American-Eurasian J. Agric. & Environ. Sci., 11 (1): 34-37, 2011
ISSN 1818-6769

Oxidative Stability of Edible Oils Imported to Iran

[1]A. Barmak, [1]P. Hajeb, [1]Y. Rezaei, [2]S Akbar zadeh and [1]G.H. Mohebbi

[1]Department of Food and Drug, Bushehr University of Medical Sciences, Bushehr, Iran
[2]Faculty of Medicine, Bushehr University of Medical Sciences, Bushehr, Iran

Abstract: The oxidative stability index (OSI) and acid values (AV) were determined for different cooking oils imported to Iran through Bushehr province. The OSI value were 11.004, 22.591, 2.82, 4.88 and 6.53 for corn oil (CO), palm oil (PO), grape seed oil (GSO), refined olive oil (ROO) and soybean oil (SBO), respectively. The AV were 0.12, 0.153, 0.10, 0.09 and 0.903 for corn oil (CO), palm oil (PO), grape seed oil (GSO), refined olive oil (ROO) and soybean oil (SBO), respectively; that is sorted based on ascending of their stability times. According to these results, data showed that the stability time of the Palm oil was the longest among all the oils samples. The study showed that blending of GSO, SBO, CO with PO was effective to some extent in increasing the OSI amounts of 8.1, 16.71 and 49.65%, respectively. An important finding of the present study is that the addition of 25% of PO was equally effective in improving the OSI at 110°C, especially on ROO / PO blend. In all cases, the OSI increased from 0.5 to 5 h.

Key words: Edible Oils · Oxidative Stability · Acid Value (AV)

INTRODUCTION

Lipid oxidation is one of the most critical factors affecting the shelf life of Oil. It can have negative effects on color, texture, odor, flavor and Nutritional quality [1, 2]. The Oxidative Stability Index (OSI) value of oils and fats is one of the most important parameters for their quality assessment [3, 6] and is well correlated to the longevity of an oil sample. [4-8].

A number of methods have been developed to assess the resistance of oil and fat to oxidation. Among these techniques, the Rancimat Test has gained acceptance and is the most commonly used due to its ease of use and reproducibility [9]. The Rancimat method developed by Hadorn and Zurcher [10] involves conveying a flow of air through the oil sample contained in a sealed and heated container. This method produces peroxides during the primary oxidation phase and organic acids with a low molecular weight, aldehydes and ketones with a typical rancid odor during the secondary oxidation phase. These compounds are conveyed by the air flow into a second reservoir containing distilled or deionized water that is continuously monitored for conductivity. The sudden variation of conductivity shows the presence of organic acids. The time that elapses between the beginning of the process and the appearance of the secondary reaction products is called oil stability index (OSI) [4, 11, 12]. It is defined as the induction period that is the time needed before the rate of lipid oxidation of an oil sample rapidly accelerates [10].

Determinations of the oxidation stability in oil by rancimat method do not needed expensive and environmentally hazardous chemicals and time consuming titrations [9, 13]. The most usual temperature used for Rancimat Analysis have reported oxidative stability values at different temperatures (110-120 °C) in order to reduce the analysis time [10].

The aim of the present study was to investigate the use of OSI to predict the shelf-life of cooking oils imported to Iran. Also a comparable protective effect of palm oil on different oil blends was evaluated.

MATERIALS AND METHODS

Samples: The 38 Samples of corn oil (CO), palm oil (PO), grape seed oil (GSO), soybean oil (SBO) and refined olive original oils (ROO) were collected randomly according to edible fats and oils sampling method of the Iranian National Standard [21]. The oil consignments, intended for import to Iran, were in different volume of 0.5, 1, 2 and

Corresponding Author: G.H. Mohebbi, Food and Drug, Bushehr University of Medical Sciences, 7514633341, Bushehr, Iran. Tel: +987712520984.

2.5 lit. Samples were transferred to toxicology labs in Food and Drug Control Laboratory and kept at 4°C until analysis.

Apparatus: A Metrohm Rancimat model 743 (Herisau, Switzerland) capable of operating over a temperature range of 50-220 °C was used in this study.

Method: The automated Metrohm Rancimat apparatus was used for the comfortable determination of induction period of oil samples at constant temperature of 110°C, approved by the American Oil Chemists Society (AOCS) Cd 12b-92 [15]. For oxidative stability measurement, each oil sample (5 g) was weighted into the reaction vessel glassware. The conductimetry cells were filled with deionized water up to 60 ml [19]. A stream of filtered, cleaned and dried air was bubbled into oil samples contained in reaction vessels. The flow rates used at this temperature was 22 L h^{-1} for all determinations. The OSI was automatically determined by the apparatus. All determinations were carried out in duplicate. Although, the presence of a cleaner system, the glassware was rigorously cleaned between each run to avoid any contamination and dried in an oven at 90°C. The tubes were cleaned by boiling them with sodium hydroxide solution 2% for 1h, followed by cooling and soaking in concentrated hydrochloric acid. The acid was washed off and the tubes were rinsed with distilled water [16, 18]. The evaluation was performed graphically after completion of the experiments [2]

The induction time (point of greatest inflection) was determined graphically after completion of the experiment (tangential intersection point). In reality the induction period is measured as the time required reaching an end point of oxidation corresponding to either a level of detectable rancidity or a sudden change in the rate of oxidation [17]. The chemical parameter of AV was analyzed based on American Oil Chemist's Society method Cd 3d-63. Results were reported as the milligrams of KOH necessary to neutralize free acids in 1 gram of sample [20].

RESULTS AND DISCUSSIONS

The OSI results for the studied oils are presented in table 1. OSI values were 11.004, 22.591, 2.82, 4.88 and 6.53 for corn oil (CO), palm oil (PO), grape seed oil (GSO), refined olive oil (ROO) and soybean oil (SBO),

Table 1: AV and OSI (Mean±SD) in different oil samples collected from Bushehr port-Iran.

Oil Samples	N	AV(mg KOH/g) Mean ±SD	OSI [h] Mean ±SD
CO	8	0.12±0.034	11.004±1.067
PO	8	0.153±0.021	22.591±0.601
GSO	8	0.10±0.014	4.82±0.490
ROO	6	0.09±0.024	4.88±1.447
SBO	8	0.903±0.065	6.53±0.39

Table 2: AV and OSI values in blends of grape seed, refined olive and soybean oils with palm oil (4:1) at 110°C.

Oil blends (ratio)	N	AV(mg KOH/g) (Mean ±SD)	$OSI_{(h)}$ (Mean ±SD)
SBO + PO (4:1)	6	0.903±0.08	7.621±0.214
GSO + PO (4:1)	6	0.129±0.037	5.21±0.414
ROO + PO (4:1)	6	0.125±0.023	9.559± 0.464
CO+PO (4:1)	6	0.14±0.034	9.772±0.437

respectively. Table 1 also illustrates the results of AV prior to the start of the Rancimat test. Mean of AV were 0.12, 0.153, 0.10, 0.09 and 0.903 for corn oil (CO), palm oil (PO), grape seed oil (GSO), refined olive oil (ROO) and soybean oil (SBO), respectively.

Based on the collected data, to determine the protective effect of palm oil on the other oils, several combinations were evaluated and 4:1 was selected. Also, their related AV and OSI were calculated. The results are reproduced in Table 2, which summarizes the effect of PO on the stability (Mean±SD) of grape seed, refined olive and soybean oil blends at 110°C.

Figure 1 Shows stability times of Corn (CO), palm (PO), grape seed (GSO), refined olive (ROO) and soybean oils (SBO). That is sorted based on ascending of their stability times. According to these results, the OSI of the Palm oil was the longest, among other oils.

Relative to ROO, the addition of 1:4 amounts of PO to ROO, OSI significantly increases to 1.96 times (95.88%) compare to the initial value. From the results obtained, it is apparent that blending of GSO, SBO, CO with PO was effective to some extent in increasing the OSI amounts of 8.1, 16.71 and 49.65%, respectively. At the level of the 4: 1 blend, a further increase of the induction period could be observed in ROO / PO than the other oil blends.

An important finding of the present study is that the addition of 25% of PO was equally effective in improving the OSI at 110°C, especially on ROO / PO blend. ROO, GSO, SBO, CO composition of the representative oils studied and their blends with palm are given in Figure 2. In all cases, the OSI increased from 0.5 to 5 h.

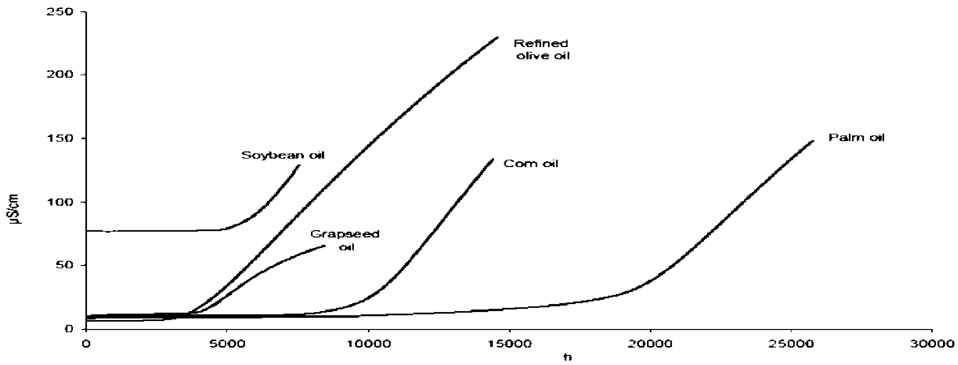

Fig. 1: Stability times for soybean (SBO), refined olive (ROO), grape seed (GSO), Corn (CO) and palm oils (PO) was shown

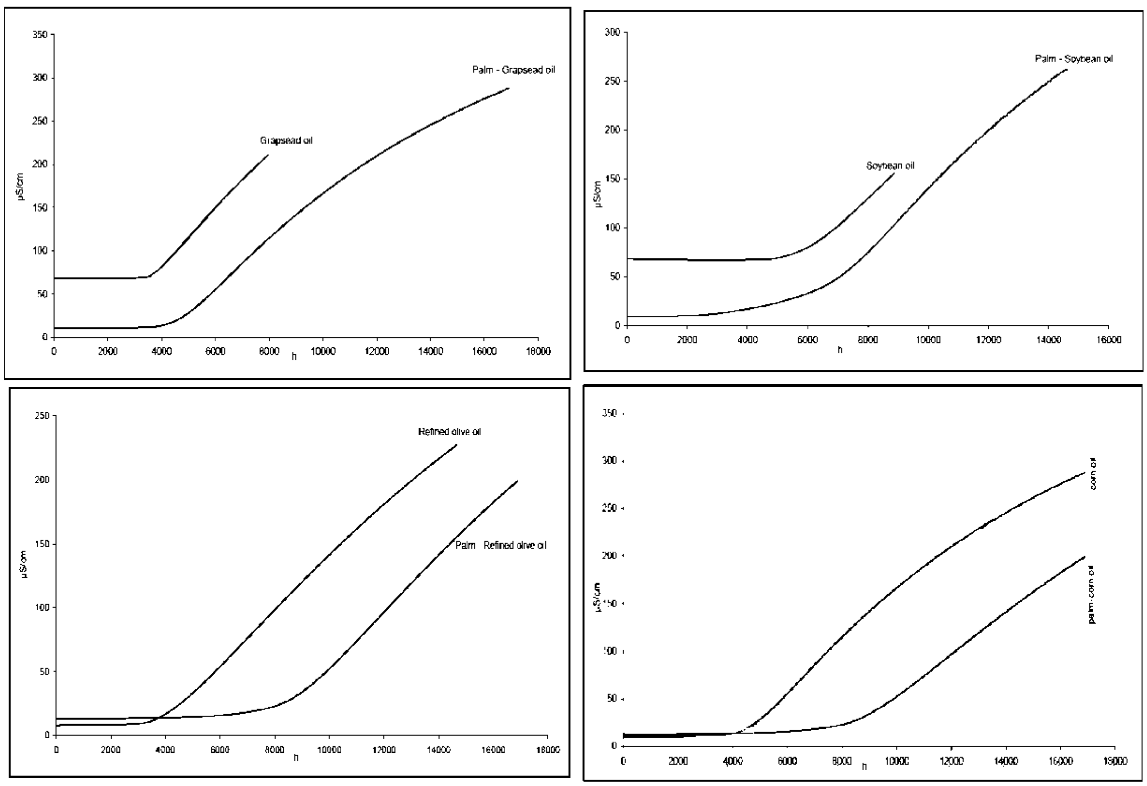

Fig. 2: Comparisons of OSI for GSO, SBO, CO in blending with PO with their initial values

CONCLUTION

In conclusion, based on data obtained from this study, OSI can be used to compare various oils to predict their respective shelf lives. This OSI analysis showed that PO can be used directly to enhance GSO, SBO, CO stabilities, especially on ROO / PO blend.

Measures suggested that acid value is not a very important factor for oxidation stability, or that it is important only in combination with other parameters.

REFERENCES

1. Mateos, R., M. Uceda, M.P. Aguilera, M.E. Escuderos and G.B. Maza, 2006. Relationship of Rancimat method values at varying temperatures for virgin olive oils. Eur. Food Res. Technol., 223: 246-252.
2. Jannat, B., M.R. Oveisi, N. Sadeghi, A. Behfar, M. Hajimahmoodi, F. Jannat and S. Khoshnamfar, 2008. Shelf Life Prediction of Infant Formula by Using Rancidity Test. Iranian J. Pharmaceutical Res., 7(4): 269-273.

3. Farhoosh, R., 2007. The effect of operational parameters of the Rancimat method on the determination of the oxidative stability measures and shelf-life prediction of soybean oil. J. Amer. Oil. Chem. Soc., 84: 205-209.
4. Matthaus, B.W., 1996. Determination of the oxidative stability of vegetable oils by Rancimat and conductivity and chemiluminescence measurements. J. Am. Oil. Chem. Soc., 73: 1039-1043.
5. Anwar, F., M.I. Bhanger and T.G. Kazi, 2003. Relationship between Rancimat and active oxygen method values at varying temperatures for several oils and fats. J. Am. Oil. Chem. Soc., 80: 151-155.
6. Kowalski, B., K. Ratusz, D. Kowalska and W. Bekas, 2004. Determination of the oxidative stability of vegetable oils by differential scanning calorimetry and Rancimat measurements. Eur. J. Lipid. Sci. Technol., 106: 165-169.
7. Velasco, J., M.L. Andersen and L.H. Skibsted, 2004. Evaluation of oxidative stability of vegetable oils by monitoring the tendency to radical formation. A comparison of electron spin resonance spectroscopy with the Rancimat method and differential scanning calorimetry. Food Chem., 85: 623-632.
8. Issaoui, M., G. Flamini, M.E. Hajaij, P.L. Cioni and M. Hammami, 2007. Oxidative Evolution of Virgin and Flavored Olive Oils Under Thermo-oxidation Processes. J. Am. Oil. Chem. Soc., DOI 10.1007/s11746-011-1800-5.
9. Mendez, E., J. Sanhueza, H. Speisky and A. Valenzuela, 1996. Validation of the Rancimat test for the assessment of the relative stability of fish oils. J. Am. Oil. Chem. Soc., 73: 1033-1037.
10. Hadorn, H. and K. Zurcher, 1974. Zur Bestimmung der Oxydations- stabilitat von O¨ len und Fetten. Dtsch Lebensm Rundsch, 70: 57-65.
11. Oxitester, Analysis system for quality control of vegetable oil www. Oxitester.com. Web site: www. cdr-mediared.com.
12. Knothe, G. and R.O. Dunn, 2003. Dependence of oil stability index of fatty compounds on their structure and concentration and presence of metals. J. Am. Oil. Chem. Soc., 80: 1021-1026.
13. Hasenhuettl, G.L. and P.J. Wan, 1992. Temperature effects on the determination of oxidative stability with the Metrohm Rancimat. J. Am. Oil. Chem. Soc., 69: 525-527.
14. Mohebbi, G.H., A. Jahangiri, S. Akbar zadeh and P. Hajeb, 2011. Inhibition of Acetyl Cholinesterase activity in farmers exposed to organophosphate pesticides in Bushehr, Iran. American-Eurasian J. Toxicological Sci., 3(3): 127-129.
15. Oil Stability Index, in Official Methods and Recommended Practices of the American Oil Chemists' Society, 4th ed. Champaign, 1994, Method Cd., pp: 12b-92.
16. Polvillo, M., G. Márquez-Ruiz and M.C. Dobarganes, 2004. Oxidative Stability of Sunflower Oils Differing in Unsaturation Degree during Long-Term Storage at Room Temperature. JAOCS, 81: 6.
17. Laubli, M. and P. Bruttle,1986. Determination of the oxidative stability of fat and oils, comparison between an activeoxygen method (Aocscd 12-57) and rancimat method. J. Am. Oil. Chem. Soc., 63: 792-795.
18. García-Moreno, P.J., M.M. Muñío, R. Pérez-Gálvez, A. Guadix and E.M. Guadix, 2010 oct 25-29. Measuring the oxidative stability of fish oil by the RANCIMAT test. Food innova, International conferen (1986ce on food innovation. University of Granada, Spain.
19. Liliana, N.C. and A.A. Carelli, 2010. Relation between Oxidative Stability and Composition in Argentinian Olive Oils. J. Am. Oil. Chem. Soc., 87: 1189-1197. DOI 10.1007/s11746-010-1598-6.
20. AOCS official method. 1999. Cd 3d-63: Acid value. Champaign, IL (USA): American Oil Chemist's Society.
21. ISIRI 493 (Institute of Standards and Industrial Research of Iran). 2004. Edible fats and Oils-sampling.