Influence of spices on the quality of rapeseed oil during storage

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Abstract

The paper presents some results of an investigation dealing with the effect of flavouring of rapeseed oil with rosemary, thyme and basil on the oxidative stability, sensory evaluation and content of phenolic compounds of the oils. The oils were stored for 26 weeks at room temperature and 7 days at 50°C, respectively. The addition of spices had some effect on the oxidative stability, but the effect was not much pronounced at room temperature. Only after 22 weeks the oils without spices showed a stronger increase of the peroxide value than the flavoured oils. At 50°C the effects were clearer. Addition of rosemary and thyme resulted in only a small increase of the peroxide value and also the addition of basil reduced the increase of oxidation in comparison to oil without spices. The sensory quality of the oils changed during storage from an aroma typical for the used spice to a more astringent taste. During storage an increasing amount of volatile compounds from the spices were found in the oil. An increase of the total volatile compounds during storage was observed. Some of the phenolic compounds migrate from the spices into the oil, but the amount was small and the main phenolic compounds of spices were not found.

Key words: basil, flavouring, oxidative stability, phenolic compounds, rapeseed oil, rosemary, thyme

Introduction

Edible rapeseed oil became increasingly popular within the last years, because of the interesting fatty acid composition, which has some advantages from the nutritional point of view. For the marketing with edible oils it is necessary to present continuously new and innovative products to the consumers. In this context the flavouring of edible oils with spices for the preparation of salads and other foods occurred on the market. Some of these spices are known to contain higher amounts of effective antioxidant components, e. g. rosemary (Schwarz et al., 1992; Hopia et al., 1996; Nguyen et al., 1999). From this the aim of the work was to investigate the effect of spices on the quality of the oils during storage, especially in view of the oxidative state and the sensory quality.

Materials and Methods

Each, 1.5 g of dried material from rosemary, basil and thyme, respectively, purchased from a local supermarket was added to 200 mL of refined rapeseed oil. Several bottles of the oils flavoured with spices were stored at room temperature for 26 weeks and every two weeks at the beginning of the experiment, later every four weeks one bottle was taken and the oils were assessed with regard to the sensory quality. Additionally some chemical parameters describing the oxidative status of the oils were investigated. The content and the composition of phenolic compounds extracted from the oils were determined. Also a storage experiment at accelerated temperature over a period of 7 days at 50°C was carried out.

Table 1. Methods used for the evaluation of the status of the stored oils

No.	Parameter	Method	Reference
1	Anisidine value	DGF C-III 3b	DGF, 2005
2	Oxidative stability (Rancimat 120°C)	Cd 22-91	AOCS, 1990
3	Free fatty acids	DGF C-V 2	DGF, 2005
4	Tocopherol composition	DGF F-II 4	DGF, 2005
5	Peroxide value	DGF C-VI 6a (02)	DGF, 2005
6	Sensory assessment	modified DGF C-II 1 (97)	DGF, 2005
7	Volatile compounds	Dynamic Headspace-GC	Brühl and Fiebig, 2005
8	Content of phenolic compounds	HPLC	Mateos et al., 2001

Results

The results show that all types of spices used in this investigation were suitable to change the sensory sensation of the initial oils towards the taste and smell of the appropriate spice, because oil as a very good aroma carrier took in the aroma components of the spice. Shortly after addition of the spices the oils tasted and smelled accordingly to the appropriate spice. After 20 weeks of storage the aroma changed to more unpleasant sensations and became increasingly astringent. Figure 1 shows the increase of volatile compounds during storage of oil after addition of rosemary over a period of 6 days at 50°C. During this time the amount of volatile compounds migrated from the spice into the oil increased for about 50 times. A similar

result, but not as clear was also found for rosemary, basil and thyme stored at room temperature.

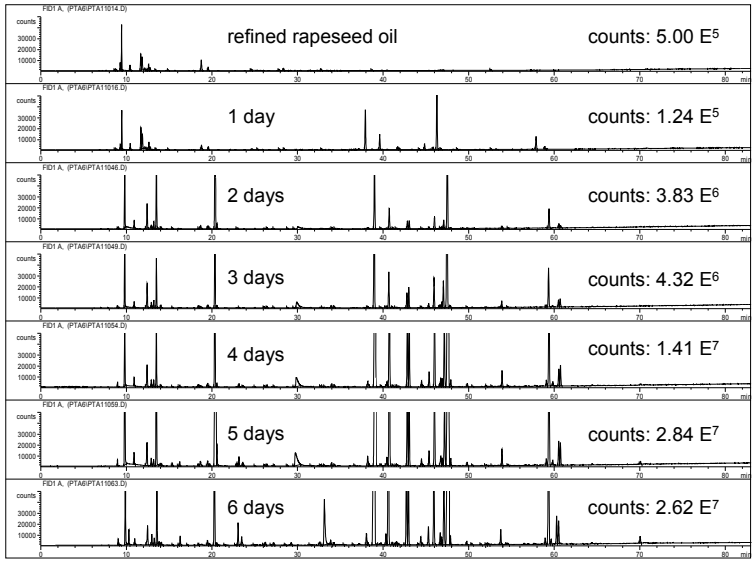

Fig. 1. Development of volatile compounds in rapeseed oil flavoured with rosemary stored at 50°C over a period of 6 days.

Only a small increase of the content of free fatty acids was observed for the oils stored with different spices, although the increase in oils flavoured with spices was higher in comparison to oils without addition of spices. But the differences between the oils were only significant for thyme ($p < 0.05$) (results not shown). One reason for a slightly faster formation of free fatty acids after addition of spices could be spice-own or microbial enzymes which are able to degraded triglycerides. Nevertheless for a high quality of the oil a microbial clean spice material is necessary, since otherwise a faster degradation of triglycerides and a faster formation of free fatty acids is to be expected.

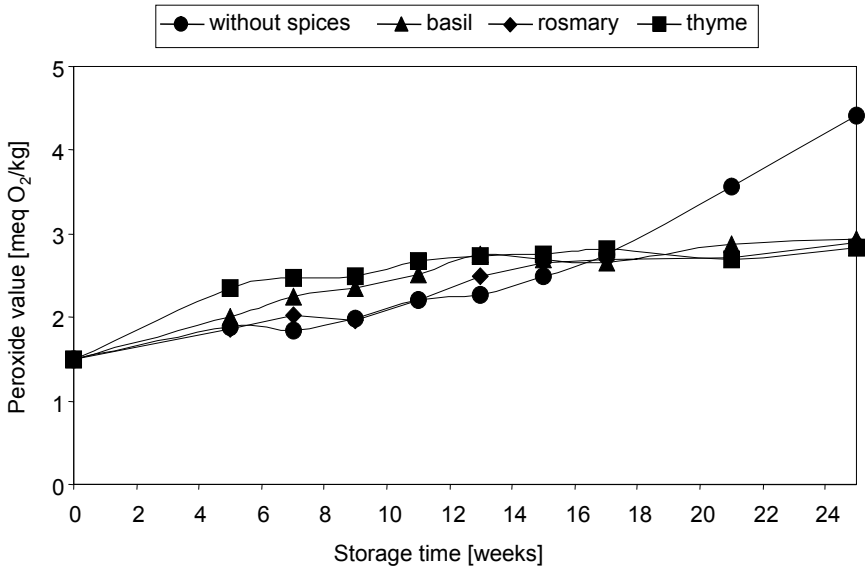

Fig. 2. Effect of basil, rosemary and thyme on the peroxide value of rapeseed oil during storage at 20 °C.

The influence on the oxidative state of oils enriched with spices during storage depends on one hand on the composition of the phenolic compounds of the spices and on the other hand on the migration of phenolic compounds from spices into the oil. Figure 2 shows the development of the peroxide value of oils enriched with rosemary, basil and thyme in comparison to oil without addition of spices. While the peroxide value of the oils enriched with spices showed only a weak increase of the peroxide value from 1.5 to 2.5 meq O_2/kg within 26 weeks of storage, oil without spices reached a peroxide value of 4.0 meq O_2/kg. This indicates a significant ($p < 0.05$) influence of the three tested spices on the oxidative stability of the oil during storage. The same effect was observed for measuring the oxidative stability by Rancimat at 120°C. By addition of spices to the oils the oxidative stability measured by Rancimat was enlarged (results not shown).

The differences between the different spices were unincisive regarding the formation of peroxides, but the effect was much clearer at higher storage temperature. Possibly, storage at higher temperatures enables an easier migration of compounds with an antioxidative activity from the spices into the oil. Using 50°C as storage temperature, the peroxide value of oil without addition of spices increased within 7 days to about 30 meq O_2/kg, while addition of spices resulted in a significant

improvement of the oxidative stability of the oils.

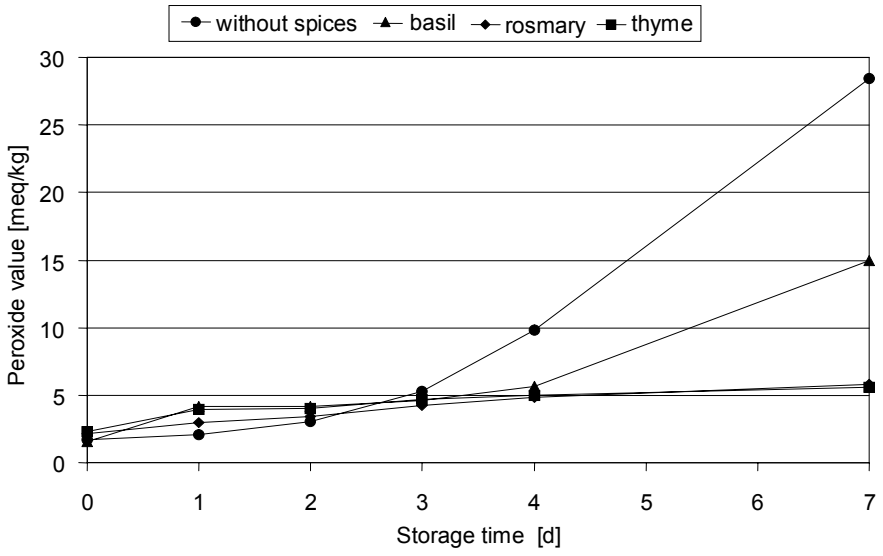

Fig. 3. Effect of basil, rosemary and thyme on the peroxide value of rapeseed oil during storage at 50 °C.

Flavouring with basil reduced the peroxide value for a half and the effect was much more pronounced by addition of rosemary and thyme, respectively. In that case the peroxide value increased only to about 5 meq O_2/kg. A similar result was found for the oxidative stability measured by Rancimat at 120°C which increased with increasing storage time for rosemary and thyme.

The content of tocopherols in rapeseed oil was not influenced by the addition of spices. During storage the content of tocopherols continual decreased, but no difference by the addition of spices in comparison to the samples without spices was observed (data not shown).

Looking on the migration of phenolic compounds from spices into oil it is obvious that only very small amounts of these compounds go into the oil. After 5 weeks only 10.3 and 58.2 mg/100 g oil were found in oil flavoured by basil and rosemary, respectively, in comparison to 7.4 mg/100 g of the initial oil. Figure 4 shows the HPLC-chromatograms of the phenolic compounds extracted from oils after storage with appropriate spices. It is obviously that the amount of some compounds increased as storage time went by. But interestingly rosmarinic acid, characteristic for and the main phenolic compound of spices was not found, while other substances already described as phenolic compounds of spices, luteolin and apigenin occurred in only small amounts. Although spices contain high amounts of phenolic compounds only a small amount is oil-soluble and migrates into the oil during storage. The main part of the phenolic compounds remains in the spices. Therefore the effect of the phenolic compounds on the oxidative stability is only small. Since the migration of phenolic compounds into the oil is improved at accelerated temperatures in that case spices can contribute to a higher oxidative stability.

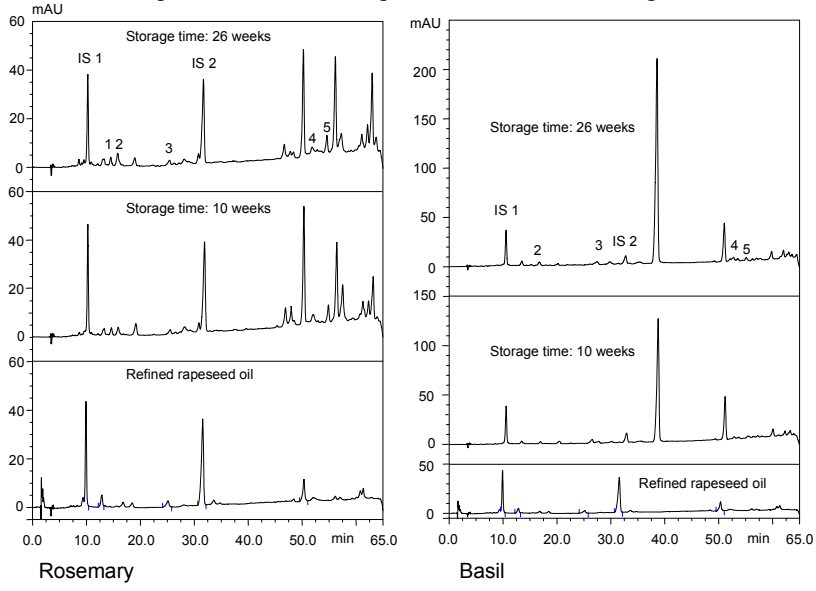

Fig. 4. HPLC chromatograms of phenolic compounds extracted from oils flavoured with rosemary and basil.

(IS 1 = p-hydroxyphenylacetic acid, IS 2 = o-coumaric acid, 1 = vanillin, 2 = vanillic acid, 3 = p-coumaric acid, 4 = luteolin, 5 = apigenin)

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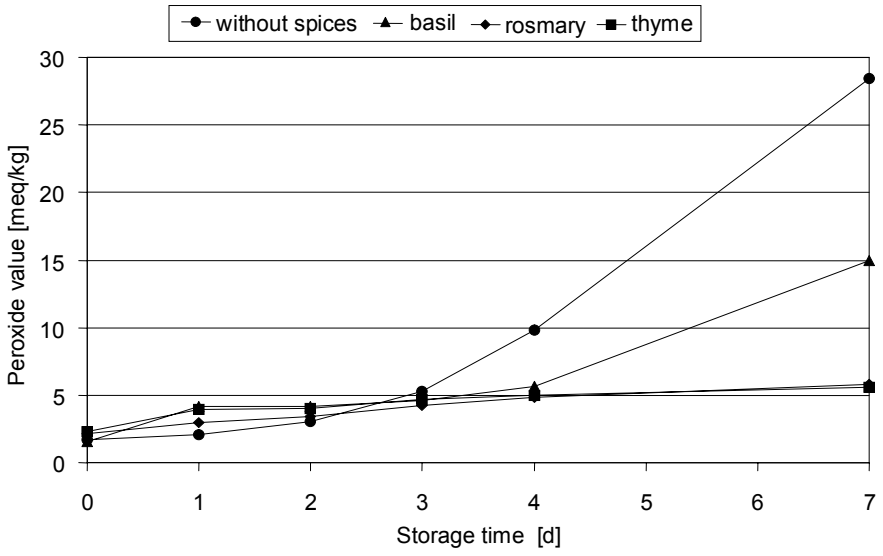

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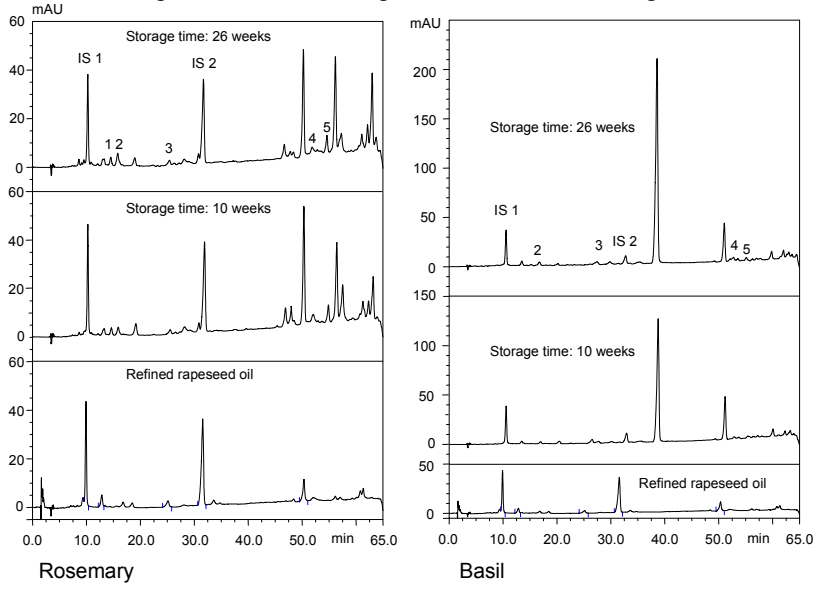

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Conclusion

The improvement of the oxidative stability of oils by addition of and flavouring with spices is only small at room temperature and a little more pronounced at accelerated temperature, since the migration of phenolic compounds into the oil was improved by the higher temperature. The main effect of spices is the flavouring of the oil and not the improvement of the oxidative stability. During storage the amount of volatile compounds which migrate from spices into the oil increased significantly, but during long-term storage the taste of the oils changes to astringent sensations, which has to be taken into consideration.

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