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THE QUALITY AND STORAGE STABILITY OF BUTTER MADE FROM SOUR CREAM WITH ADDITION OF DRIED SAGE AND ROSEMARY

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Abstract: The aim of the present study was to assess the storage stability of butter made from sour cream with 2% addition of dried herbs: sage or rosemary. Pasteurised cream was acidified with „FL-DAN" DVS culture (Chr. Hansen). The analyses were done after production as well after cold storage and comprised: acidity of butter plasma, fat acidity, iodine number, peroxide number, TBA test, Kreis test. Directly after production butter samples were subjected to sensory assessment as well as analysis for fundamental chemical composition. Addition of herbs had a significant effect on the butter composition as well as acidity of its plasma. The notes from the sensory assessment for all products exceeded 4 pts and the differences between the results were insignificant. The results of chemical analyses suggest that addition of rosemary herb was more effective in retardation of lipolysis than supplementation with sage, but both supplemented products were less stable during storage than the control sample.

Key words*:* sage (*Salvia officinalis*), rosemary (*Rosmarinus officinalis*), butter, storage stability, lipid oxidation

Introduction

According to *Walstra et al. (1999)* the butter deteriorates by auto-oxidation of fat, what leads to flavor defects after 1 month to 2 years under the cold storage conditions, depending on the temperature of storage, quality of original milk and the proceeding of processes involved in butter manufacturing. Generation of off-flavors is accompanied with the formation of hydroperoxides which are harmful to human health. The process of fat oxidation can be prevented by adding natural or synthetic antioxidant substances. However, it was found that the artificial antioxidants, like BHT (butylated hydroxytoluene) or BHA (butylated hydroxyanisole) are not safe for human consumption (are suspected to have carcinogenic activity). On the other hand, increasing sensitivity of consumers to synthetic ingredients as well as their increasing awareness about the effect of diet

on their health contributed to the increasing trend to use natural additives for the stabilization of fat-containing foodstuffs.

Spices and herbs are known to posses a great potential as the natural antioxidants in food. Sage (*Salvia officinalis*) and rosemary (*Rosmarinus officinalis*) extracts are one of the most widely used for that purpose *(Özcan, 2003; Rižnar et al., 2006; Shiota et al. 1999)*. Their strong antioxidant properties are attributed to high content of phenolic components. The active substances found in rosemary are: monoterpenes (eteric oils), diterpene phenols (carnosic acid, carnosol, rosmanol, epirosmanol, isorosmanol, methyl carnosate), phenolic acids (rosmarinic acid), flavonols and triterpene acids (ursolic acid, oleanolic acids, butilinic acids) *(Rižnar et al., 2006)*. As sage belongs to the same plant family as rosemary (*Labiatae*) it contains also the same active components. The main antioxidative and antimutagenic effect of sage is more often related to the presence of such compounds like: carnosic acid, carnosol, rosmarinic acid and camphor *(Vuković-Gačić et al., 1996; Yanishlieva-Maslarova and Heinonen, 2001)*.

The strong and effective antioxidant and antimicrobial properties of rosemary and sage extracts, which comprise retardation of lipid oxidation by prolongation of the induction time and lowering the number of harmful microorganisms, were well documented in meet products and vegetable oils. These properties can be even many times stronger than those stated for synthetic antioxidants like BHA or BHT *(Estévez et al., 2007; Güntensperger et al., 1998; Lee et al., 2003; Rižnar et al., 2006; Shelef et al., 1980)*. Some authors reported also the antimicrobial and antioxidative effect of extracts and essential oils of herbs and species on butter *(Ayar et al., 2001; Farag et al., 1990; Żegarska and Rafałowski, 1997)*. On the other hand, there is lack of investigations on the effect of fresh or dried spices added directly to the food, however such products exist in the market or traditional cuisine e.g. garlic butter, sage butter. The aim of our study was an estimation of the effect of dried sage or rosemary herb additives on the chemical and sensory characteristic as well as storage stability of sour-cream butter.

Materials and Methods

Sweet pasteurized cream (30% of fat) was purchased from local Milk Corporation. The dried herbs: rosemary and sage were purchased from local shop with healthy food.

Before churning, the cream undergone souring (2% of FL-DAN Chr. Hansen DVS culture), temperature treatment: temp. 16°C/ 3-4 h, temp. 8°C/9-10 h and temp. 11-14 °C until churning. The churning was conducted in periodical, conical churns filled to 40% with cream. After the butter grains reached the diameter of 2-4 mm (30-40 min) the butter milk was drained off and the grains

washed three times with water and hand worked to reach the proper dispersion of water droplets which was checked using "Dysperwod" test papers. The butter mass was then divided into three parts: one was mixed with 2% of dried rosemary herb, the second one – with the respective additive of sage and the third was left without any additives (called "natural butter"). The butter samples were packed and stored at 4ºC.

Directly after production the butter samples were subjected to the assessment of basic chemical composition and sensory evaluation. Other analyses were conducted every month for 5 months in two replicants and in two series.

The water, non-fat solids and fat contents were assessed by the routine Kohman method *(Zmarlicki, 1978)*. Sensory evaluation was conducted on the basis of 5-point (1-5 pts) hedonic scale with the following parameters being assessed: flavor, color, taste and consistency by 5 trained panelists (students and academic staff).

Acidity of plasma (pH) as well as acidity (expressed as acid degrees i.e. ml 1 N NaOH/100 g of fat) and peroxide number (mmoles 0_2/kg of fat) of butter fat were conducted by the procedure described in *PN-A-86207 (1980)*. The iodine number was determined using Hanus method. The Kreis test was performed by the procedure described by *Budsławski (1973)*. Thiobarbituric test (TBA) was carried out as follows: 2 ± 0,01g of butter fat was placed in the test tubes, then 8 cm^3 of distilled water, 6 cm^3 of thiobarbituric reagent and 3 cm^3 20% thrichloroacetic acid were added. After mixing, the tubes were placed in boiling water bath and left for 20 minutes. After cooling in cold water the liquid in tubes was adjusted to the volume of 20 cm^3 with distilled water. The aqueous, pink layer was then collected and the absorbance was measured at the 533 nm against the blank sample (reagents without butter fat) prepared simultaneously.

Obtained results were subjected to statistical analysis with Statistica 7.0 (StatSoft) software. En effect of rosemary and sage additives and time of storage was estimated on the basis of two-way analysis of variance and the differences between arithmetic means of the results were determined based on Duncan test at the significance levels of $p \leq 0,05$ and $p \leq 0,01$.

Results and Discussion

The chemical composition and the results of sensory evaluation of three kinds of butter are given in the table 1. All examined butter samples were characterized with the fat and water contents which met the Polish requirements for the unsalted butter of extra class (fat content ≥82%; water content ≤ 16%). Rosemary and sage butters contained significantly higher non-fat solids content. They contained also lower levels of fat and water and the differences, with one exception, were also significant. The notes from the sensory evaluation for all

products exceeded 4.50 pts and there was no significant difference between the results.

Table 1. Chemical composition and sensory evaluation of butters (x ± SD, n = 4)

Composition [%]	Butter kind		
	natural	with rosemary	with sage
Fat	86.89 ± 1.74 ^{ab}	84.05 ± 0.29 ^{a}	83.85 ± 1.68 ^{b}
Water	12.99 ± 0.36 ^{a}	12.65 ± 0.17	12.40 ± 0.26 ^{a}
Non-fat solids	1.02 ± 0.29 ^{AB}	3.07 ± 0.45 ^{A}	3.30 ± 0.12 ^{B}
Sensory evaluation [pts]	4.65 ± 0.07	4.62 ± 0.08	4.56 ± 0.11

$^{A, B}$ mean values in rows followed by the same letters are significantly different at $p \leq 0{,}01$;
$^{a, b}$ mean values in rows followed by the same letters are significantly different at $p \leq 0{,}05$;

Table 2. Least square means of the chemical analyses of butter plasma and fat in dependence on the herb additive and storage time

Parameter	Butter kind			Time of storage [months]					
	N	R	S	0	1	2	3	4	5
pH of plasma	4.57 A	4.82 A	5.19 A	4.74 ABa	4.89 ab	4.85 c	4.99 ACc	4.95 BD	4.76 CDb
Iodine number [g J_2/100g fat]	30.78	30.37	30.94	31.45 A	32.72 Ba	32.38 C	26.82 ABCDb	29.88 ab	30.92 D
Fat acidity [acid degrees]	1.83 A	2.12 B	3.72 AB	2.09 AB	1.87 CDa	2.03 EFb	2.63 abc	3.40 ACEcd	3.32 BDFd
Peroxide number [mM O_2/kg fat]	1.30 A	2.27 A	2.71 A	1.59 Aa	0.00 AB	3.63 AB	2.70 Ba	0.37 AB	4.28 AB
TBA [A_{530}]	0.12 Aa	0.07 a	0.06 A	0.15 ABCD	0.06 AE	0.03 BF	0.02 CGa	0.07 DHa	0.16 EFGH

A, B, C, D, E, F, G, H – mean values in rows followed by the same letters are significantly different at $p \leq 0{,}01$;
a, b, c, d – mean values in rows followed by the same letters are significantly different at $p \leq 0{,}05$;
N - natural butter; R - butter with rosemary; S - butter with sage.

Table 2 presents the results of two-way analysis of variance of the chemical analyses of butter plasma and fat as affected by the herb additive and storage time. All examined parameters, except iodine number, were highly influenced by the butter kind. Generally, the addition of dried herbs resulted in higher pH of plasma, higher acidity and peroxide number of butter fat but with lower level of the substances reacting in TBA test.

The butters with herbs, especially with sage, were characterized with higher pH of plasma when compared to the natural butter (Figure 1). It may indicate the inhibitory effect of herbs on the lactic acid bacteria growth, which was also reported by *Ayar et al. (2004)*. The level of this parameter remained almost

unchanged during the whole experimental period and was placed in the down region of the required range of 4.5-6.9 (PN-A-86207:1980).

Figure 1. The effect of the butter kind and storage time on the plasma pH

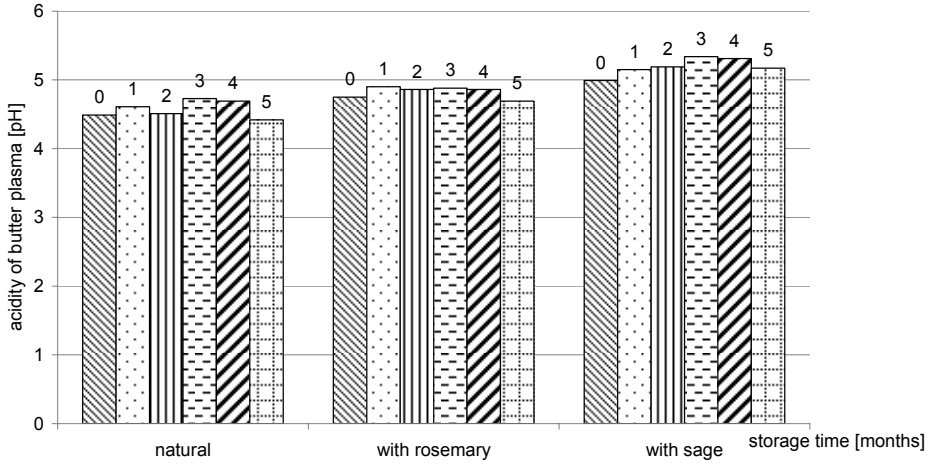
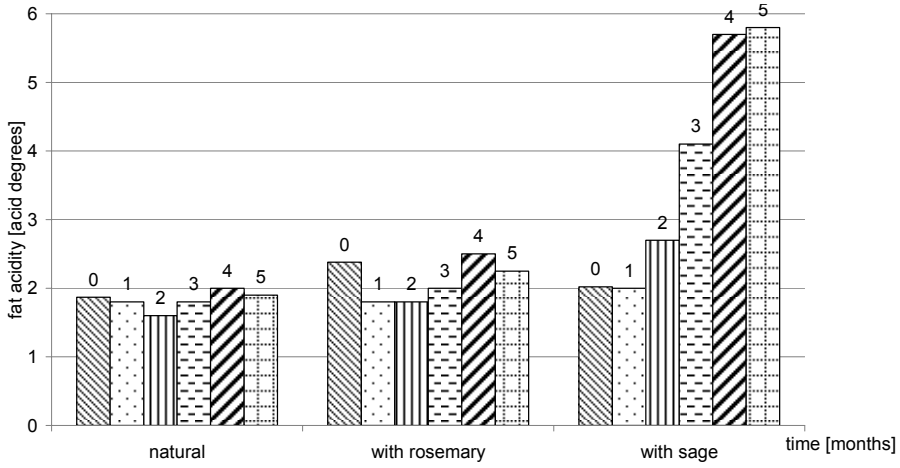


Figure 2. The effect of the butter kind and storage time on the fat acidity

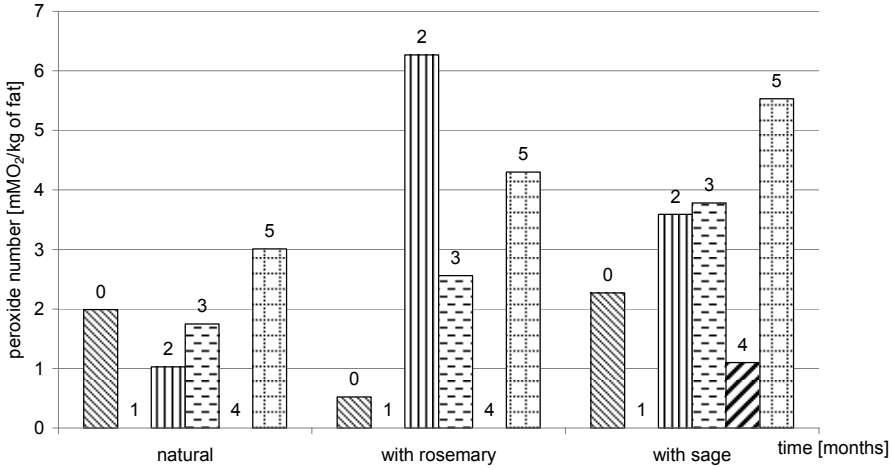


Degree of lipolysis expressed as fat acidity fluctuated only in the narrow range during the experiment for the natural and rosemary butters (Figure 2). On the other hand, sage butter was much more susceptible to lipolysis, which rapidly accelerated after the second month of cold storage, reaching the value of 5.8 after five months of keeping at 4°C. In the case of the butter without herbs it did not exceed 2 acid degrees which is the limiting value according to the obligatory

requirements *(Commission Regulation (EC) No 2771/1999)*. The investigations of *Jasińska and Wąsik (2005)* revealed that savory added to the butter resulted in significantly higher lipid acidity during the cold storage.

The study of *Żegarska and Rafałowski (1997)* revealed that addition of the ethanolic extract of sage in the amount of 0.1-0.2 to the sweet cream directly before churning affected lower level of peroxide value during storage of butter or butter fat at 20 and 60 °C, respectively. Also methanolic extracts of sage, rosemary and oregano were effective in retardation of oxidation (TBA test, peroxide value) and lypolisis (FFA) processes in butter *(Ayar et al., 2001)*. In our investigations we stated lower level of peroxides only for rosemary butter during the first month of storage (Figure 3). Generally, the herb additives did not prevent the oxidation of butter.

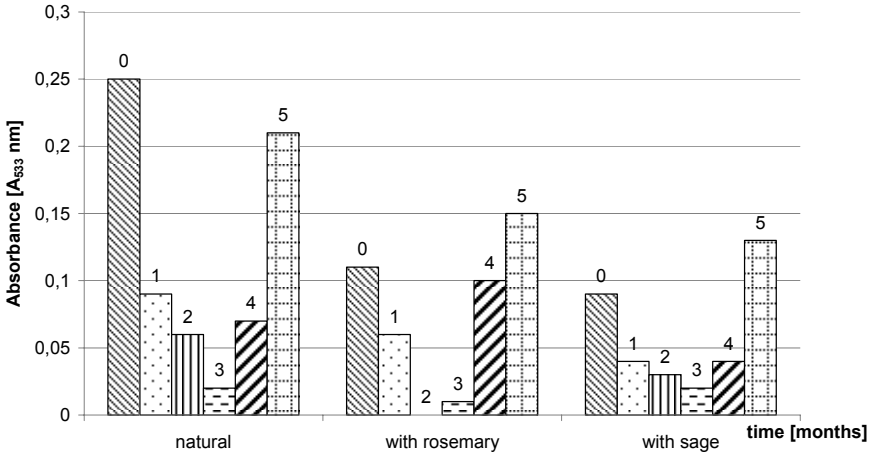
Figure 3. The effect of the butter kind and storage time on the peroxide number value



The TBA test measures the concentration of secondary oxidation products i.e. aldehydes (mainly malonoaldehyde) and ketones *(Farag et al., 1990)*. Generally, the sage and rosemary butter exhibited much more lower level of TBA reacting substances (TBARS) than the natural butter (Figure 4). It is consisted with the results obtained by *Shahidi et al. (1995)* for comminuted pork system, who stated that the ground sage and rosemary inhibited the formation of TBARS by more than 10% over 21-days storage at 4°C.

The negative results of Kreis test indicate the absence of aldehydes generating off-flavors.

Figure 4. The effect of the butter kind and storage time on the TBA test results



The obtained results suggest that the addition of dried sage and rosemary to the sour-cream butter did not prevent the lipolysis and formation of peroxides during cold storage. The microbial instability of herbs and species seem to be the major problem. Moreover, the antioxidant and antimicrobial action of essential oils and extracts is much more effective because they contain concentrated antioxidant substances. The herb butter should be consumed freshly prepared and rather as the component of cooked or baked (thermally treated) meal than for bread spreading.

Conclusion

- Rosemary and sage addition significantly affected the chemical composition of the butter, pH of plasma as well as changes in butter lipids during storage.
- The obtained results suggest that the addition of dried sage and rosemary to the sour-cream butter did not decrease the fat acidity and peroxide number during cold storage.
- The results of TBA test revealed that the sage and rosemary butters contained significantly lower concentration of secondary products of oxidation i.e. aldehydes (mainly malonoaldehyde) and ketones than the butter without herbs.

Kvalitet i stabilnost tokom skladištenja putera napravljenog od kisele pavlake sa dodatkom sušene žalfije i ruzmarina

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Rezime

Dodavanje puteru antioksidativnih supstanci je jedan od najjednostavnijih načina za sprečavanje procesa pogoršanja, odn. propadanja tokom čuvanja. Prirodni antioksidansi kao što su različite biljke i začini se preporučuju jer su bezbedni, efikasni i tradicionalno se koriste u pripremi hrane. Najčešće korišćeni u ovu svrhu su alkoholni ekstrakti ili etarska ulja žalfije i ruzmarina, koji se karakterišu dobro dokumentovanim antioksidantskim i antimikrobiološkim dejstvom.

Cilj ovog istraživanja je bio da se oceni stabilnost putera napravljenog od kisele pavlake sa 2% dodatih sušenih biljaka (žalfija i ruzmarin), u uslovima skladištenja. Pasterizovana pavlaka je ukiseljena dodavanjem kulture „FL-DAN" DVS (Chr. Hansen). Svi ogledi su urađeni u dve serije i sa ponavljanjem. Analize su se sastojale od: pH plazme putera, kiselost masti, Kreis test, jodni i peroksidni broj, TBA test. Neposredno nakon proizvodnje uzorci putera su podvrgnuti senzornoj analizi kao i analizi osnovnih hemijskih sastojaka.

Dobijeni podaci su pokazali da je dodavanje žalfije i ruzmarina imalo signifikantan uticaj na nivo nemasnih čvrstih materija, masti i sadržaj vode. Senzorne ocene putera za sve proizvode su bile više od 4.50 poena i nije bilo signifikantnih razlika između dobijenih rezultata. Puter koji je sadržavao biljke, posebno puter sa žalfijom, je imao veću pH vrednost plazme u poređenju sa običnim puterom, što ukazuje na inhibitorni efekat biljaka na bakterije mlečne kiseline. Dodavanje sušene žalfije i ruzmarina u puter od kisele pavlake nije uticalo na povećanje kiselosti masti i peroksidni broj tokom perioda skladištenja. S druge strane, TBA test je pokazao da puter sa žalfijom i ruzmarinom karakteriše niži nivo sekundarnih proizvoda oksidacije, odn. aldehida (uglavnom malon aldehid) i ketona za razliku od putera bez dodatih biljaka.

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