INDUCTION PERIODS OF WALNUT OIL SAMPLES DURING THE RANCIMAT MEASUREMENT

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Abstract: Oxidative stability is an important parameter in the characterization of fats and oils.

This paper presents a comparative study of walnut oil stability at different temperatures, processing and storage assessed by the method Rancimat. Presented data denotes the oxidative stability of walnut oil depending on the duration and storage temperature. It was found that at high temperatures 60° C and 40° C during induction, nut oil has been considerably reduced. In some samples it was zero. Experimental data confirm that the induction which characterizes oxidative stability of walnut oil depends on the chemical composition of nuts, their quality and the method of extraction, processing and storage parameters: temperature, humidity, duration.

Key words: walnut oil, oxidative stability, Rancimat method

Introduction

Lipid oxidation is a major problem in food technology – both from a health perspective and from an economic perspective. It can occur in foods that are high in fat as well as in in low-fat foods. In food science oxidative stability is an important property of edible oils. It is represented by the time in which an oil sample resists to oxidation and it can used to evaluate when oil reaches an oxidation level inadequate for human ingestion or even for its utilization in frying processes [1].

The Rancimat test is a method of measuring the resistance of fats and oils to oxidation. It is based on the measurement of the induction time, which decreases the aging and degradation of fat. The induction time depends on the type of fat, the degree of unsaturation, added antioxidants and frying conditions. It should not decrease by more than 50% from its initial value. What all measurement methods have in common is that they measure the oxidative stability of oils at an elevated temperature (usually 100-120°C) before and after adding oxygen, and are thus able to monitor the free radical mechanisms in autoxidation processes [8]. The most stable oils resist at the oxidation and result in longer induction time. Although induction time can be used to compare oils relative stability, it cannot be used to precisely represent shelf life, as the conditions in which the oil is stored will have a major influence on shelf life. Induction time can be used to indicate the relative stability of oil when stored under the same conditions [3].

Materials and methods

Materials

Walnuts (Juglans regia L.) from Cogalniceanu variety, harvested in Moldova. Oil extraction was carried out with mechanical press. After extraction oil was filtered, treated with antioxidants sych as ascorbic acid and betacarotebe. After the treatment, oil was stored at different temperatures and then used for experiments.

Medods - Induction Periods (Rancimat value) [2, 5]

Oil oxidative stability was evaluated by the Rancimat method. Stability was expressed as the oxidative induction period (IP, h) measured at 98°C on a special installation based on Rancimat method, using an apparatus of 10 g of oil sample with an air flow. Volatile oxidation products were stripped from the oil and dissolved in cold water, whose conductivity increased progressively. The time taken to reach a level of conductivity was measured.

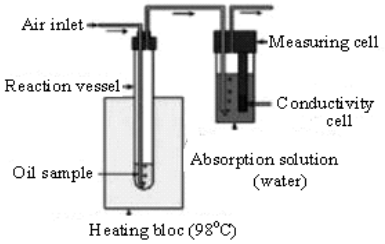

Fig.1. The system for determining the Rancimat value

Results and discussion

Oxidative stability is an important parameter for the quality assessment of animal and vegetable fats and oils. Autoxidation is affected by atmospheric oxygen; the oxidation process is initiated by radical reactions involving unsaturated fatty acids [2].

The Rancimat method is an accelerated aging test. Air is passing through the sample in the reaction vessel at constant elevated temperature. In this process fatty acids are oxidized. At the end of the volatile test, secondary reaction products are formed which are transported into the measuring vessel by the air stream and absorbed in the

measuring solution (deionized water). The continuously recorded electrical conductivity of the measuring solution is increasing due to the absorption of the reaction products.

Thus their appearance can be detected. The time until secondary reaction products are detected is called induction time. It characterizes the oxidation stability of oils and fats [5]. The induction time of the fats and oils investigated are shown in [2] for the two methods employed AOM and Rancimat at various temperatures (Table 1).

Table1. Induction Time determined by the AOM and the Rancimat Method at Various Temperatures

Sample	**Induction time at 100°C (hr)**		**Induction time at 110°C (hr)**		**Induction time at 120°C (hr)**	
	AOM	Rancimat	AOM	Rancimat	AOM	Rancimat
Peanut oil	14.18	13.80	7.65	7.25	3.92	3.25
Sunflower oil	8.32	9.27	4.40	4.55	2.37	2.27
Olive oil	30.90	29.37	14.20	12.95	7.70	6.42

The IP of walnut oil and rapeseed oil determined with the Rancimat method at 120ºC the average of walnut oil sampling 80-84 min and rapeseed oil 206-209 min [4]. Walnut oil is more unstable in the rancimat test when compared to hazelnut oil because

walnut oil contains much higler levels of polyunsaturated fatty acids [6, 7].

Table 3. Total Oil, Rancimat Value and Peroxide Value of Walnuts oils [6]

Selection and origins	Total oil, %	Peroxide value, meqO_2/kg fat	Rancimat value, h
Europe and United States			
Esterhazy	64.2	2.2	3.9
G139	64.2	4.1	3.9
G120	65.3	4.6	7.5
Tehama	67.6	2.0	6.1
Vina	66.9	3.3	7.5
New Zealand	64.5 … 68.9	1.0 … 5.4	4.2 … 7.8

Interestingly, the stability of the extracted oils from individual cultivars ranged widely and more unstable oils such as those extracted from the European-sourced of nuts (Esterhazy and G139) did not have higher levels of linoleic (18:2) and linolenic (18:3) acids compared to more stable oils extracted from Vina, G120 and Stanley (table3) [6].

In Table 3 there are presented the experimental data obtained by measuring the induction time of walnut oil stored at different temperatures. Presented data denotes the oxidative stability of walnut oil on the duration and temperature of storage. It was found that at high temperatures 60°C and 40°C during induction nut oil has been considerably reduced. In some samples it was zero.

Table.4. Rancimat value of Walnuts oil stored at different temperatures

Type of oils	Storage time, days	Induction Periods (Rancimat value), min	Specific Gravity at 25°C
Walnut oil, stored at 20 °C	control	90	919.0
	3	60	922.0
	7	45	920.0
	10	45	920.0
	14	40	921.5
Walnut oil, stored at 40°C	control	90	919.0
	3	30	919.0
	7	15	918.0
	10	0	919.0
	14	0	921.0
Walnut oil, stored at 60°C	control	195	916,0
	2	120	916,0
	4	90	916,0
	8	75	916,0
	10	0	920,0
	12	0	925,0

Figure 2 shows the determination of the induction time of oil samples tested under Rancimat method. The method is based on the conductometric determination of volatile degradation products and feature plotting of the conductivity against time. The evaluation is performed graphically after completion of the experiment.

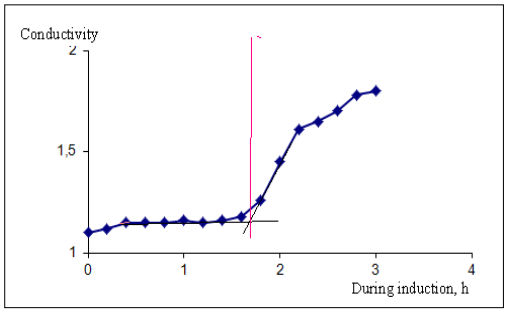

Fig.2. Graphic determination of the induction time by the tangent method (Rancimat value)

Conclusion

Oxidative stability is an important parameter in the characterization of fats and oils. The Rancimat test is a method of measuring the resistance of fats and oils to oxidation. Walnut oil is more unstable in the Rancimat test when compared to other vegetable oils because walnut oil contains much high levels of polyunsaturated fatty acids.

Oxidative stability of walnut oil depends on the chemical composition of nuts, their quality and the method of extraction, processing and storage parameters: temperature, humidity, duration of storage.

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