Journal of Basic and Applied Engineering Research
Print ISSN: 2350-0077; Online ISSN: 2350-0255; Volume 2, Number 13; April-June, 2015 pp. 1072-1074

http://www.krishisanskriti.org/jbaer.html

Effectiveness of Lemon Peel Oil in Control of Oxidation of Sunflower Oil during Microwave Heating

Sagarika Bhattacharyya[1] and Ankhi Maiti[2]

[1,2]Department of Chemistry, Dr Sudhir Chandra Sur Degree Engineering College, Kolkata, WB, India
E-mail: [1]sagarika.bhattacharyya@dsec.ac.in, [2]ankhipurkait@gmail.com

Abstract—*The aim of the study is to investigate the effectiveness of Aromatic plant oil (lemon peel oil, Citrus Limon) in controlling the lipid oxidation of vegetable oil (sunflower oil) when heated in microwave oven at high temperature. Lipid peroxidation during heating was determined by estimating the acid value, peroxide value, conjugated dienes (CD) and conjugated trienes (CT) for the samples heated and the original sunflower oil before heating. From the results, it can be stated that lemon peel oil might be used as potential natural antioxidant when used at minimum level of 800 ppm. The study also points that lemon peel oil can also be a suitable substitute of synthetic antioxidants which have many adverse effect on human health. Objective of study was to evaluate the antioxidant effects of some essential oil (lemon peel oil)on stability of sunflower oil during frying.*

1. INTRODUCTION

In food industry, Sunflower oil is widely used as a frying media because of its high smoke point (above 23^0 C or 45^0 F). To select a cooking or frying media it is very important to know oil's heat tolerance with the way of heating method. SFO in an important source of fat which contains a considerable amount of essential fatty acid like linoleic acid. Linoleic acid is an omega -6-fatty acid which is very susceptible to oxidation. The oxidation mainly occurs during thermal processing (1,2).

The oxidation of unsaturated fatty acids is one of the major causes of the development of off flavor compounds and in reduction in the nutritional value of food products (3). Generally, during frying synthetic antioxidants are added in edible oil to retard lipid peroxidation and to avoid the development of any off flavor in fried products. But it is well known fact that synthetic antioxidants are very toxic and carcinogenic (4) and their use in edible oil during heating is very much discouraged. There are two essential fatty acids which are linoleic acid (LA) and alpha linoleic acid(A LnA).These two acids play important role in synthesis and gets metabolized to produce highly unsaturated fatty acids or long chain polyunsaturated fatty acids which have numerous role in physiological system. The balanced fat or oil containing these essential fatty acids and other micronutrients should be stable at high temperature so that it could be able to supply its essential constituents through cooked and fried products. A variety of vegetable oils are marketed in India by focusing the health and nutritional benefits. Some common vegetable oils are mustard oil, sunflower oil, soybean oil, groundnut oil, rice bran oil, sunflower oil, palmolein oil etc which are very much used in our kitchen for cooking, frying, deep frying. It is reported that the thermal polymerization occurs between the esters of isomeric linoleic acid and linolenic acids and oils rich in acids with conjugated unsaturation, polymerize extensively within few minutes. O`Connor et.al demonstrated that linoleic acid and linolenic acids are highly susceptible to oxidation which subsequently led to formation of conjugated isomers of the next higher order. Cis- trans conjugated isomers. The rate of polymerization of linolenates was much more rapid than for the corresponding dishes. It was also reported that the rate of oxidation of the linolenic (18:2) is twelve times greater than oleic acid (18:1), while linoleic acid (18:3) is 2 times greater than that of linoleic (18:2) fatty acid chain.

It is reported that conjugated trienoic fatty acids isomers namely pumic acids (cis-9-trans-11-cis-13-octadecatrienoic acid) and alpha-elacostearic acid obtained from the seeds of common vegetables such as trichosanthes anguina (snake gourd), respectively have effective differences in the cis and trans content in the conjugated series, linoleic acid as occuring in linseed oil and other vegetable oils has cis configuration only. Traditionally, Indian foods are prepared through frying process. So the cooking oil should meet the frying criteria as well as should be stable at high temperature. One of major cause of quality deterioration in lipid containing foods during frying is lipid oxidation. The primary oxidation products being hydro peroxide, which decomposes to produce a variety of volatile compounds that result in off flavor and off odour of oils.

Some synthetic antioxidants such as butyl hydroxyl anisole (BHA),tetra-butyl hydro quinone (TBHQ) and widely added

to food stuff to avoid or reduce oxidative effects. Recent studies have indicated that such components can cause hazards such as carcinogenesis and toxicosis.Therefore, there has recently been high interest to use natural antioxidants present in species and plant materials as promising substitutes. Essential oils contain complex odours volatile components which are soluble in oil.

Essential oils are used in food and pharmaceuticals industries because of their antifungal antibacterial antioxidant and other effects. Generally different species are used in cooking media to increase the flavor and taste of food.

But epidemiological and preclinical evidences shows that spices also act as minor dietary constituents having anticancer characteristics. Anticarcinogeneric effects of some Indian plant products were studied by Arunak, et.al. According to them the cumin seeds, basil leaves are commonly used in Indian cooking, many prove to be valuable anticarcinogenic agents.

The beneficial properties in spices may be due to the presence of potent phytochemicals in them. Plants have capacity to synthesize a diverse array of chemicals .In plants these compounds function to attract beneficial and repel harmful organisms, serve as photoprotectants and respond to environmental changes.

In human they can have complementary and overlapping actions including antioxidant, anti mutagenic and inflammatory effects. Thus incorporation of these species during deep fat frying may prove to be beneficial for our health.

2. MATERIAL AND METHODS

2.1 Vegetable oil

Sunflower oil was purchased from local market. The composition of oils is shown in table1,2,3.

2.2 Aromatic plant oil

Lemon peel oil (LPO) was supplied by European flavors & fragrances (PVT) LTD. The other chemicals used for analysis were of high purity grade (Merck) and the composition of lemon peel oil was analyzed.

2.3 Thermal heating (Microwave) of oil

Two samples of sunflower oil (SO)1 (having no lemon peel oil) and (SL)1 (having 800 ppm of lemon peel oil) were heated in microwave oven for minutes at 160^0C. sample s were taken out of oven and small amount of oil were collected for analysis of acid value, peroxide value, % diene and % triene estimation. Then the samples SO1 and SL1 were kept under vacuum for 24 hours. The same procedure was repeated for 7 days with these sample set and simultaneous analysis.

2.4 Analytical analysis

Acid value and peroxide values were determined by standard methods according to AOCS (1998).Fatty acid composition of sunflower oil was analyzed following the standard methods. The physiochemical specification of the lemon peel oil as well as its GC analysis is given in table (3).

2.5 Gas chromatograph analysis

Column used is silica capillary column ECI. Study is done by ramping program prior to measurements, in which the sample in the column is gradually heated till the injected material is completely exhausted .The reading is mapped as percentage on area and height graph.

2.6 Spectrophotometric analysis

Sample of SA1 and SO1 of 200mg were dissolved in100ml n-hexane and mixed thoroughly. The optical densities were measured at 232 and 267 nm wavelength by UV spectrophotometer (specifications) for estimation of diene and trienes respectively. The % of conjugated acids were calculated following the method of AOCS (1998)

3. RESULT AND DISCUSSION

The initial characteristics of sunflower oil used is given in Table1.It is a well known fact that presence of antioxidants can considerably reduce the degradation of edible oils during heating. The study was to investigate the possible reduction of oxidative rate by addition of aromatic plant oil as natural antioxidant in edible oils. The acid value, peroxide value and percentage of diene and triene content in the oil (without LPO) compared to that of sample with LPO supports the fact that addition of natural oil about 800ppm with antioxidant properties does preserve the oil from oxidative degradation to some extent .

Table 1: Fatty acid composition of some common cooking oil

S. No	oil/fat	fatty acid% by weight			EFA
		SFA	MUFA	PUFA	
1	Groundnut oil	20	50	50	32
2	Mustard oil	6	67	27	2
3	Sunflower oil	7.4	35	57.2	57
4	Soya bean oil	16	24	60	10
5	Rice bran oil	20	45	35	15
6	Snake gourd oil	13	27	-----	60
7	Bitter gourd oil	39	8	-----	53

Table 2: Micronutrients of edible vegetable oil

S. No	oil	Tocopherol and Tocotrienol (ppm)	Oryzanol (ppm)	Natural antioxidants (ppm)
1	Sunflower	487	0	487
2	Soya bean	1000	0	1000
3	Rice bran	417	2000	2417
4	Olive	51	0	51

Table 3: Composition of sunflower oil in microwave Heating

Major fatty acids %(W/W)				
16:0	18:0	18:1	18:2	others
4.5	2.9	35.0	57.2	0.2

Table 4: Technical specification of lemon Seed oil

S. No	physical appearance	clear mobile liquid
1	color	yellow
2	Refractive index	1.45-1.47
3	specific gravity	0.8345-0.8545
4	flash point	43^0C

Table 5: Microwave heating of sunflower oil

Heating Time (min)	Acid Value		Peroxide value	
	SO1 Oil	SL1 Oil	SO1 Oil	SL1 Oil
1	2.12	2.86	0.99	0.95
2	1.90	2.45	2.55	4.57
3	2.90	2.54	4.78	4.26
4	2.81	2.67	5.57	5.21
5	3.60	3.37	5.74	6.52
6	3.42	3.40	8.53	8.71
7	2.85	1.80	12.81	10.5

Table 6: Changes of the content of conjugated Dienes and Triene (%)

S. No	Heating time	Diene		Triene	
		SO	SL	SO	SL
1	to	---	---	--	---
2	t1	0.5060	0.5013	0.103	0.99
3	t2	--	--	--	--
4	t3	--	---	--	---
5	t4	0.708	0.681	0.0840	0.0709
6	t5	---	---	---	---
7	t6	0.828	0.752	0.0694	0.0656

4. ACKNOWLEDGEMENTS

We are thankful to JIS group Management for their constant encouragement in research work .Also to Dr Sudhir Chandra Sur Degree Engineering College and Calcutta University for carrying out this work. Mr Arup Kumar Hazra is being thanked for his help during the work.

REFERENCES

[1] O'Connor, R.T, D C Heinzelman, M.Caravella and ST Bauer, Oil and soap, 23, 5 (1946)

[2] Gertz C.,klosternmann S.,Kochhar S.P.Testing and comparing oxidative stability of vegetable oils and fats at frying temperature.Eur.J.lipid sci tech; 102:543-551.(2000)

[3] Chakrabarty,M M,Chemistry & Technology of oils and Fats, Allied Publishers PvT.Ltd,New Delhi pp 80-83 (2003).

[4] S.Bhattacharjee,A Sengupta.The Internet J of nutrition and wellness (ISSn:1937-8297) Vol 7,No 1,(200).

[5] El Anany A.M .Influence of pomegranate (puniea granatum) peel extract on the stability of SFO during deep fat frying process.Electron J .Food plants chem.;2:14-19,(2007)

[6] Hemalatha G.Seasame lignans enhance the thermal stability of edible vegetable oils.105, 1076-1085.(2007)

[7] Albi, T; Lanzon, A: Guonda.A; perez- camino,M.C; Leon .M. Microwave an conventional heating effects on some physical and chemical parameters of edible fats .J Agrie food chem., 45,3000-3003, (1997)

[8] Dostalova, J; hanzlik,p; Reblova,z; pokarny, J Oxidative changes of vegetable oils during microwave heating .Czech J .food sci.,23,230-239. (2005)

[9] zhang y,Yang L,Zu Y,Chen X,Wang F,Liu F,Oxidative stability of sunflower oil supplemented with carnoric acid compared to synthetic antioxidants during accelerated storage.Food Chem;118:656-62, (2010)