78	1.86	0.56	1.45	4.70	5.24	1.11	1.13	2.90	5.21	NS	*
Arg	1.06	1.68	1.43	1.39	2.28	6.11	8.75	11.48	1.56	1.71	1.21	2.17	**	NS
Thr	1.00	1.08	2.15	4.23	0.26	0.81	2.46	3.36	0.52	2.09	1.62	2.34	NS	**
Ala	5.29	5.35	6.26	9.21	1.92	2.29	5.78	5.73	3.84	5.08	4.58	8.19	**	**
Pro	4.25	8.16	9.68	12.36	2.12	4.84	10.07	12.84	2.80	5.89	8.60	12.89	**	***
Tyr	0.89	1.23	3.80	3.38	0.54	0.51	2.74	2.22	0.59	1.13	1.01	2.98	NS	**
Val	12.30	13.06	23.96	24.79	7.51	7.64	8.97	9.38	1.50	6.46	7.27	10.14	***	**
Met	1.22	2.46	2.51	3.80	0.35	1.04	2.95	3.31	0.71	1.58	2.08	3.66	NS	***
Cys	3.20	3.88	6.88	9.05	1.19	2.42	5.56	7.53	2.39	3.38	4.84	6.85	**	***
ile	1.26	2.01	10.60	11.06	0.16	2.58	6.90	6.91	0.32	2.39	5.15	6.35	NS	***
Leu	2.87	9.43	15.22	28.16	1.78	7.90	12.26	25.10	1.56	4.33	12.80	24.78	NS	***
Phe	2.56	4.72	10.20	12.90	3.26	4.06	9.25	11.82	2.34	4.36	8.25	11.34	NS	***
Trp	0.21	0.46	1.26	1.29	0.16	0.16	1.26	1.12	0.31	0.33	0.32	0.31	NS	*
Lys	4.15	7.19	16.81	20.06	1.88	4.19	15.75	16.25	3.77	6.51	8.38	15.09	NS	***

Ala: alanine, Arg: arginine, Asn: asparagine, Asp: aspartic acid, Cys; cycteine, Gln: glutamine, Glu: glutamic acid, Gly: glycine, His: histidine, Leu: leucine ile: isoleucin, Lys: lysine, Met: methionine, Phe: phenylalanine, Pro: proline, Ser: serine, Thr: threonine, Trp: tryptophan, Val: valine; C: control. CP5: 5% minced caper. CP10: 10% minced caper; *P<0.05; **P<0.01; ***P<0.001; s: sample. d: day

The contents of leucine and isoleucine were the highest in the control sample. Val is mostly found in food products of animal origin. The highest content was detected in the control sample and showed an increasing trend during ripening. LYS, limited in vegetative nutriments but abundant in animal based food (meat, milk, egg), is an important amino acid for human health. ALA is present in almost all proteins. As presented in Table 3, the highest average level of alanine content was detected in the control sample and showed an increase during storage. CYS was found in highest value in the control sample and was followed by the sample with %5 caper and the %10 caper respectively. The contents of LEU increased in all samples during storage and were the highest in the control sample. The highest PRO content was measured in the samples with caper addition. Similar results were obtained by Yerlikaya and Karagozlu, (2014).

3.3. Sensory analysis

Sensory perception is a complex process, which is influenced by factors such as the level of flavour compounds, texture and appearance of cheese (Smit et al. 2005). A comparison of the sensory data for the three cheeses during ripening is given in Table 4. The mean scores for colour/appearance and flavour scores, homogenity and cutaway wiew of between the experimental cheeses significant during ripening (P<0.05; P<0.01; P<0.001). The cheeses made by using capers had slightly bitter flavour. This may be probably due to capers may have negatively influenced the flavour scores of the cheeses. The lower hardness score in cheeses CP5 and CP10.

Table 4. Sensory properties of cheeses added capers during ripening

Day	Sensory properties	C	CP5	CP10	*Ps*	*Pd*
1	Color	4.67±0.38	3.92±0.58	4.00±0.90	**	**
	Appearance	4.33±0.53	3.83±0.82	4.00±0.69	***	**
	Texture	3.75±0.69	3.75±1.07	3.67±0.90	NS	NS
	Acidity	3.92±0.53	3.67±0.95	3.33±0.53	NS	NS
	Taste and flavour	4.50±0.79	3.75±0.95	3.50±1.13	*	**
	Fruit rate	ND	4.00±1.07	3.67±0.95	***	NS
	Hardness	3.83±0.98	3.67±0.49	3.67±1.13	NS	NS
	Cutaway wiev	4.25±1.13	3.58±1.27	3.83±0.53	*	*
	Chewiness	4.00±1.21	4.17±0.90	4.00±0.69	NS	*
	Raggedness	3.92±0.90	4.08±0.95	3.92±0.90	NS	NS
	Fattyness	4.42±0.58	3.25±0.90	3.58±0.76	NS	*
	Homogeneity	4.83±0.38	2.67±0.90	3.33±0.49	***	NS
30	Color	4.83±0.38	4.17±0.53	3.92±0.49	**	**
	Appearance	4.50±0.38	3.83±1.07	3.58±0.95	***	**
	Texture	4.33±0.69	3.73±0.90	3.55±0.79	NS	NS
	Acidity	4.42±0.76	4.00±0.75	3.91±1.03	NS	NS
	Taste and flavour	4.33±1.15	4.00±0.69	3.82±0.76	*	**
	Fruit rate	ND	3.73±0.98	3.55±1.37	***	NS
	Hardness	4.58±0.82	3.75±1.11	3.58±1.07	NS	NS
	Cutaway wiev	4.67±0.00	4.08±0.69	3.83±0.79	*	*
	Chewiness	4.30±1.11	4.08±1.21	3.92±1.11	NS	*
	Raggedness	4.30±1.30	4.17±1.07	3.92±0.98	NS	NS
	Fattyness	4.64±0.49	4.00±0.53	3.83±0.58	NS	*
	Homogeneity	5.00±0.00	3.50±0.98	3.50±0.98	***	NS
60	Color	4.33±0.76	3.58±0.79	3.83±0.69	**	**
	Appearance	4.25±0.76	3.58±0.95	3.67±0.49	***	**
	Texture	3.92±0.69	3.83±0.98	3.67±0.98	NS	NS
	Acidity	3.42±0.79	3.25±1.11	3.42±1.13	NS	NS
	Taste and flavour	2.88±0.49	2.83±0.98	3.33±1.11	*	**
	Fruit rate	ND	3.80±0.18	3.42±0.98	***	NS
	Hardness	3.50±0.90	3.09±1.07	3.42±0.53	NS	NS
	Cutaway wiev	3.50±0.98	3.27±0.82	3.58±0.79	*	*
	Chewiness	3.18±0.76	3.42±0.98	3.67±0.95	NS	*
	Raggedness	3.09±0.63	3.83±0.53	3.83±0.79	NS	NS
	Fattyness	3.50±0.69	3.75±0.38	3.92±0.69	NS	*
	Homogeneity	3.83±1.11	3.33±0.49	3.83±0.76	***	NS
90	Color	4.67±0.76	4.00±0.58	4.42±0.76	**	**
	Appearance	4.83±0.38	4.08±0.58	4.25±0.53	***	**
	Texture	4.33±1.11	3.92±0.58	4.00±0.69	NS	NS
	Acidity	4.25±0.58	3.50±0.79	4.00±0.69	NS	NS
	Taste and flavour	4.33±0.53	3.58±1.38	3.08±1.15	*	**
	Fruit rate	ND	3.86±0.05	3.78±0.69	***	NS
	Hardness	4.58±1.15	3.67±0.53	4.17±0.69	NS	NS
	Cutaway wiev	4.58±0.79	4.00±0.95	4.25±0.69	*	*
	Chewiness	4.50±0.90	3.83±0.90	4.08±0.38	NS	*
	Raggedness	4.25±0.53	3.67±0.98	3.83±0.69	NS	NS
	Fattyness	4.33±0.58	3.75±0.38	3.58±0.53	NS	*
	Homogeneity	4.83±0.38	3.67±0.76	3.50±0.53	***	NS

CP5: 5% minced caper. CP10: 10% minced caper; *P<0.05; **P<0.01; ***P<0.001; s: sample. d: day

3.4. ABTS radical cation scavenging activity

The total antioxidant capacity (TAC) is an important quality parameter for medicinal plants and many in vitro antioxidant test methods are used for such determination. TAC of capper fruits were measured by

ABTS+● radical scavenging activity methods in the study. ABTS+● radical scavenging activity shown in Table 5.

Table 5. Antioxidant capacity (mg/g trolox equivalent) of cheeses added capers during ripening

Day	C	CP5	CP10	*Ps*	*Pd*
1	51.04±0.98	73.14±1.17	85.37±2.62	***	***
30	68.12±0.75	97.46±0.33	103.29±0.45	**	**
60	108.87±0.49	123.23±2.68	129.9±2.68	***	***
90	110.58±1.43	130.56±0.70	133.16±1.00	**	**

CP5: 5% minced caper. CP10: 10% minced caper; *P<0.05; **P<0.01; ***P<0.001; s: sample. d: day

The method of scavenging the stable free radicals ABTS+● activity test. The results indicated that there were some differences in ABTS+● antiradical activity in cheeses added capper. The CP10 sample which in the sample with 10% minced caper had the highest ABTS+● which is an indicator of total antioxidant capacity, and followed by CP10, CP5 and C. Differences in the ABTS+● values of the cappers samples were significant (P< 0.05). ABTS+● radical scavenging activities of samples showed that the highest capper concentration, was in C which is the hightest antiradical activity. Radical activity values of samples were found between 51.05 µg/gr- 133,16 µg/gr TE in Model cheeses.

4. Conclusion

In this study, effect of capper addition on some physical and chemical properties of Model Cheese was investigated. Capper addition to cheese showed some negative effects as fat value, while the chemical properties were improved, particularly the amino acid composition and antioxidant capacity. In conclusion, the use of capers changed the sensory profiles and antioxidant capacity of the cheeses.

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