Ausgabe für imr:livelyzachary

Die Inhalte sind urheberrechtlich geschützt. Eine Weitergabe an unberechtigte Dritte ist untersagt.
Journal of Food Safety and Food Quality 66, Heft 1 (2015), Seiten 1–24

Arch Lebensmittelhyg 66,
10–17 (2015)
DOI 10.2376/0003-925X-66-10

© M. & H. Schaper GmbH & Co.
ISSN 0003-925X

Korrespondenzadresse:
dsert@konya.edu.tr

[1]) Necmettin Erbakan University, Faculty of Engineering and Architecture, Department of Food Engineering, Konya, 42090, Turkey; [2]) Sakarya University, Faculty of Engineering, Department of Food Engineering, Sakarya, 54040, Turkey; [3]) Selcuk University, Faculty of Agriculture, Department of Food Engineering, Konya, 42075, Turkey

The effect of some spices extracts on the oxidative stability of Yayik butter

Einfluss von Gewürzextrakten auf die oxidative Stabilität von Fassbutter

Durmuş Sert[1]), Derya Arslan[1]), Ahmet Ayar[2]) and M. Musa Özcan[3])

Summary

The effects of ethyl acetate extracts of some spices on Yayik butter stability were investigated. All extracts were individually incorporated to butter at the levels of 0.2 and 0.5 %. For comparison, a positive control (0.01 % *t*-butyl-4-hydroxyanisole; BHA) and a non additive-negative control were also prepared and tested. The butter samples were stored at 5 and 25 °C for both 120 days. The antioxidant activities of clove, thyme, rosemary, ginger and sumac extracts were similar to the activity of BHA in butter. Free fatty acid values of butter samples fortified by ethyl acetate extracts of cumin, sumac, rosemary, clove, sage and thyme were significantly lower than the values of negative control sample; whereas these fortified samples showed similar values to that of positive control sample. The antioxidative effects of extracts were more evident when the samples were stored at 25 °C. Sumac extract showed significant positive effects on storage stability of butter regarding both lower peroxide and thiobarbituric acid values. Cinnamon and sumac extracts brought the most preferred aroma in butter samples stored at 5 and 25 °C.

Keywords: Yayik butter, Spice extract, Storage stability, Oxidation, Lipolysis

Zusammenfassung

In dieser Studie wurde der Einfluss von Ethylacetatextrakten verschiedener Gewürze auf die Stabilität von Fassbutter untersucht. Alle Extrakte wurden 0.2 und 0.5 % der Butter hinzugefügt. Zum Vergleich wurde eine Positiv-Kontrolle mit 0.01 % t-butyl-4-hydroxyanisole (BHA) und eine Negativ-Kontrolle (ohne Zusätze) hergestellt und untersucht. Die Butterproben wurden für einen Zeitraum von 120 Tagen bei 5 und 25 °C gelagert. Eine antioxidative Wirkung auf Fassbutter, ähnlich wie BHA, besitzen Nelken, Thymian, Rosmarin, Ingwer und Sumach-Extrakte. Der Gehalt an freien Fettsäuren der Butterproben, die mit Ethylacetatextrakte von Kreuzkümmel, Sumach, Rosmarin, Nelken, Salbei und Thymian angereichert waren, war wesentlich geringer als die der Negativ-Kontrollen. Sie hatten jedoch vergleichbare Werte, wie die der Positivkontrollen. Die antioxidative Wirkung der Extrakte, der bei 25 °C gelagerten Proben war noch deutlicher. Sumach-Extrakte haben bezüglich der geringen Peroxid- und Thiobarbitursäure-Werte eine positive Auswirkung auf die Lagerstabilität von Fassbutter. Zimt und Sumach-Extrakte haben bei der 5 und 25 °C Lagerung bevorzugte Aromaeigenschaften entwickelt.

Schlüsselwörter: BHA, Gewürze, Lagerstabilität, Oxidation, Lipolyse

Ausgabe für imr:livelyzachary
Die Inhalte sind urheberrechtlich geschützt. Eine Weitergabe an unberechtigte Dritte ist untersagt.

Ausgabe für imr:livelyzachary Die Inhalte sind urheberrechtlich geschützt. Eine Weitergabe an unberechtigte Dritte ist untersagt.

1. Introduction

Milk, cream and yoghurt are the most common sources used in butter production in different areas of Turkey. 'Yayik butter', which has been traditionally produced in Turkey for centuries, is produced from fresh or 'tulum' yoghurt (strained yoghurt made from cow, goat or sheep milk). This type of butter is very popular due to its characteristic aroma (Atamer 1993). Sheep, goat or cow milk can be used in making yoghurt, and during the making of 'yayik butter', some amount of water is mixed with the yoghurt and churned. The microflora of yayik butter may be affected by differences in traditional processing methods, packaging materials [goat's skin, clay (soil) cup or cleaned rumen], and storage conditions (Konar and Hayaloglu 1999; Kaya 2000; Zhao et al. 2000).

Deterioration (lipolysis and oxidation) of milk fat due to several factors causes flavor impairment, lowers nutritional quality, and creates serious problems for storage stability. Oxidative deterioration of butter oil is one of the major concerns of the dairy industry. The onset of rancidity in butter oil may be usually due to oxidation of unsaturated glycerides leading to development of peroxides and/or due to hydrolysis of glycerides resulting in increased levels of free fatty acids (FFA) (Amr 1991; Bindal and Wadhwa 1991; Joshi and Thakar 1994; Muir 1996).

Health protection and economic reasons have necessitated investigations aimed at enhancing the oxidation stability of lipids and lipid-containing products. There is an increasing trend towards adding suitable harmless natural antioxidants to these products and, in particular, an increasing interest in herbs and spices as sources of natural antioxidants (Akgul and Ayar 1993; Ozcan and Akgul 1995; Ayar et al. 2001; Lee and Shibamoto 2002; Calucci et al. 2003).

The extracts from leaves of rosemary and sage are mainly used as antioxidative spice additives today among many spices and herbs which were proved to have antioxidative effects. The stabilization effect of the additives depends strongly on the composition of the complex lipid system and of the lipid-containing foods, as well as on the conditions of processing and storage (Shahidi and Han 1993; Yanishlieva et al. 2006).

In determining storage stability and quality of butter, the peroxide value reflecting the oxidation of fatty acids, the amount of free fatty acid and the degree of lipolysis are taken into consideration (Munro et al. 1992). When the amount reaches 1.8 mg KOH/g fat, there is a perceptible off-flavour in butter. In a study carried out by Atamer and Sezgin (1984) the relation between the amount of FFA and peroxide value against butter flavour was analysed. Samples with FFAs exceeding 3.3 mg KOH/g fat were recognized as rancid or spoiled by 59 % of the panellists. An off-flavour is also perceived in butter when peroxide values reach 2 meq O_2/kg fat. Interestingly, the acceptable value is set at 10 meq O_2/kg fat by the Food Regulations in Turkey (Anonymous 1990).

In this study, effects on the oxidative stability of sage (*Salvia officinalis* L., leaves), cinnamon (*Cinnamomum zeylanicum,* tree bark), rosemary (*Rosmarinus officinalis* L., leaves), clove (*Syzygium aromaticum* L., buds), sumac (*Rhus coriaria* L., fruit pericarp), oregano (*Origanum vulgare* L., leaves), ginger (*Zingiber officinale,* rhizome), cumin (*Cuminum cyminum* L., fruit) and thyme (*Thymus vulgaris* L., leaves) extracts in butter samples stored at different temperatures were evaluated.

2 Materials and Methods

2.1 Materials

Dried spices; sage, cinnamon, rosemary, clove, sumac, oregano, ginger, cumin, thyme were purchased from a local herb shop. These spices were ground and then 100 g of each sample was soaked in ethyl acetate for 24 h to obtain an extract which is easily soluble in butter. The mixture was then filtered and the filtrate was evaporated to dryness by a vacuum evaporator at 30 °C. Yayik butter was obtained from a local dairy plant.

The extracts were added at two levels; 0.2 and 0.5 % (w/w). Also, control sample was included in the assay which contained none of the extracts or additives. In addition, *t*-butyl-4-hydroxyanisole (BHA) was separately added at a level of 0.01 % to compare the natural extracts and synthetic antioxidants.

2.2 Storage and sampling

Samples of 100 g of butter were placed into plastic cups and the cups were sealed with aluminium foil. The effects of different storage temperatures (room temperature, 25 °C and refrigerator temperature, 5 °C) were investigated for 120 days. 40 cups of each treatment were prepared to be used for the analyses. At each sampling time two cups were removed from the incubator and each was submitted to analyses. In this study, mean values obtained during storage time were used.

2.3 Methods

2.3.1 pH measurement

The pH values of butter samples were determined at room temperature with an 315i/SET pH-meter and combined sentix 42 electrode (WTW, Weilheim, Germany). Standard buffer solutions (pH 4.01 and 7.01; WTW, Weilheim, Germany) were used for calibration.

2.3.2 Water activity measurement

Water activity (A_w) measurements were performed with an Aqualab apparatus (Model Series 3TE, Decagon Devices Inc., Pullman, WA). Pure water (1.000 ± 0.003 %) was used as standard for equipment calibration.

2.3.3 Determination of free radical scavenging activity

For determination of radical-scavenging activities of methanolic and ethanolic extracts of the spices were prepared. Methanol and ethanol extracts from the spices were obtained by maceration. 100 g of grounded materials were mixed with 500 ml ethanol; the flasks were tightly closed and macerated at room temp. for 10 h in an orbital stirrer at 75 rpm. The mixture was then filtered through Whatman 1 filter paper, and washed with 100 ml ethanol, both extracts were combined, the solvent was evaporated in vacuum drier at 55 ºC. The extracts were stored in amber bottles in the dark at 4 ºC until utilization. The same procedure was followed by using methanol as solvent to get methanolic extracts.

The stable 1,1-diphenyl-2-picryl hydrazyl radical (DPPH) was used for determination of free radical-scavenging activity of the extracts (Koleva et al. 2002). Different concentrations of each spice extract were added, at an equal volume, to methanolic and ethanolic solution of DPPH (100 µm). After 15 min at room temperature, the absorbance was recorded at 517 nm. BHA was used as a control standard. IC_{50} values denote the concentration of sam-

Ausgabe für imr:livelyzachary Die Inhalte sind urheberrechtlich geschützt. Eine Weitergabe an unberechtigte Dritte ist untersagt.

Ausgabe für imr:livelyzachary

Die Inhalte sind urheberrechtlich geschützt. Eine Weitergabe an unberechtigte Dritte ist untersagt.
Journal of Food Safety and Food Quality 66, Heft 1 (2015), Seiten 1–24

ple, which is required to scavenge 50 % of DPPH free radicals. Lower absorbance of the reaction mixture indicated higher free radical scavenging activity. The percent of DPPH discoloration of the samples was calculated according to the formula:

Antiradical activity (%) =
100 x [(absorbance of control – absorbance of sample) / absorbance of control)]

Extract concentration providing 50 % inhibition (IC_{50}) was calculated from the plot of inhibition percentage against extract concentration. Tests were carried out in triplicate.

2.3.4 Peroxide value (PV)

Approximately 5 g butter was weighed into an erlenmeyer flask and dissolved in 10 ml chloroform. Then, 15 ml acetic acid and 1 ml saturated potassium iodine (KI) were added and mixed for 1 min. The mixture was left in the dark at room temperature for 5 min. Then, distilled water (75 ml) was added and the mixture was shaken vigorously. Starch solution (1 %, 1 ml) was added and the resulting solution was titrated with 0.002 N sodium thiosulphate ($Na_2S_2O_3$) until the colour became clear. The peroxide value was calculated using the formula (AOAC 1990):

$$PV = [(V1–V0)\ N]/M$$

$V1$ is the amount of $Na_2S_2O_3$ used for titration (ml), $V0$ is the amount of $Na_2S_2O_3$ used for the blank (ml), N is the normality of $Na_2S_2O_3$ and M is the amount of sample (g). PV are expressed as milliequivalents (meq) of active oxygen per kg of butter.

2.3.5 Free fatty acids (FFA)

The FFA content was evaluated according to the method described by AOAC (1977) and results were expressed as % oleic acid. About 5–10 g butter was weighed into an erlenmeyer flask, 30 ml neutralized ethanol and two drops of phenolphthalein indicator were added and the mixture was warmed to promote dissolution. The solution was titrated with a solution of 0.1 N KOH until the pink color was stable for at least 20 s.

2.3.6 Thiobarbituric acid (TBA) test

TBA value was determined according to a modified version of the method described by Kuruppu et al. (1985). Butter sample (0.2–1.0 g) was weighed in a screw-capped test tube and 10 ml of a 7.5 % trichloroacetic acid solution and 0.01 g BHA were added. The mixture was shaken vigorously for exactly 1 min by means of a vortex mixer (Labnet, VX-100). After that, 3 ml of a 1 % solution of TBA were added and the tube was placed in a boiling water bath for 40 min. After cooling, the fat was removed from the reaction mixture by shaking it with 3 ml chloroform followed by centrifugation. The optical density of the pink aqueous phase containing the reaction product was measured at 530 nm.

2.3.7 Sensory analysis

The panel for sensory analysis consisted of ten members from the researchers at the faculty, who were familiar with the quality characteristics of the yayik butter. The panelists evaluated the aroma of samples by using a 10-point scale (1-worst to 10-best).

2.3.8 Statistical analysis

COSTAT software (Version 2.1) was used to perform the statistical analyses. Differences in samples due to addition of some spices extracts were tested statistically. Significant differences among the means were determined by using Duncan's multiple comparison tests at P<0.01 (Costat 1990).

3 Results and Discussion

The pH values of butter samples ranged between 4.77–5.19. The storage temperatures significantly (P<0.01) influenced the pH values as that the samples stored at 25 °C had lower pH values than the values of samples stored at refrigerator (Fig. 1). Addition of spice extracts led to fluctuations at pH values. In general, the pH values decreased when the extract amount increased whereas the butter samples which were fortified by the extracts of sage, clove and rosemary expressed increases in pH at both storage temperatures. Ozkan et al. (2007) reported that pH of plain butter decreased from 4.99 to 4.91 between the 20th and 60th days of storage while addition of *Satureja clicica* essential oil to the butter led to a higher decrease.

Negative and positive (BHA, 0.01 %) control samples showed pH values of 5.75 and 5.98, respectively, when the samples stored at 5 °C and these values were 5.56 and 5.66, respectively, when the samples stored at 25 °C. There were not significant correlations between oxidation degree and water activity as well as between pH values. The values obtained in the present study were in the range of values (4.50–5.23) reported by Sagdıc et al. (2002) for churned butter.

Butter samples showed significant differences between the a_w values (P<0.01). 0.5 % extract containing samples

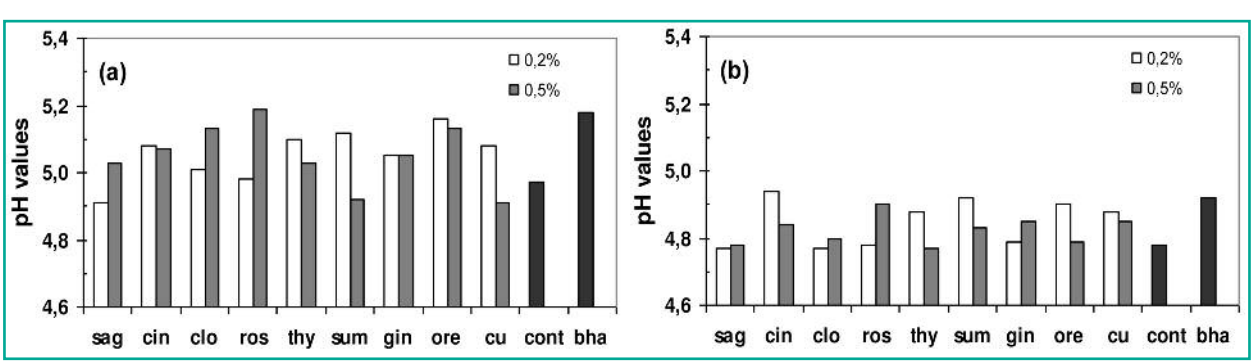

FIGURE 1: *pH values of butter samples (a: 5 °C, b: 25 °C).*

List of abbreviations (for all figures): *sag = sage; cin = cinnamon; clo = clove; ros = rosemary; thy = thyme; sum = sumac; gin = ginger; ore = oregano; cu = cumin; cont = control; bha = t-butyl-4-hydroxyanis*

Ausgabe für imr:livelyzachary
Die Inhalte sind urheberrechtlich geschützt. Eine Weitergabe an unberechtigte Dritte ist untersagt.

Ausgabe für imr:livelyzachary Die Inhalte sind urheberrechtlich geschützt. Eine Weitergabe an unberechtigte Dritte ist untersagt.

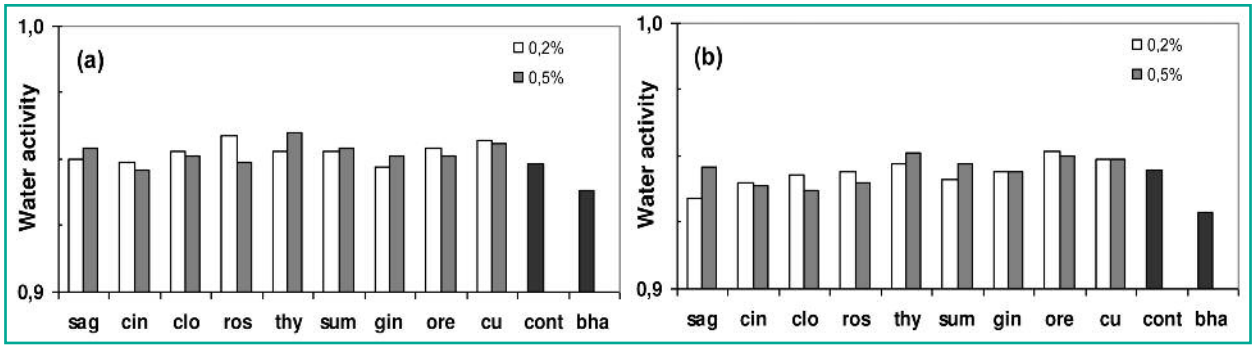

FIGURE 2: *Water activity values of butter samples (a: 5 °C, b: 25 °C).*

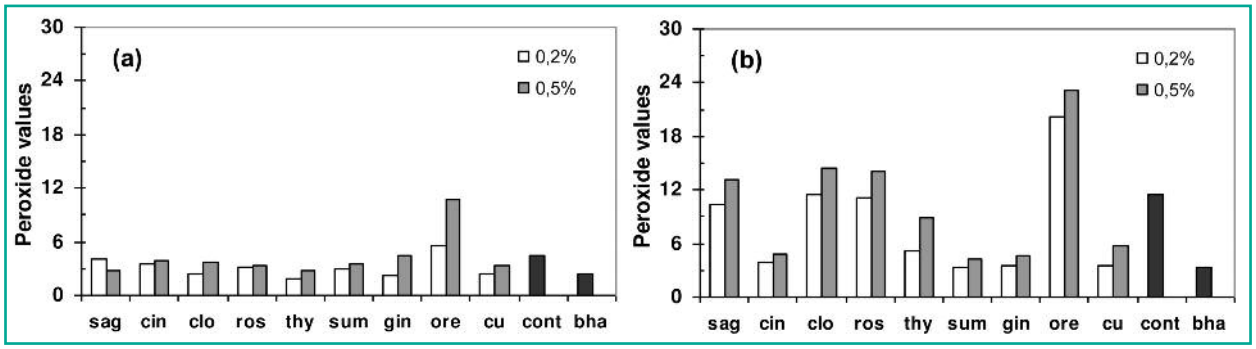

FIGURE 3: *Peroxide values of butter samples (meq O_2/kg fat) (a: 5 °C, b: 25 °C).*

had lower a_w values than the samples containing 0.2 % extract. The samples stored at 5 °C showed much higher decrease in a_w than the samples stored at 25 °C during storage (Fig. 2). The a_w values of butter samples stored at 5 °C ranged between 0.938 (positive control) and 0.960 (0.5 % thyme extract added) and the average value was 0.951. The a_w values of samples stored at 25 °C varied between 0.929 (positive control) and 0.952 (0.2 % oregano extract added) with the average value 0.943. BHA added butter samples showed the lowest a_w (0.929–0.938). The oxidation rate of lipids strongly depends on water activity. In dry milk products, oxidation proceeds very rapidly with very low moisture content (a_w<0.1). However, if the water content is increased to a_w of about 0.3, lipid oxidation become a minimum rate. At a higher water activity, the oxidation rate can be increased if there is any catalyst present in the product (Krishna and Prabhakar 1992).

The free radical scavenging capacities of the methanolic and ethanolic extracts (IC_{50}) were given in Table 1. It was found that methanolic extracts of clove, thyme and rosemary had antioxidant activities comparable to that of BHA. In previous studies, sage and rosemary were shown to have similar patterns of phenolic compounds and the antioxidative activity was attributed mainly to carnosic acid and rosmarinic acid (Brieskorn and Domling 1969; Cuvelier et al. 1996). Both methanolic and ethanolic extracts of sage, cinnamon and cumin showed lower radical scavenging activities (IC_{50} between 51.6–95.55 MetOH, 117.5–261.6 EtOH) than those of the rest of spice extracts. The PVs and FFA contents of butter samples fortified with spice extracts, which showed high radical scavenging activities, were not low; but it can be claimed that there were a positive relationship between the TBA values and radical scavenging activity. That is, sumac, clove, thyme and rosemary extracts revealed lower TBA results in yayik butter and had higher radical scavenging activities than the other extracts.

The average PV of butter samples were given in Figure 3 as meqO_2/kg fat. PV of butter samples increased throughout the storage period. The increase in PV of butter samples stored at 5 ºC was lower than those stored at 25 ºC (P<0.01). Lean and Mohamed (1999) reported that PV of the butter cake samples containing ethanolic extract of clove increased from 0.56 to 15.45 meq peroxide/kg fat after 4 weeks of storage at 27 °C. In another study on butter, PV of control sample increased from 0 to 11, PV of the butter samples containing phenolics (gallic acid) extracted from spices increased from 0 to 5.1 after 84 days storage at 50 °C (Soulti and Roussis 2007). Generally, PV of butter samples with 0.5 % spice extracts were lower than that of the negative control at 5 ºC, except for those containing ginger and oregano extracts. Both levels of oregano extracts in yayik butter exhibited prooxidant effect at both storage temperatures. It was reported that very high doses of antioxidants could lead to prooxidant effects (Akgul

TABLE 1: *DPPH (IC_{50}, µg/ml) values of spice extracts added to butter samples.*

Spices	Methanol extract	Ethanol extract
Sage	51.60	260.52
Cinnamon	53.84	117.57
Clove	11.94	46.12
Rosemary	14.56	48.35
Thyme	13.27	32.62
Sumac	19.17	39.37
Ginger	16.89	82.53
Oregano	26.28	62.55
Cumin	95.55	261.68
BHA	10.00	

Ausgabe für imr:livelyzachary Die Inhalte sind urheberrechtlich geschützt. Eine Weitergabe an unberechtigte Dritte ist untersagt.

Ausgabe für imr:livelyzachary

Die Inhalte sind urheberrechtlich geschützt. Eine Weitergabe an unberechtigte Dritte ist untersagt.
Journal of Food Safety and Food Quality 66, Heft 1 (2015), Seiten 1–24

1993). There are many reports describing that polyphenols act as prooxidants in the presence of metal ions (Chaubal et al. 2005).

During the storage time, 0.5 % levels of thyme followed by cumin, rosemary, sumac, clove, cinnamon and sage extracts were the most effective on retarding oxidation at 5 ºC. The butter samples containing 0.5 % levels of sumac, ginger, cinnamon, cumin and thyme extracts had lower PV than the other samples at 25 ºC. Thyme, ginger and clove extracts for 0.2 % concentration at 5 ºC; sumac extract at 25 ºC exhibited better antioxidant effect than BHA (Fig. 3). 0.2 % sumac and cumin extracts exhibited the same antioxidative effect as 0.01 % BHA at 25 ºC.

Ozcan and Akgul (l995) investigated the antioxidant effects of essential oils and methanolic extracts of different spices in sunflower oil stored at 70 ºC. Sumac, rosemary and sage showed the most antioxidant effect. It appears that a relationship exists between the antioxidant effect and the chemical composition of spice tested. The cinnamon extract was recommended to be used as a food antioxidant together with the improvement of food palatability (Mancini-Filho et al. 1998).

Several research groups have determined antioxidant and protective effects of sage, sumac, cumin, clove and oregano and their extracts on fats and oils (Amr 1991; Economou et al. 1991; Akgul and Ayar 1993; Ozcan and Akgul 1995; Trojakova et al. 2001; Ayar et al. 2001; Ozcan 2003; Gulcin et al. 2003; Poncea et al. 2004; Kosar et al. 2007). Kaya (2000) found that peroxide formation in yayik butter was higher than in milk butter, and higher storage temperature increased peroxide content.

Gur and Ova (1997) reported that methanol extracts of oregano were effective on the storage stability of olive oil, since the oil samples containing this extract showed lower peroxide values than the samples without extrats. Methanolic extract of sage was reported to be the most effective antioxidant on butter stability among the extracts used (sage, rosemary and oregano) (Ayar et al. 2001).

Gramza-Michalowska et al. (2007) reported that methanol extracts of rosemary led to higher stability than BHT in butter. The extract of *Salvia euphratica* subsp. *euphratica* were reported as the most active in terms of antioxidant potential among six different subspecies of *Salvia euphratica* from Turkey (Tepe et al. 2006).

Fasseas et al. (2007) reported that meat proteins and heat treatment had significant effects on antioxidative effects of oregano and sage essential oils and these oils significantly decreased the oxidation. It was also reported by Zegarska et al. (1998) that, addition of ethanol extracts from deodorized rosemary leaves to cream revealed strong antioxidant effect.

Barbut et al. (1985) determined that oleoresin of rosemary in Turkish sausage exhibited a more antioxidative effect than BHA and exerted a similar effect as BHT. Amr (1991) demonstrated that the stability of sheep's anhydrous butter during long-term storage was improved in the presence of rosemary and sage. Banias et al. (1992) showed that methanolic extracts of sage, rosemary and oregano together with BHA, BHT and ascorbyl palmitate were effective in stabilizing lard stored at 75 ºC. Akgul and Ayar (1993) reported that sage, rosemary, oregano, thyme and sumac exhibited high antioxidative effects in sunflower oil stored at 50 ºC.

FFA value of butter samples was given in Figure 4. FFA content in butter samples increased throughout the storage time at both 5 and 25 ºC. FFA value of the negative control sample showed the highest increase during storage at both temperatures. Butter samples stored at 5 ºC had FFA ratios which increased less than that of samples stored at 25 ºC ($P<0.01$). Siezen and Van den Berg (1992), Casrberg (1992) and Ayar et al. (2001) demonstrated the effect of storage temperature on the increase of FFA. In general, FFA increase in 0.5 % extract-added butter samples was lower than in 0.2 % extract-added samples.

FFA values of 0.5 % cumin extract added butter (1.45 % oleic acid) at 5 ºC and 0.5 % cumin extract added butter (average 1.72 % oleic acid) at 25 ºC were the lowest. Prevention of FFA formation by these extracts might be due to their antimicrobial effects, which were reported by many studies before (Akgul and Kıvanc 1989; Akgul l993; Con et al. 1998; Ayar et al. 2001).

FFA values in butter samples containing cumin, thyme, clove, sumac, cinnamon and rosemary (at 5 ºC and 25 ºC); oregano extract (at 5 ºC) and ginger and sage extracts (at 25 ºC) was significantly lower than that of the negative control sample. Amr (1991) determined that FFA values of rosemary and sage-added sheep's anhydrous butter were reported to remain below 10 g/kg as oleic acid equivalents. Significant inhibitory properties were reported for cinnamon, cloves, sumac, thyme, oregano, rosemary and sage spices and their extracts and essential oils (Synder 1997; Ayar et al. 2001).

Malonaldehyde and TBA reactive substances are produced as a result of oxidation of polyunsaturated fatty acids. TBA values of butter samples were shown in Figure 5. 0.5 % spice extracts added butter samples at 5 °C had generally lower TBA values than that of the negative control group and similar to that of positive control. The lowest TBA value was also determined for the samples containing 0.5 % sumac, clove, thyme and rosemary extracts at 5 ºC; and clove, sumac, rosemary, thyme at 25 °C. The TBA value significantly ($P<0.01$) increased

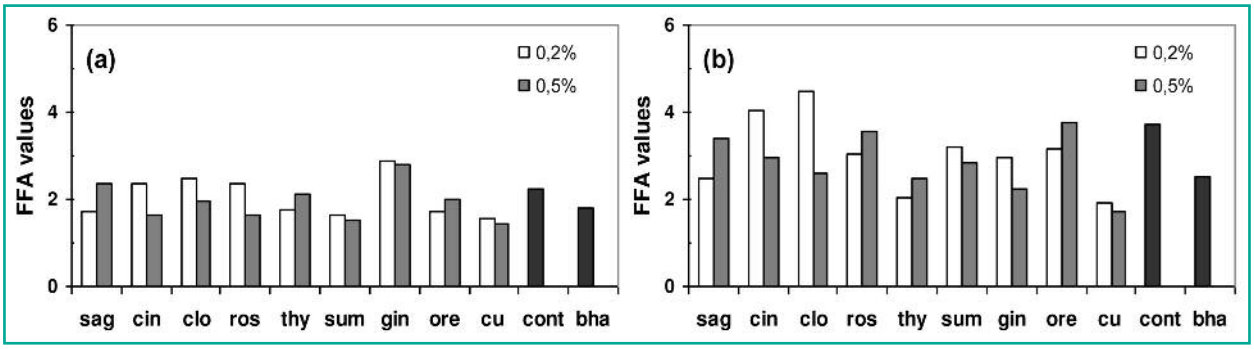

FIGURE 4: *FFA values of butter samples (% oleic acid) (a: 5 °C, b: 25 °C).*

Ausgabe für imr:livelyzachary
Die Inhalte sind urheberrechtlich geschützt. Eine Weitergabe an unberechtigte Dritte ist untersagt.

Ausgabe für imr:livelyzachary Die Inhalte sind urheberrechtlich geschützt. Eine Weitergabe an unberechtigte Dritte ist untersagt.

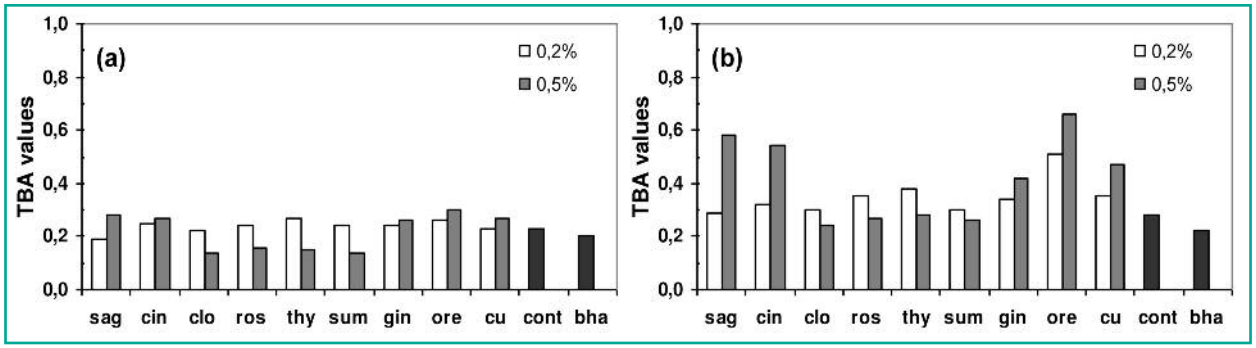

FIGURE 5: *TBA values of butter samples (malonaldehyde equivalent/g fat) (a: 5 °C, b: 25 °C).*

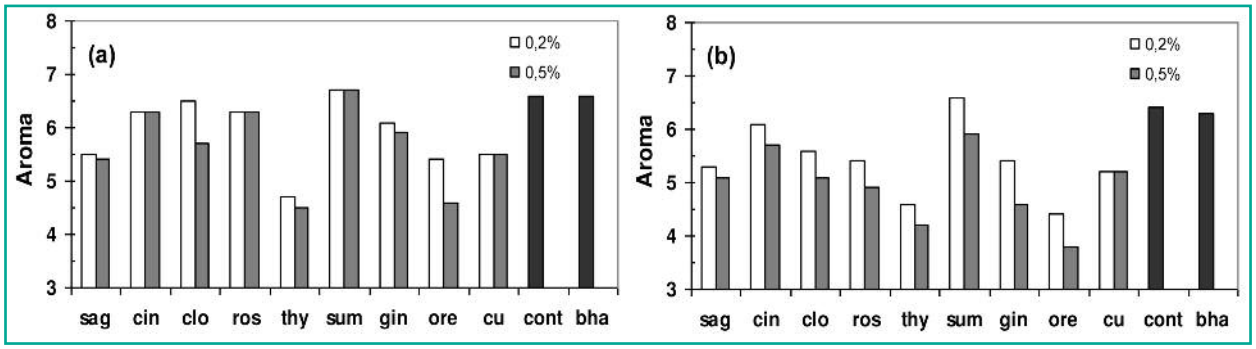

FIGURE 6: *Aroma values of butter samples (a: 5 °C, b: 25 °C).*

during storage. The TBA values of samples stored at 5 ºC were generally lower than those of stored at 25 ºC. Inatani et al. (1983) determined that the extracts of rosemary extract prepared in different solvents showed lower TBA values than that of control, and similar values to those of BHA and BHT incorporated samples. Shahidi et al. (1995) investigated the stabilization of meat lipids with ground spices. Significant inhibition of TBA reactive substances was reported for rosemary, clove, sage and oregano.

TBA values of butter samples containing BHA, gallic acid, clove extract and control were reported to increase from 0.21 to 1.62, 0.31 to 1.41, 0.18 to 0.81, and 0.31 to 1.41 mg malonaldehyde/g fat respectively, at 27 °C after 4 weeks storage (Soulti and Roussis 2007). Kaya (2000) found that TBA content in yayik butter was higher than that of milk butter, and higher storage temperature increased TBA content.

The sensory evaluation of butter samples in terms of aroma were given in Figure 6. The samples containing sumac, cinnamon, rosemary, ginger and clove extracts stored at 5 ºC had highest scores comparable to control samples, while cinnamon and sumac extracts were again the most preferred in butter samples stored at 25 ºC. On the other hand, 0.2 % was found superior to 0.5 % extract concentration in terms of the effects on aroma of the product. The unacceptability of aroma for 0.5 % extract concentration compared to 0.2 % was more evident for the samples containing clove and oregano extracts at 5 ºC and for the samples containing sumac, ginger and oregano extracts in 25 ºC. Whereas, there were not any difference in aroma scores of samples fortified with cinnamon, rosemary, sumac and cumin extracts at 5 ºC and with cumin extract at 25 ºC regarding the different concentrations, 0.2 % and 0.5 %. The aroma scores were significantly higher for the samples stored at 5 ºC when compared to the samples kept at 25 ºC.

Table 2 shows correlations between some properties of butter samples tested in this assay. Negative correlations were determined between aroma-PV and aroma-TBA, while there was a slight positive correlation between aroma and pH. However, there was not a significant correlation between aroma-a_w and aroma-FFA. A_w and pH showed a positive correlation while the correlation was negative between a_w and FFA values. There were negative correlations between pH and -PV, -FFA, -TBA. The formation of FFA and primary oxidation products might lead to decrease in pH of butter. As expected, PV showed significant positive correlations with FFA and with TBA and this positive correlation was determined between FFA and TBA, too. All these three parameters are the indicators of oxidation and deterioration in butter.

4 Conclusions

The results of this study show that ethyl acetate extracts of cinnamon, ginger and cumin exert significant effects on the

TABLE 2: *Correlation efficients among some properties of yayik butter.*

	Aroma	A_w	pH	PV	FFA	TBA
Aroma	1					
A_w	–0.214	1				
pH	0.328 (*)	0.297 (*)	1			
PV	–0.532 (***)	–0.114	–0.527 (***)	1		
FFA	–0.109	–0.351 (*)	–0.594 (***)	0.592 (***)	1	
TBA	–0.539 (***)	–0.076	–0.519 (***)	0.606 (***)	0.435 (**)	1

***: Correlation is significant at the 0.01 level

Ausgabe für imr:livelyzachary Die Inhalte sind urheberrechtlich geschützt. Eine Weitergabe an unberechtigte Dritte ist untersagt.

Ausgabe für imr:livelyzachary

Die Inhalte sind urheberrechtlich geschützt. Eine Weitergabe an unberechtigte Dritte ist untersagt.

oxidative stability of yayik butter regarding lower peroxide values. Nevertheless, thiobarbituric acid values of clove, rosemary and thyme extracts added yayik butter samples were lower. Sumac extract showed antioxidative effects in terms of both peroxide and thiobarbituric acid values.

There was significant difference between the antioxidative effects of extracts in samples stored at refrigeration temperature and those which stored at higher temperature. The antioxidative effects of extracts were more evident when the samples stored at 25 ºC.

Sage (5 and 25 ºC) and oregano (25 ºC) extracts showed prooxidant effect in butter at 0.5 % level regarding both higher peroxide and thiobarbituric acid values than that of control samples.

When different extract concentrations of essential oils added in butter samples were compared, better results were obtained in terms of oxidative stability in butter samples containing 0.5 % level of spice extracts.

Cinnamon and sumac extracts brought the most preferred aroma in butter samples stored at 5 ºC and 25 ºC. On the other hand, 0.2 % was found superior to 0.5 % extract concentration in terms of the effects on aroma of the product.

There were negative correlations between pH and -PV, -FFA, -TBA. PV showed significant positive correlations with FFA and with TBA and this positive correlation was determined between FFA and TBA, too.

Acknowledgements

This project was supported by The Scientific and Technological Research Council of Turkey (TUBITAK), Turkey.

References

Akgul A (1993): Spice Science and Technology. Ankara, Turkey.

Akgul A, Kıvanc M (1989): Antibacterial effects of spices, sorbic acid and sodium chloride. Doga Turk J Agric For 13: 1–9.

Akgul A, Ayar A (1993): Antioxidant effects of Turkish spices. Doga Turk J Agric For 17: 1061–1068.

Amr AS (1991): Effectiveness of synthetic and potential natural antioxidants in improving the stability of sheep's anhydrous butter fat during long-term storage. J Sci Food Agr 55 (1): 75–85.

Anonymous (1990): Gıda Maddeleri Tüzüğü. Hukuk Dizisi No. 21 (39). Istanbul: Bayrak Matbaacılık.

AOAC (1977): Official method. Free fatty acids. Washington, DC: Association of Official Analytical Chemists.

AOAC (1990): Official methods of analysis (15th ed.). Washington, DC: Association of Official Analytical Chemists.

Atamer M, Sezgin E (1984): Tereyağlarında lipolitik ve oksidatif bozulmaların saptanmasında yararlanılan asit ve peroksid değerleri ile aroma arasındaki ilişki. Gıda 6: 329–334.

Atamer M (1993): Butter Technology Practice Test. Ankara, Turkey.

Ayar A, Ozcan M, Akgul A, Akin N (2001): Butter stability as affected by extracts of sage, rosemary and oregano. J Food Lipids 8 (1): 15–25.

Banias C, Oreopoulou V, Thomopoulos CD (1992): The effect of primary antioxidants and synergistic on the activity of plant extracts in lard. J Am Oil Chem Soc 69 (6): 520–524.

Barbut S, Josephson DB, Maurer AJ (1985): Antioxidant properties of rosemary oleoresin in turkey sausage. J Food Sci 50 (5): 1356–1359.

Bindal MP, Wadhwa BK (1991): Renovation of rancid ghee. Ind J Dairy Sci 44 (5): 323–326.

Brieskorn C, Domling HJ (1969): Carnosic acid as an antioxidant in rosemary and sage leaves. Z Lebens Wiss Techn 28: 25–30.

Calucci L, Pinzino C, Zandomeneghi M, Capocchi A, Ghiringhelli S, Saviozzi F, Tozzi S, Galleschi L, (2003): Effects of gamma-irradiation on the free radical and antioxidant contents in nine aromatic herbs and spices. J Agr Food Chem 51 (4): 927–34.

Casrberg HB (1992): Lipase activity. Bull. IDF 271, 18–20.

Chaubal VR, Deshpande H, Deshpande NR (2005): Methyl gallate, the medicinally important compound: a review. Electro J Env Agr Food Chem 4 (4): 956–962.

Con AH, Ayar A, Gokalp HY (1998): Antimicrobial activity of the essential oils from some spices. Food 23: 171–175.

Costat (1990): Costata reference manual (V2.1). Berkery, USA.

Cuvelier ME, Richard H, Berset C (1996): Antioxidative activity and phenolic composition of pilot-plant and commercial extracts of sage and rosemary. J Am Oil Chem Soc 73: 645–652.

Economou KD, Oreopoulou V, Thomopoulos CD (1991): Antioxidant activity of some plant extracts of the family labiatae. J Am Oil Chem Soc 68 (2): 109–113.

Fasseas MK, Mountzouris KC, Tarantilis PA, Polissiou M, Zervas G (2007): Antioxidant activity in meat treated with oregano and sage essential oils. Food Chem 106 (3): 1188–1194.

Gramza-Michalowska A, Korczak J, Regula J (2007): Use of plant extracts in summer and winter season butter oxidative stability improvement. Asia Pac J Clin Nutr 16 (Suppl1): 85–8.

Gulcin I, Sat IG, Beydemir S, Elmastas M, Kufrevioglu OI (2003): Comparison of antioxidant activity of clove (*Eugenia caryophylata* Thunb) buds and lavender (*Lavandula stoechas* L.). Food Chem 83 (3): 393–400.

Gur E, Ova G (1997): Antioxidative activity of oregano (*Oreganum onites* L.) extracts in refined olive oil. Food Tech 2, 7/8: 56–64.

Inatani R, Nakatani N, Fuwa H (1983): Antioxidative effect of the constituents of rosemary (*Rosmarinus officinalis* L.) and their derivatives. Agr Biol Chem 47: 521–528.

Joshi NS, Thakar PN (1994): Methods to evaluate deterioration of milk fat-a critical appraisal. J Food Sci Tech 31(3): 181–196.

Kaya A (2000): Properties and stability of butter oil obtained from milk and yoghurt. Nahrung 44 (2): 126–9.

Konar A, Hayaloglu A (1999): Tereyağ üretim yöntemleri, krema ve yoğurttan elde edilen tereyağların fizikokimyasal, mikrobiyolojik ve duyusal nitelikleri-II. Standard 448: 53–58.

Koleva II, van Beek TA, Linssen JP, de Groot A, Evstatieva LN (2002): Screening of plant extracts for antioxidant activity: a comparative study on three testing methods. Phytochem Analysis 13 (1): 8–17.

Kosar M, Bozan B, Temelli F, Baser KHC (2007): Antioxidant activity and phenolic composition of sumac (*Rhus coriaria* L.) extracts. Food Chem 103 (3): 952–959.

Krishna GA, Prabhakar JV (1992): Effect of water activity on secondary products formation in autoxidizing methyl linoleate. J Am Oil Chem Soc 69 (2): 178–183.

Kuruppu DP, Schmidt K, Farkas J, Langerak DI, van Duren MDA (1985): The effect of irradiation and fumigation on the antioxidative properties of some spices. Acta Aliment 14 (4): 343–353.

Lean LP, Mohamed S (1999): Antioxidative and antimycotic effects of turmeric, lemon-grass, betel leaves, clove, black pepper leaves and *Garcinia atriviridis* on butter cakes. J Sci Food Agr 79 (13): 1817–1822.

Lee KG, Shibamoto T (2002): Determination of antioxidant potential of volatile extracts isolated from various herbs and spices. J Agr Food Chem 50 (17): 4947–52.

Ausgabe für imr:livelyzachary
Die Inhalte sind urheberrechtlich geschützt. Eine Weitergabe an unberechtigte Dritte ist untersagt.

Ausgabe für imr:livelyzachary Die Inhalte sind urheberrechtlich geschützt. Eine Weitergabe an unberechtigte Dritte ist untersagt.

Mancini-Filho J, Van-Koiij A, Mancini DA, Cozzolino FF, Torres RP (1998): Antioxidant activity of cinnamon (*Cinnamomum zeylanicum,* Breyne) extracts. Boll Chim Farm 137 (11): 443–7.

Muir DD (1996): The shelf-life of dairy products: 3. Factors influencing intermediate and long life dairy products. Int J Dairy Technol 49 (3): 67–72.

Munro DS, Cant PAE, MacGibbon AKH, Illingworth D, Kennett A, Main AJ (1992): In: Early R (ed) Concentrated milk fat products. In The Technology of Dairy Products, VCH, New York.

Ozcan M, Akgul A (1995): Antioxidant activity of extracts and essential oils from Turkish spices on sunflower oil. Acta Aliment 24: 81–90.

Ozcan M (2003): Antioxidant activities of rosemary, sage, and sumac extracts and their combinations on stability of natural peanut oil. J Med Food 6 (3): 267–70.

Ozkan G, Simsek B, Kuleasan H (2007): Antioxidant activities of *Satureja cilicica* essential oil in butter and in vitro. J Food Eng 79 (4): 1391–1396.

Poncea AG, del Vallea CE, Rourac SI (2004): Natural essential oils as reducing agents of peroxidase activity in leafy vegetables. LWT-Food Sci Technol 37 (2): 199–204.

Sagdıc O, Arıcı M, Simsek O (2002): Selection of starters for a traditional Turkish yayik butter made from yoghurt. Food Microbiol 19 (4): 303–312.

Shahidi F, Han XQ (1993): Encapsulation of food ingredients. Crit Rev Food Sci 33 (6): 501–47.

Shahidi F, Pegg RB, Saleemi ZO (1995): Stabilization of meat lipids with ground spices. J Food Lipids 2 (3): 145–153.

Siezen RJ, Van den Berg G (1992): Lipases and their action on milkfat. Bull. IDF 294, 4–6.

Snyder O (1997): Antimicrobial effects of spices and herbs. http://www.hi-tm.com/Documents/Spices.html. Accessed 29 Oct 2011.

Soulti K, Roussis IG (2007): Inhibition of butter oxidation by some phenolics. Eur J Lipid Sci Tech 109 (7): 706–709.

Trojakova L, Reblova Z, Pokorny J (2001): Determination of oxidative stability in mixtures of edible oil with nonlipidic substances. Czech J Food Sci 19 (1): 19–23.

Tepe B, Sokmen M, Akpulat HA, Sokmen A (2006): Screening of the antioxidant potentials of six Salvia species from Turkey. Food Chem 95 (2): 200–204.

Yanishlieva NV, Marinova E, Pokorny J (2006): Natural antioxidants from herbs and spices. Eur J Lipid Sci Tech 108 (9): 776–793.

Zegarska Z, Rafalowski R, Amarowicz R, Karamac M, Shaidi F (1998): Stabilization of butter with deodorized rosemary extract. LWT-Food Sci Technol 2006: 99–102.

Zhao T, Doyle MP, Berg DE (2000): Fate of *Campylobacter jejuni* in butter. J Food Protec 63 (1): 120–2.

Address of corresponding author:
Durmuş Sert
Necmettin Erbakan University
Faculty of Engineering and Architecture
Department of Food Engineering
Konya, 42090
Turkey
dsert@konya.edu.tr

Kontakte

Sie interessieren sich für ein Abonnement des „Archivs“?
Telefon (0 51 81) 80 02-50
Telefax (0 51 81) 80 02-55
E-Mail dieter.meyer@p-d-ges.de

Sie interessieren sich für Anzeigen- oder Beilagenwerbung?
Telefon (0 51 81) 80 02-53
Telefax (0 51 81) 80 02-55
E-Mail a.m.peter@p-d-ges.de

Presse Dienstleistungs-gesellschaft mbH & Co. KG
Ravenstraße 45 · 31061 Alfeld (Leine)
Postfach 16 42 · 31046 Alfeld (Leine)
Telefon (0 51 81) 80 02-0
Telefax (0 51 81) 80 02-55
E-Mail info@p-d-ges.de

Ausgabe für imr:livelyzachary Die Inhalte sind urheberrechtlich geschützt. Eine Weitergabe an unberechtigte Dritte ist untersagt.