International Journal of Theoretical & Applied Sciences **6**(1): 14-19(2014)

ISSN No. (Print): 0975-1718
ISSN No. (Online): 2249-3247

Study of Effect of Temperature on Shelf Stability of Soybean-Corn Oil Blends

Atul Thakkar

Astral Institute of Technology and Research, Indore, (MP)

(Corresponding author Atul Thakkar)
(Received 15 November, 2013, Accepted 10 January, 2014)

ABSTRACT: Soybean oil because of certain advantages is cultivated on large scale in recent years in India particularly in M.P, U.P, and part of Maharashtra. Soybean oil meal is rich in protein and the oil has ready outlet in vanaspati manufacture with the possibility, that it may be utilized as edible oil. The direct use of soybean oil for deep frying purpose has certain limitation as it contains significant amount of linolenic acid i.e. about 6.8 %. These polyunsaturated acids made the soybean oil unstable even under ambient conditions. Secondly the consumers do not have liking of the fishy flavor of the oil during deep-frying. Significant improvement in shelf life and thermal stability and flavor reduction can be achieved by lowering the linolenate content of soybean oil by blending in different proportions with corn oil.
Corn oil widely used as an all purpose cooking oil and margarine because of the unique flavor it attributes and because it is more stable to oxidation than linolenate containing oil such soybean oil. Corn oil has milder taste and less expensive than most other types of vegetable oils. In present study to improve the stability and yet retain fluidity the soybean oil is blended with more stable corn oil thereby reducing linolenic acid content. The thermal stability for all the blends is studied by determining their Physico-chemical properties and fatty acid composition using standard methods.

Keywods: Soybean oil, corn oil, Thermal stability.

I. INTRODUCTION

Oils rich in Monosaturated fatty acid are gaining more importance these days due to their specific advantages over other oils. They are more stable towards oxidative changes over polyunsaturated fatty acid rich oils and hence prove to be better choice for frying or cooking application. Polyunsaturated fatty acid rich oils are more prone to oxidative changes, and hence promote oxidation in both food and non-food products, although important from health point of view. Thus while selecting oil or fat one has to consider both aspects that-oil should not be too much saturated and unsaturated as well. In fact as per latest guidelines of WHO/Japanese Heart Association the ideal ratio of SAFA: MUFA: PUFA should be 1:1.5:1.In order to derive maximum benefits from oil it is advised to consume a mixture of oils in order to maintain a balance between the fatty acids, and possible to keep cholesterol level in control.

Now-a-days a number of blended oils are available in the market. For instance, blends of rice bran and sunflower oils.

Soyabean oil is rich in protein but direct use of soybean oil has some limitation as it contains linolenic acid and it becomes unstable even under ambient conditions.

To increase stability of soybean oil linolenic acid content must be reduce it can be done by changing fatty acid compositon this is possible by blending with more stable oils compare to soybean oil.

In soybean oil linolenic acid is oxidized twice as quickly as linoleic acid and produces short chain aldehydes with flavor that are even stronger and less acceptable than those produced from linoleic acid, due to this odor of oil change. It can be used after one or two frying. It is the most saleable oil in india.

Corn oil contains a significant amount of ubiquinone and high amounts of alpha and gamma tocopherols (vitamin E) that protect it from oxidative rancidity. It has good sensory qualities for use as salad and cooking oil. Corn oil is highly digestible and provides energy and Essential Fatty Acids (EFA). Linoleic acid is a dietary essential that is necessary for integrity of the skin, cell membranes, the immune system, and for synthesis of icosanoids. Icosanoids are necessary for reproductive, cardiovascular, renal and gastrointestinal functions and resistance to disease. Corn oil is highly effective food oil for lowering serum cholesterol. The use of corn oil to contribute to PUFA intake of 10% in the diet would be beneficial to heart health. It is rich in linoleic acid one of the three fatty acids.

Corn oil beyond food and consumer product replacing petroleum in many industrial applications it is use as biofuel. Use of corn oil as a biodiesel is increases and for this purpose investment in cultivation of corn oil is increases not only in India but in Global states.
It is used in pharmaceutical, cosmetic industries, paper, textiles, plastics, baked goods, candies, soups and mixes. It is also used as skin soother and softener.

MATERIAL AND MEHOD

Chemicals used

A wide variety of chemicals were used in the experiments which are listed below. Acetic acid ,Acetone , Carbon tetrachloride,ethyl alcohol, HCl, Glacial acetic acid (All S.D.Fine Chemicals); Methanol, Chloroform,& BF3-methanol solution (Qualigens); Hexane & Heptane (HPLC grade, Qualigens); Wijs Solution (Merck Grade); isopropyl alcohol (China). Before using these solvents, their expiry was checked and these were stored properly.

Reagens Used

Sodium hydroxide Sodium thiosulphate Sodium sulphate Potassium iodide Sodium chloride,15% potassium iodide solution(15 gm of potassium iodide dissolve in 100 ml of water), potassium dichromate (All Qualigens). Before using these reagents their expiry was checked and was stored properly.

Indicators

Phenolphthalein (Qualigens): It was used by dissolving 1gm of phenolphthalein in alcohol.
Starch (Qualigens):-Starch prepared by dissolving 1gm of soluble starch in 200ml distilled water and boil for few seconds. These indicators were prepared freshly as per the requirement of test. To observe proper colour changes during titration.

Raw Material

Soybean oil and Corn oil were purchased from market package of 1 liter. Before analysis, manufacturing and expiry date was checked properly. Before starting analysis, the colour and odor of these oils were checked.

Methods

(i) Iodine value

Iodine value is a measure of the degree of unsaturation in oil. It is constant for particular oil or fat. Iodine value is useful parameter in studying oxidative rancidity of oils since higher the unsaturation the greater the possibility of the oils to go rancid. This is the most important test to determine stability of oils.

(ii) Peroxide value

Rancidity is brought about by the action of air on the oil which is - oxidative rancidity, where in, the fat takes up oxygen with the formation of peroxides. Peroxide value is the peroxide content in the oil. Procedure for determination for Peroxide value test was used from AOCS method.

(iii) Free fatty acid value

Free fatty acids are usually presents in oils along with the triglycerides. It increases during storage. It is keeping quality of oil; therefore the free fatty acid content generally increases on storage. This is most important test to find out quality of oils. This test performed according to the AOCS method.

(iv) Fatty acid composition

To find out fatty acid composition of oils gas chromatographic method is used because fatty acid evaluated in GC only it give prominent result. In this method oils first has to convert into methyl esters and then injected into the GC. Prepared sample seal in dry GC vial and kept in refrigerator before injection. Test performs as per the method of AOCS.

The five major fatty acids in soybean oil are palmitate, stearate, oleate, linolenate, and linoleate. The fatty acids differ in the number of carbon and hydrogen atoms they contains, which causes differences in the nutritional value of each and their influence on the characteristics of food products. It show change in percentages when blend with other oils.
All these tests were performed simultaneously. This study was followed by Thermal stability.
In thermal stability study the sample was kept in oven which was set at 60^{o}C. This stability analysis has been done continuously for seven days.
For the thermal stability blends were prepared in the proportions given as in table 1. Pure oils were taken as reference. 250ml of sample taken in the 500 ml beakers, it was labeled properly. The beakers were not closed. Then the beakers placed in the preheated oven at 60^{o}C for 6 hr.
Then the samples were taken out, cooled at room temperature and analyzed for iodine value, free fatty acid content and peroxide value using AOCS methods. Then the samples were allowed to remain overnight at room temperature in a closed shelf. Next day the samples were again kept inside preheated oven for 6hr. followed by testing as above. Thermal stability testing was done continuously for seven days i.e.in all for 42 hours.

Table 1: Ratio of blends and symbols used

First Oil	Second Oil	Ratio (1st:2nd)	Symbol used
Soybean	Corn oil	80:20	SC–1
Soybean	Corn oil	60:40	SC–2
Soybean	Corn oil	50:50	SC–3
Soybean	Corn oil	40:60	SC–4
Soybean	Corn oil	20:80	SC–5
Soybean	Corn oil	0:100	C

RESULT AND DISCUSSION

The characteristics and fatty acid composition of oils used in the study are given in tables (from Table 2 to 5). All the oils were used fresh. During the storage studies at room temperature a small but steady rise in free fatty acid content and peroxide value and fall in iodine value was observed in all blends. In Shelf Stability (at room temperature) upto our 42 hours study Iodine value for pure soybean oil is ranging from (134.1 to 129.5), and Soybean oil, Corn oil composition ranging from (127.2 to 120.8), (120.7 to 115.8), (115.3 to 112.9), (108.1 to 104.9), (101.8 to 93.5) for pure corn oil (95.6 to 89.4). (Table 02, Figure 01). All these values indicate decrease in values of blends at high range compared to the pure oils. Decrease in iodine value may be due to the polymerization.

Table 2: Thermal stability: Iodine value.

S:C (%)	INITIAL	6 (hrs)	12 (hrs)	18 (hrs)	24 (hrs)	30 (hrs)	36 (hrs)	42 (hrs)
100:00	134.1	133.9	132.7	132.5	130.3	130.5	129.6	129.5
80:20	127.2	125.3	124.7	123.2	122.3	121.9	120.5	120.8
60:40	120.7	120.6	119.7	118.3	117.9	116.9	116.1	115.8
50:50	115.3	115.0	114.8	114.5	114.5	113.7	113.3	112.9
40:60	108.1	108.0	107.5	106.9	106.3	105.9	107.2	104.9
20:80	101.8	97.3	97.0	96.7	95.3	94.7	93.9	93.5
00:100	95.6	93.4	93.0	92.9	92.7	91.5	89.7	89.4

Table 3: Thermal stability: free fatty acid content.

S:C (%)	INITIAL	6 (hrs)	12 (hrs)	18 (hrs)	24 (hrs)	30 (hrs)	36 (hrs)	42 (hrs)
100:00	0.14	0.17	0.18	0.20	0.22	0.25	0.29	0.30
80:20	0.15	0.18	0.19	0.23	0.25	0.30	0.33	0.34
60:40	0.17	0.18	0.20	0.22	0.23	0.25	0.30	0.31
50:50	0.18	0.19	0.20	0.21	0.23	0.24	0.29	0.30
40:60	0.20	0.22	0.24	0.25	0.27	0.29	0.30	0.31
20:80	0.21	0.23	0.25	0.26	0.29	0.30	0.31	0.32
00:100	0.25	0.26	0.27	0.28	0.30	0.31	0.32	0.33

Table 4: Thermal stability: Peroxide value.

S:C (%)	INITIAL	6 (hrs)	12 (hrs)	18 (hrs)	24 (hrs)	30 (hrs)	36 (hrs)	42 (hrs)
100:00	3.1	4.3	4.9	5.1	5.9	6.7	6.9	7.2
80:20	2.1	2.9	3.8	4.2	5.1	5.9	6.6	7.0
60:40	1.9	2.9	3.8	4.5	5.2	5.9	6.1	6.9
50:50	1.2	2.5	3.5	4.8	5.9	6.2	6.9	7.2
40:60	0.9	2.0	3.1	4.3	5.6	6.5	7.0	7.5
20:80	0.6	1.9	3.0	4.2	5.5	6.4	7.2	7.8
00:100	0.3	1.3	2.4	3.5	4.7	5.5	6.0	6.5

Table 5: Results of Fatty acid composition (at 60°C for 42 hours).

S:C	PALMITIC ACID	STERIC ACID	OLEIC ACID	LINOLEIC ACID	LINOLENIC ACID
100:00	10.7	3.9	22.7	50.8	6.6
80:20	10.9	3.8	23.9	50.6	5.6
60:40	11.0	3.7	25.2	50.1	5.3
50:50	11.3	3.5	25.6	49.8	4.9
40:60	11.5	3.4	28.0	49.5	3.5
20:80	12.3	3.0	30.1	49.2	2.5
00:100	13.2	1.0	35.6	48.9	0.7

Peroxide values in Shelf Stability (at room temperature) up to our 42 hours study for pure soybean oil is ranging from (3.1 to 7.2), and Soybean oil ,Corn oil composition Peroxide value ranging from (2.1 to 7.0), (1.9 to 6.9), (1.2 to 7.2), (0.9 to 7.5), (0.6 to 7.8) for pure corn oil (0.3 to 6.5) (Table 04, Figure 02). Free fatty acid content in Shelf Stability (at room temperature) up to our 42 hours study for pure soybean oil is ranging from (0.14 to 0.30), and Soybean oil,Corn oil composition Free fatty acid value ranging from (0.15 to 0.34), (0.17 to 0.31), (0.18 to 0.30), (0.20 to 0.31), (0.21 to 0.32) for pure corn oil (0.25 to 0.33) (Table 03, Figure 03). The changes in these values may be due to oxidation

As per our observation after 42 hours. There is a increase in a value of fatty acid content & provide whereas iodine clue decreases marginally the provide value in the oil increased the oxidative stability as compared to after oil at last it has been conduced that the rate of decease in provide is very high in soybean oil as compared to corn oil.

This may be due to the presence of significant amount of linolenic acid in soybean oil, which is prone to oxidation. The rate of oxidation of all blends is slow as compared with pure soybean oil. When corn oil was blended with Soybean oil iodine value of soybean oil decreases and progressive changes observed in the peroxide value that is oxidative stability of Soybean oil increases. Corn oil has better shelf life than the soybean oil, Hence when soybean oil is blended with corn oil there is an increase in shelf life stability of soybean oil. Thus the present study of three blends certainly help to improve shelf life of soybean oil as compared to pure soybean oil.

Fatty acid composition in Shelf Stability (at room temperature) linolenic acid content for pure soybean oil is (6.6), and Soybean oil ,Corn oil composition linolenic acid content (5.6), (5.3), (4.9), (3.5), (2.9) and for pure corn oil (0.7) (Table 5). After 42 hours value of free Fatty acids are changed.

It is indicated that, when soybean oil blended with corn oil there is decrease in value of linolenic acid content. After 42 hours also linolenic acid content show decrease comparing to initial stage of blending. The blend of Soybean oil with the corn oil shows good stability.

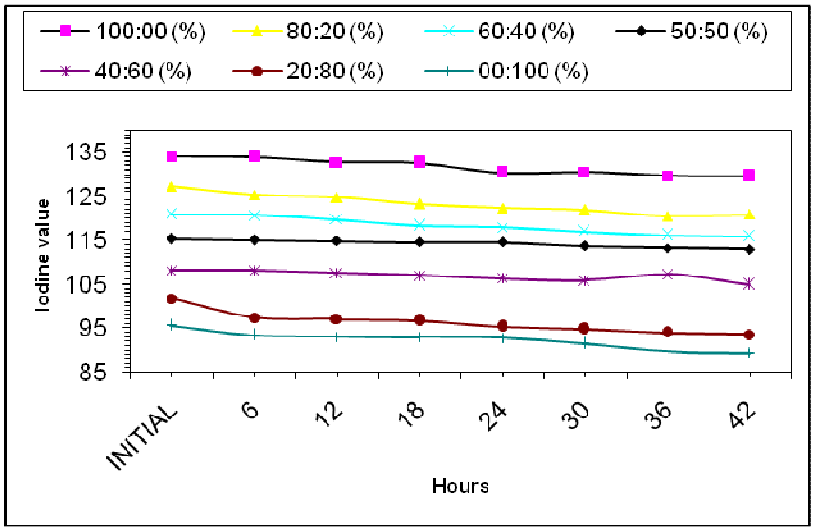

Fig. 1 : Graphical Represents of Iodine value of blends.

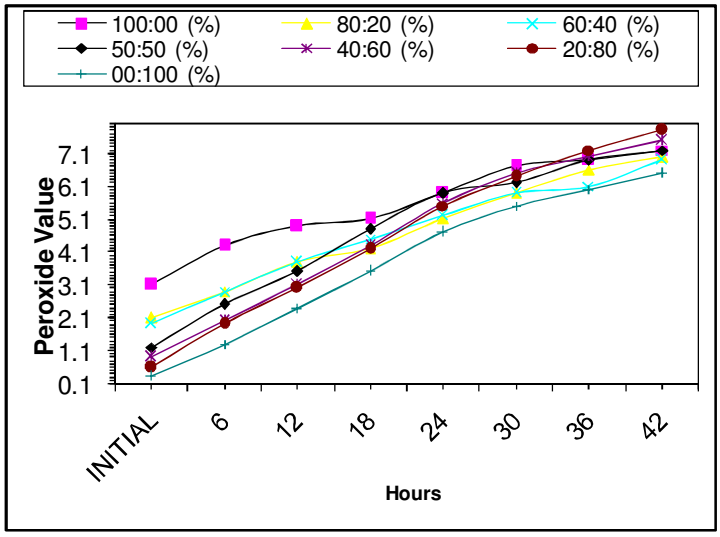

Fig. 2 : Graphical Represents of peroxide value of blends.

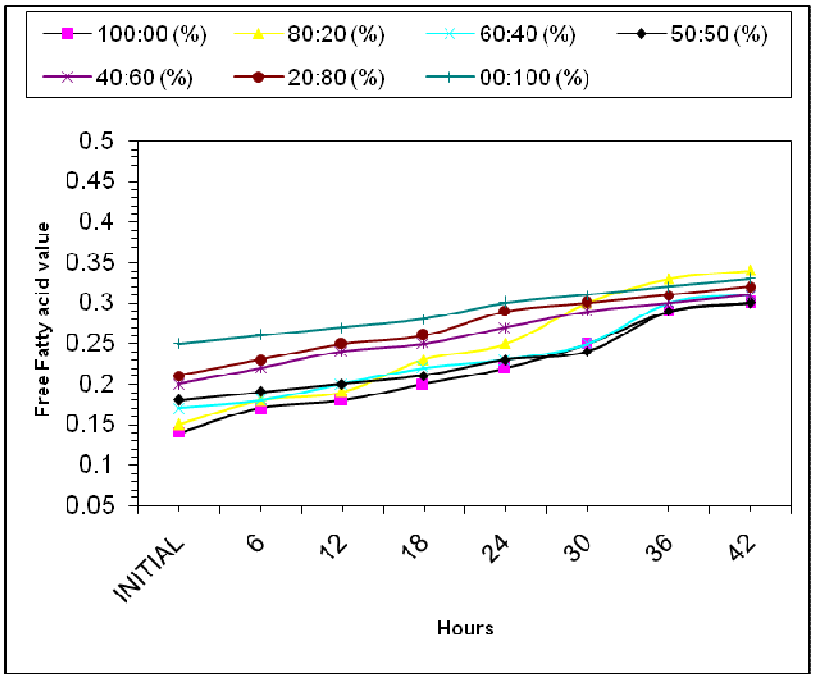

Fig. 3: Graphical Represents of FFA value of blends.

REFERENCES

[1]. Saska, M., and Rossiter, G.J., *J. Am. Oil Chem. Soc.*, **68**: 436-439, (1991).

[2]. Handoo, S.K., Gupta, Sanjoy., and Agarwal, T.N., *J. Oil Tech. Assoc. of India.*, **24**: 83, (1992).

[3]. Handoo, S.K., Bagga, K.K. and Sharma, K.P. *J. Am. Oil Chem. Soc.,* **26**: 91, (1994).

[4]. Young,C., in Balley's industrial Oil and Fat products,5th edition, Interscience publication, **2**, 339, (1996).

[5]. Bhattacharya, D.K.., *J. Am. Oil Chem. Soc.*, **77**, 1683-1686, (1998).

[6]. McCaskill, D.R., and Zhang, F.J. *Am. Oil Chem. Soc.,* **53**: 50-54, (1999).

[7]. Chopra, Rainy, and Nagraj, G., *J. Am. Oil Chem. Soc.,* **36**: 21, (2004).

[8]. Oil Technology Association of India, (Source: SEA News Circular), **8**, (2006).

[9]. Choe, Eunok.,, David., B., *Comprehensive review in Food Science and Food Safety*, **2**, (2006)

[10]. Choe, E., D., Min. B., *Journal of Food Science*. **72**, 77–86, (2007).

[11]. Basturk, Ayhan.., Javidipour, Issa., and Boyaci, Ismail, H., *Journal of Food Lipids* **14**, 170–188, (2007).

[12]. Ryan, Liliana, C., Marta, G.M., Valeria Nepole, Silvia Conci, Nelson, R., rosso., *International Journal of Food Science & Technology*, **43**, 193–199, (2008).

[13]. Francisca, Manzanarez-López., herlinda soto-valdez, Rafael Auras, Elizabeth Peralta, *Journal of Food Engineering*. **104**, 508–517, (2011).

[14]. Fawzy, Mohamed, Mohamed Khaled, Wahdan. M., *Food Chemistry*, Vol. **132**, 873-879, (2012).

[15]. Maria, Teresa o Sorio, Simon A. Haughey, Christopher., Elliott, T., Anastasios Koidis., *Food Research International*. **10,** 1016, (2013).