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EFFECT OF DIFFERENT ALKALI CONCENTRATIONS DURING THE REFINING PROCESS ON THE OXIDATIVE STABILITY OF SUNFLOWER AND SOYBEAN OILS

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Abstract

The oxidative stability of bleached soybean and sunflower oils which were previously refined using NaOH and KOH at concentrations of 12, 14 and 16 Bé° was studied in comparison with semirefined sunflower and crude soybean oils.

Semirefined sunflower oil and crude soybean oil showed the highest stability. Oils previously refined using 12 Bé° NaOH or KOH had an acceptable stability. Higher NaOH concentrations resulted in a decrease of stability.

Keywords: sunflower oil, soybean oil, refining, oxidative stability.

Introduction

The oxidative stability of edible oils is one of the important quality characteristics. This stability is mainly depending on the fatty acid composition of oils and the presence of antioxidants (natural or artificial).

Both sunflower and soybean oils are relatively sensitive to autooxydation due to the high concentration of unsaturated fatty acids. The overall tendency to reduce or eliminate the use of synthetic additives (including antioxidants) stimulate efforts to optimize processing technology to achieve as high oxidative stability as possible.

This work was devoted to studies on the effect of alkali refining on the stability behaviour of bleached sunflower and soybean oils.

Materials and Methods

Sampling

The samples used in this work were local crude soybean oil and semi-refined sunflower oil which was imported from the U.S.A. by Misr Oils and Soap Company in Sandoub, Mansoura, Egypt.

Process of Refining

Degumming: The degumming was carried out according to the method suggested by WIEDERMANN [1].

Dewaxing: The method used in this work was recommended by HARALDSSON [5].

Alkali refining: Alkali refining of dewaxed oil was performed according to the method of Wiedermann [1] as follows: The dewaxed oils were heated to 33°C then treated with alkali solutions at different concentrations. The refining losses were determined for the different samples.

Sodium hydroxide and potassium hydroxide were used with both oils (i.e. sunflower and soybean oils) at concentrations of 12, 14, 16, 18 and 20 Bé°, also sodium carbonate and sodium bicarbonate were used, with both oils at concentrations of 12, 14, 16 and 20 Bé°. Such alkalies were added in equivalent amounts to the free fatty acid present in dewaxed warm sunflower or soybean oil. Both oils and alkali were heated to 75°C, then the samples were centrifuged to separate the soapstock from the neutral oil. The neutral oil was dissolved in ether, transferred to a separatory funnel for washing with saturated sodium chloride solution to remove the formed soap. The etheral oil was dried over anhydrous sodium sulphate, filtered and the ether was evaporated at 40°C.

The refining loss was estimated for each treatment followed by the determination of physical and chemical properties.

Bleaching: Bleaching of the neutral oil was carried out according to the method of Wiedermann [1].

Stability Behaviour

The effect of oxidation was studied using the following quick method: A completely homogenized fluffy mixture of the sample under investigation and starch powder in a ratio of 1 : 9 (w : w) was prepared to increase the surface exposed to oxidation. Each mixture was then divided in to 9 parts of equal weights, and these were kept in a glass dish at 60°C ± 1°C in an oven. Samples were taken at different periods of 2, 4, 6, 9, 12, 15, 18, 21, and 25 days.

The samples taken were dissolved in ether, and were washed with distilled water, and were separated in separatory funnels, the ether layer was dried over anhydrous sodium sulphate and was filtered, then the ether was evaporated. The samples were kept in the refrigerator until needed for other determinations.

Peroxide Value (PV)

The peroxide values of samples were determined according to the method of AOCS official methods [6].

Results and Discussion

The results of the investigations are summarized in *Tables 1, 2* and illustrated in *Figs. 1* and *2*.

As it was expected, the stability is decreasing with the degree of refining of the products. The highest oxidative stability was found in the case of crude oil. The results are in good agreement with the investigations of MORRISON [2], KWON et al. [3] and JUNG et al. [4].

Concerning the alkali treatment of oils it could be stated that the oils treated with NaOH and KOH of 12 $Bé^0$ concentration had the highest oxidative stability. The measured peroxide values are only slightly higher than those of the crude oil.

Higher alkali concentrations are in every case disadvantageous so their use is not recommended.

Table 1

Peroxide values* of semi-refined and bleached samples of sunflower oil when conducted at 60°C as a thermal stability examination

Time in days	Semi-refined oil	Bleached sample of which were refined by NaOH			refined by KOH		
		12 Bé°	14 Bé°	16 Bé°	12 Bé°	14 Bé°	16 Bé°
Zero	12.81	2.2	2.4	1.9	2.1	2.0	2.1
2	22.90	17.8	28.2	34.3	18.1	66.4	42.4
4	33.80	34.2	53.7	63.1	36.1	127.1	80.2
6	45.20	50.1	80.2	93.4	54.4	158.3	120.2
9	61.60	74.6	120.1	137.2	81.3	159.6	148.3
12	78.80	100.2	134.7	141.3	110.1	156.6	147.2
15	97.10	111.3	130.1	135.2	115.2	153.3	142.7
18	102.10	106.2	125.6	130.2	111.3	150.4	139.8
21	97.10	104.4	124.7	128.8	107.8	150.1	140.1
25	93.20	102.7	123.1	129.1	108.3	149.2	139.7

* Peroxide values expressed as milleq./kg oil

Table 2

Peroxide values* of crude and bleached samples of soybean oil when conducted at 60°C as a thermal stability examination

Time in days	Semi-refined oil	Bleached sample of which were refined by NaOH			refined by KOH		
		12 Bé°	14 Bé°	16 Bé°	12 Bé°	14 Bé°	16 Bé°
Zero	12.50	1.8	1.7	1.9	1.7	1.9	1.8
2	21.10	13.9	32.5	25.6	28.2	14.9	40.2
4	29.10	25.8	64.2	30.3	33.2	26.6	81.6
6	37.20	38.7	95.9	75.5	80.3	40.4	120.7
9	50.20	57.2	140.0	112.2	120.4	60.4	150.0
12	62.30	76.5	142.2	131.7	139.2	81.0	148.6
15	75.20	95.2	139.7	127.2	134.2	101.1	145.1
18	86.70	106.8	135.1	122.4	128.6	109.8	141.1
21	90.20	100.2	132.2	118.3	123.6	104.3	137.3
25	82.60	98.8	131.7	116.2	122.2	101.9	134.7

*Peroxide values expressed as milleq./kg oil

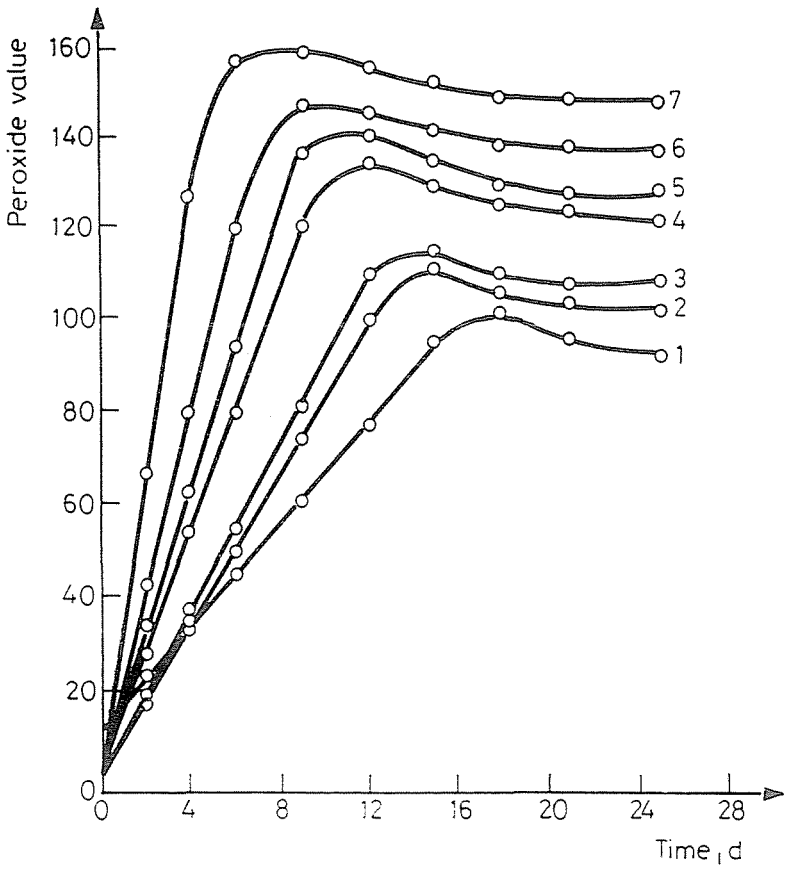

Fig. 1. The peroxide value during thermal stability of sunflower oil: where 1. semi-refined sunflower oil. Bleached sunflower oil of which refined oil by: 2. 12 Bé° NaOH, 3. 12 Bé° KOH 4. 14 Bé° NaOH, 5. 16 Bé° NaOH 6. 16 Bé° KOH and 7. 14 Bé° KOH

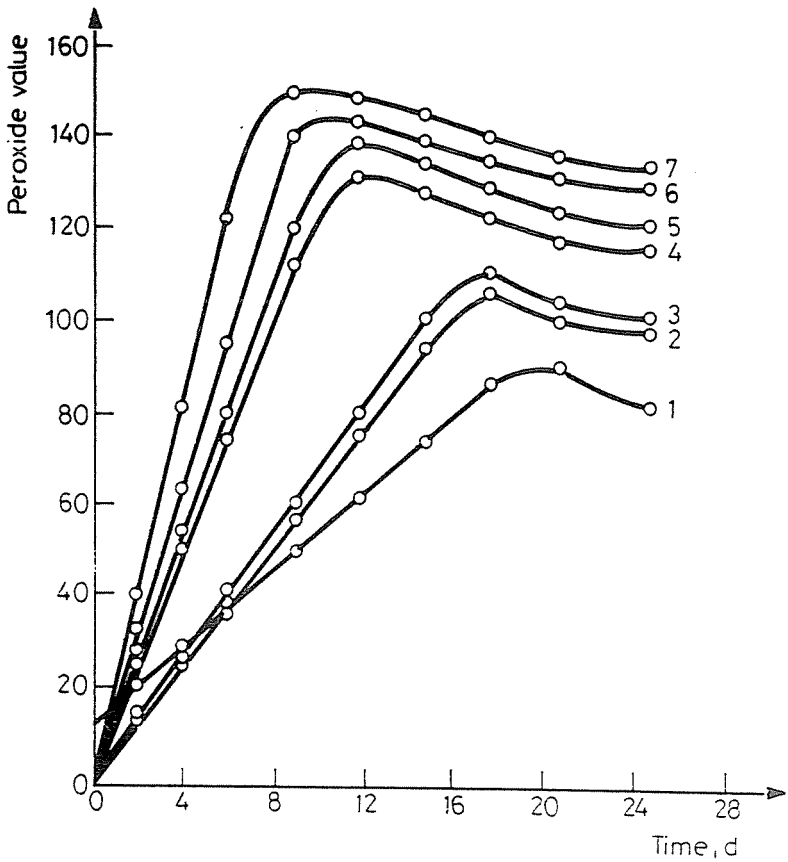

Fig. 2. The peroxide value during thermal stability of soybean oil: where 1. crude soybean oil. Bleached soybean oil of which refined oil by: 2. 12 Bé° NaOH, 3. 12 Bé° KOH 4. 16 Bé° NaOH, 5. 12 Bé° KOH 6. 14 Bé° NaH and 7. 16 Bé° KOH

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