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Effect of storage period under normal conditions on malondialdehyde and peroxide value of some raw oils

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Abstract: In this study, the oxidative quality of raw hazelnut, olive, sunflower oils and animal fat commonly used in Turkey was examined. Fat and raw oil samples were stored two months at room conditions. Malondialdehyde (MDA) concentration was measured weekly and lipid peroxide (LP) was analyzed spectrophotometrically at the beginning and end of the study. At the beginning of the study, MDA value was the highest in animal fat and the lowest in hazelnut oil. At the last week of storage, oxidation tendency due to MDA was 0.687 in animal fat; 0.314 in olive oil; 0.792 in hazelnut oil and 0.582 in sunflower oil, and oxidation tendency due to LP was 0.656 in animal fat; 0.240 in olive oil; 0.744 in hazelnut oil, and 0.560 in sunflower oil. We have found that raw olive and sunflower oils are the most stabile oil types against to oxidation. We concluded that fodder industry should select the oils with low oxidation tendency. It would be more useful for them, as well as for other companies, to take into account appropriate using time period and storage conditions determined according to oxidative characteristics of each oil when using it.

Keywords: Animal fat, Olive, Hazelnut, Sunflower oil, Oxidation, Storage.

Bazı ham yağların normal koşullarda bekleme sürelerinin malondialdehit ve lipid peroksid düzeylerine etkisi

Özet: Bu çalışma, yaygın olarak kullanılan yağ kaynaklarından ham zeytin, fındık ve ayçiçeği yağları ile don yağının normal koşullardaki oksidatif seyrini saptamak amacıyla gerçekleştirildi. Bir yağ fabrikasından alınan ham zeytin, fındık ve ayçiçeği yağları ve rendering ünitesinden elde edilen don yağı örnekleri iki ay süreyle normal koşullarda tutularak haftalık malondialdehit (MDA) düzeyleri ve çalışma başlangıç ile bitimindeki lipid peroksit (LP) miktarları spektrofotometrik yöntemle belirlendi. Kontrol numunelerinde en yüksek MDA düzeyi don yağında saptanırken, en düşük MDA ise fındık yağında tespit edilmiştir. MDA verileri doğrultusundaki oksidasyona yatkınlık, çalışma bitiminde don yağında 0.687; zeytin yağında 0.314; fındık yağında 0.792 ve ayçiçek yağında 0.582 olarak; LP düzeyleri açısından yatkınlık ise, don yağında 0.656; zeytin yağında 0.240; fındık yağında 0.744 ve ayçiçek yağında ise 0.560 olarak bulunmuştur. Oksidasyona yatkınlık en düşük zeytin yağında; en yüksek ise, fındık yağında ortaya çıkmıştır. Fındık yağı en düşük MDA ve LP düzeylerine sahip olan yağ tipi olmasına rağmen, fındık yağında birinci haftadaki oksidasyon yatkınlığı, 0.430 düzeyinde bozulma oranıyla diğer yağlara göre yüksek oluşmuştur. Don yağında ise, oksidasyona yatkınlık her hafta artmaktadır. Sonuç olarak; yem endüstrisi gibi alanlarda oksidasyona karşı dirençli ham yağların tercih edilmesinin ya da yem ve gıda sanayinde kullanılacak ham yağların oksidatif özelliklerine uygun olarak kullanım süresine dikkat edilmesinin yararlı olacağı kanaatine varılmıştır.

Anahtar Kelimeler: Don yağı, Zeytin yağı, Fındık yağı, Ayçiçek yağı, Oksidasyon, Bekletme süresi.

INTRODUCTION

During the last decade, an increasing attention has been given to the role of biological oxidation. This subject has been an increasing interest to both food biochemists and physiologists. Oxidation essentially affects the quality and life of biological materials, foods and oils composed of polyunsaturated fatty acids (1). Since polyunsaturated fatty acids are particularly susceptible to oxidation during storage, cooking or frying of foods, the potential risk of exposure to lipid degradation of products is likely to increase (2).

In researches on oils and oil quality, pH, fatty acid composition and organoleptic status of oils have been commonly determined (3, 4). But there is no clear information about oxidation status of them due to internal end external factors. Many investigators have reported that storage period and temperature were

important factors for oils and foods contain them (1, 5) On the other hand, supplying of economical oil sources is another vital point for food and fodder industry. Oxidation and rancidity in oils are also serous problems for producers and consumers (1).

Malondialdehyde (MDA) is a much known end product of oxidation. MDA and lipid peroxide (LP) are important oxidation indicators of the raw oils and other materials (6, 7). The serious question arises as that how fast can raw oils oxidize by normal storage conditions. In this study, the effect of storage period in normal conditions on MDA and LP status of raw olive, hazelnut, sunflower oils and animal fat was aimed to research.

MATERIAL AND METHODS

Samples

Oil samples derived from olive, sunflower, nuts of hazelnut tree, and animal fat were investigated. Samples were taken from a commercial oil factory and from rendering unit of a slaughter house. Oils were storaged in dark laboratory condition at 18-20 °C for two months. Samples were saved in colored and closed glass bottles.

MDA Analysis

MDA is one of thiobarbituric acid reactive substances (TBARS). Test principle is the determination of the rate of absorbance change at 532 nm due to TBARS reactivity. MDA was estimated by double heating method of Draper and Hadley (8). For this purpose, 2.5 ml of 100 g/l trichloroacetic acid solution is added to 0.5 ml oil and to fat samples and placed in 90 °C water bath for 15 minutes. After cooling, the mixture is centrifuged at 1000 g for 10 minutes, and 1 ml of the supernatant is added to 0.5 ml of 6.7 g/l thiobarbituric acid (TBA) solution in a test tube and placed in 90 °C water bath for 15 minutes again. The solution is cooled in water and its absorbance is measured by using the Shimadzu UV 1601 spectrophotometer in Biochemistry-Physiology Laboratories of Veterinary Faculty.

LP analysis

It was analyzed by the modified method called TSE 894 for vegetable oils (9) and calculated miliequivalent oxygen peroxide in each kg of oil (mEq/kg).

Statistical Analysis

Differences in oxidation tendency between weeks and oil types for MDA and LP were determined by Exponential Function; statistical comparisons calculated by Oneway ANOVA due to $P<0.01$.

RESULTS

Weekly concentrations of MDA and LP values in oil groups are shown in Table1; each week tendency values and weekly last values in Table 2; multiple comparisons dependent variable MDA in Table 3. Distribution of oxidation tendency in oil types is presented in Figure 1. At normal conditions, storage procedure is seen to be effective for oxidation status of oils. At the beginning of the study, MDA value was the highest in animal fat and the lowest in hazelnut oil (Fig). At the last week of storage, oxidation tendency due to MDA was 0.687 in animal fat; 0.314 in olive oil; 0.792 in hazelnut oil and 0.582 in sunflower oil, and oxidation tendency due to LP was 0.656 in animal fat; 0.240 in olive oil; 0.744 in hazelnut oil, and 0.560 in sunflower oil (Table 2). We have found that raw olive and sunflower oils are the most stabile oil types against to oxidation.

Table1. MDA and LP concentrations in oil types.

	Animal fat	Olive oil	Hazelnut oil	Sunflower oil
MDA (nmol/ml)				
Control	37.351	16.139	7.608	16.160
1th week	40.340	18.444	11.700	18.390
2nd week	40.450	18.461	12.450	18.514
3 th week	43.230	21.645	12.459	18.761
4th week	48.329	21.753	14.986	20.462
5th week	54.765	21.903	16.023	23.286
6th week	68.474	22.001	16.715	25.073
7th week	71.473	22.012	16.760	26.687
8th week	74.312	22.102	16.810	28.939
LP (mEq/kg)				
Control	10.11	8.83	0.99	1.14
8 th week	19.60	11.30	2.08	2.01

Table 2. Oxidation tendency values in oil groups for each week.

Week	Animal fat		Olive oil		Hazelnut oil		Sunflower oil	
	Mean	Total	Mean	Total	Mean	Total	Mean	Total
Due to MDA								
1	0.076	0.076	0.133	0.133	0.430	0.430	0.129	0.129
2	0.006	0.079	0.001	0.134	0.061	0.492	0.006	0.135
3	0.066	0.146	0.168	0.293	0.000	0.493	0.013	0.149
4	0.111	0.257	0.005	0.298	0.184	0.677	0.086	0.236
5	0.125	0.382	0.007	0.305	0.066	0.748	0.129	0.365
6	0.223	0.606	0.004	0.309	0.042	0.787	0.073	0.439
7	0.042	0.648	0.000	0.310	0.002	0.789	0.062	0.501
8	0.038	0.687	0.004	0.314	0.002	0.792	0.081	0.582
Due to LP								
8	0.082	0.656	0.030	0.240	0.093	0.744	0.070	0.560

Table 3. Multiple comparisons dependent variable MDA.

		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval
(I) GROUP	(J) GROUP				Lower Bound
Animal fat	Olive oil	30,306*	3,53	,001	19,79195
	Hazelnut oil	36,963*	3,53	,001	26,44908
	Sunflower oil	29,372*	3,53	,001	18,85758
Olive oil	Animal fat	-30,306*	3,53	,001	-40,82155
	Hazelnut oil	6,657	3,53	,335	-3,85767
	Sunflower oil	-0,934	3,53	,995	-11,44917
Hazelnut oil	Animal fat	-36,963*	3,53	,001	-47,47867
	Olive oil	-6,657	3,53	,335	-17,17192
	Sunflower oil	-7,591	3,53	,227	-18,10630
Sunflower oil	Animal fat	-29,372*	3,53	,001	-39,88717
	Olive oil	0,934	3,53	,995	-9,58042
	Hazelnut oil	7,591	3,53	,227	-2,92330

*P<0.01

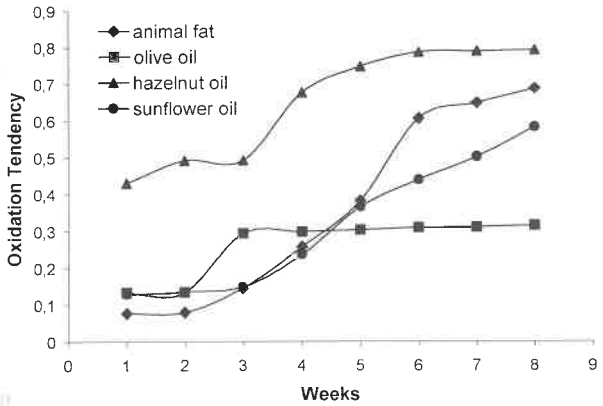

Figure 1. Distrubition of oxidation tendency values in oil types.

DISCUSSION

Oils are one of main dietary components that serve several functions in foods and animal nutrition (10, 11).

The basic molecules of oils undergo different chemical reactions during processing and storage. Some of these chemical reactions may restrict the usage and functionality of oils (12). In this study, we also found significant higher oxidation level at the end of storage period.

In addition, fatty acids in oils are the most chemically unstable food components and will readily undergo free-radical chain reactions that not only deteriorate the oils but also produce oxidative fragments, some of which are volatile and are perceived as the off-flavors of rancidity (10, 13). Oxidation reactions are thermodynamically favorable and as a result, evolutionary selection has strongly influenced the chemistry, metabolism and structure of biological materials to prevent these reactions

kinetically (14). All processing steps, including raw product selection, harvesting, storage, refining, manufacturing and distribution have impacts, on the quality of oils (10). Therefore, studies, indicating that oils have some oxidative alterations, pointed out that oxidation had also significant relationship with storage time and temperature. Our results support these findings for storage and temperature.

On the other hand oils contain polyphenols, which may confer to them greater resistance against oxidation during long-term storage (15). Polyphenol index of oil is an important point for storage of them in factories, stores and rations (15). Polyphenol index of raw oils for greater resistance against peroxidation and for long-term storage at normal conditions is advisable (16). In rations and nutrients manufacturing, a good raw material selection would be advisable in order to get a balanced oxidative status. We found that peroxidation is an important reliability parameter of rancidity related with oxidation in different oil types may contain different polyphenol indexes.

In this study, we found that only olive oil had a low oxidation tendency (Table 2). We also found that raw olive and sunflower oils were the most stable oil types. Therefore, olive and sunflower oil can be useful raw material for storage and ration preparation. Oxidation tendency of hazelnut oil changed seriously only at the first week of storage. At the end of study, MDA and LP levels were also the lowest in hazelnut oil. We concluded that fodder industry should select the oils with low tendency to oxidation. It would be more useful for them, as well as for other companies, to take into account appropriate using time period and storage conditions determined according to oxidative characteristics of each oil when using it.

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