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Shelf Life Study of Soybean-Corn Oil Blends in Varying Ratio on Storage at Room Temperature

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ABSTRACT: The oils and fats are the important nutrients for humans. They play an important role in metabolism. Fats and oils are basic food materials. Fats and oils act as a heat transfer medium, hence the oil must meet a number of requirements some of which are:

(i) It must have good thermal and oxidative stability.

(ii) Good colour.

(iii) It must have good odor and flavor.

Refined oils are purified with chemicals to remove suspended particles, toxic substances, flavors' components, colour and odor, thereby leaving behind clear and bland oil. The quality of edible oil is generally judged by flavor during storage, cooking or frying which in turn is decided by its oxidative stability and fatty acid composition. Thus Quality and stability of oil depends upon the fatty acid compositions. Oil has different proportions of saturated and unsaturated fatty acids. Fatty acids show their own characteristics and affects on our body when taken in different levels. The compositional studies of individual oils from different part of world have revealed the fact that many parameters of Physico- chemical characteristics are governed by environmental impact. In present study, the pure soybean and corn oil are blended together in varying ratio and their stability and fatty acid composition at room temperature is studied. Soybean oil is chosen because it is rich in protein and also highly nutritious, but still cannot be used for cooking purpose due to its unpleasant smell.

Keywords: Soybean Oil, Corn Oil, Blends, Stability, Composition.

I. INTRODUCTION

The production of oils and fats is less than that demanded hence India has to import oils and fats. Due to this oil prices increases and goes beyond the limit which economically weaker section cannot afford, 85 % of oilseed production is crushed for oil, remaining 15 % for food use, seeds and feed 17% of oil and fats has demanded for biodiesel. Biodiesel is made by combining alcohol (usually methanol) with vegetable oils. Promoting the uses of bio fuels is done with a target to replace petroleum fuels.

Raw refined vegetable oil and vanaspati comprises of 85% of total fats in human consumption; the balance being derived from invisible sources. Oil is the combination of fatty acids. Quality and stability of oil depends upon the fatty acid compositions. Oil has different proportions of fatty acid compositions. Fatty acids has own characteristics it affects our body in different levels.

Corn oil is cultivated in all over the India. In India, Uttar Pradesh, Madhya Pradesh, Rajasthan, and Gujarat are some of the major states to cultivate the crop. In global states also it is cultivated on a large scale. Cultivated area expanded at an average annual growth rate of 2.9%.

The corn oil has lesser taste. Although looks are oily it is not greasy. The corn oil has high chemical stability. With corn oil you can fry delicious food of good colour and luster. Every 100 gm corn oil contents 93.8% mg vitamins including some essential ones to human body such as vitamin A, vitamin D, vitamin E. The corn oil has less smoke point compared with other edible oil so it keeps the environment of polyunsaturated fats is natural advantage of corn oil.

A pale yellow liquid obtained from the embryos of corn grains used especially as a cooking and salad oil and in the manufacture of margarines. The refined product is tasteless and odorless.

Its main use is in cooking, where its high smoke point makes it valuable frying oil. It is also a key ingredient in some margarine. Corn oil has milder taste and is less expensive than most other types of vegetable oils. Corn oil is naturally ideal as unsaturated fatty acids and reduces the saturation of fatty acid. This kind of oil is healthier for human consumption. The oil has better oxidative stability.

Soybean oil is noteworthy for their high contents of linoleic acid above 35% unsaturated fatty acid which is essential for proper functioning of organs of our body.

Unlike common vegetable oil soybean oil contains about 6.8% linolenic acid because of this higher linolenic acid content soybean oil is not stable to autoxidation as desired and also flavor and odor develops more easily than the oil that contains no linolenic acid. The refined soybean oil in addition to the desired high concentration of polyunsaturated fatty acids contains several micro-constitutes. The oil after refining can be used as salad oil but during storage flavor develops due to trienoic acid. Use of the oil for deep-frying causes polymerization of fatty acids.

Applications of soybean oil fall mainly in two categories: Edible fat products meant for human consumption and Industrial fat products used for technical purposes.

(i) Edible uses: cooking oils, pharmaceutical, filled milks, margarine, coffee creamers, shortening, candy and chocolate coating.

(ii) Technical uses: pesticides, anti-static agents, anti-corrosions agents, diesel fuel, dust control agents, printing inks, oiled fabrics, alcohol, yeast, anti-foaming agent, paints,

II. MATERIAL AND METHODS

Chemical 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.

Reagent 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.

(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.

Sodium thiosulphate solution required for this test was standardized before analysis as per the standardized method and test was performed as per the AOCS method.

(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. All these tests were performed simultaneously 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 release upon the free fatty acid content. 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. All the apparatus required for this test was used calibrated with proper marking to avoid error. While performing these entire tests all the apparatus were dried to avoid contamination. 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.

Shelf stability Study. The tests above is followed by stability study. This is carried out at room temperature which was around 32-38^{o}C. Temperature was checked daily and average taken as 35^{o}C as room temperature. Soybean oil and oil blends were prepared by using the various proportions of soybean oil and other edible oils. The required quantity of soybean oil and other edible oils (each at a time) was mixed volume/volume thoroughly. The oil blends were transferred carefully to clean plastic bottles of 500ml using calibrated measuring cylinder. Plastic bottles were closed tightly, and protected from sunlight.

Storage Study at Room Temperature. The pure oils and their blends were stored in the plastic bottles of same size on a shelf for a total period of 70 days. The blends were mix properly.

Before keeping the sample on the shelf the pure oils and their blends were analyzed for free fatty acid, iodine value, and peroxide value using AOCS methods. Fatty acid composition of pure and blends was determined in first day. Then at interval of 10 days the bottles were opened and the sample was taken out and analyzed for same tests. The sample for analysis was shaken vigorously for at least 20 min to mix blends properly. Mixing of two oils is most important otherwise results will not be proper.

RESULT AND DISCUSSION

The characteristics and fatty acid composition of oils are used in the study are given in tables (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 70days study Iodine value for pure soybean oil is ranging from (134.1 to 133.0), and Soybean oil, Corn oil composition ranging from (127.3 to 123.0), (120.6 to 116.8), (115.4 to 113.1), (107.1 to 103.9), (101.7 to 97.3) for pure corn oil (95.6 to 94.1) (Table 2, Fig. 1). 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.

Peroxide values in Shelf Stability (at room temperature) upto our 70days study for pure soybean oil is ranging from (3.1to 5.0), and Soybean oil, Corn oil composition Peroxide value ranging from (2.1 to 5.6), (1.9 to 3.9), (1.2 to 4.2), (0.9 to 2.1), (0.6 to 2.3) for pure corn oil (0.3 to 1.1) (Table 3, Fig. 2). Free fatty acid content in Shelf Stability (at room temperature) upto our 70days study for pure soybean oil is ranging from (0.14 to 0.35), and Soybean oil, Corn oil composition Free fatty acid value ranging from (0.15 to 0.32), (0.17 to 0.33), (0.18 to 0.32), (0.20 to 0.34), (0.21 to 0.33) for pure corn oil (0.25 to 0.34) (Table 4, Fig. 3). The changes in these values may be due to oxidation which increases the free fatty acid content and peroxide value whereas decreases iodine value through marginally. The increase in peroxide value in the blend of soybean oil as the concentration of other oil increases indicates the increasing oxidative stability of blend as compare to other oil. The rate of decrease in peroxide value for soybean oil (Table 3) is very high as compared with 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. As the ratio of the corn oil with soybean oil increases, the oxidative stability of the soybean oil increases progressively.

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

Table 2: Shelf stability study – Iodine value.

SAMPLE	**INITIAL**	**10(Days)**	**20(Days)**	**30(Days)**	**40(Days)**	**50(Days)**	**60(Days)**	**70(Days)**
S	134.1	134.0	133.9	133.6	133.6	133.5	133.3	133.0
SC-1	127.3	127.0	126.6	126.4	125.7	124.3	124.1	123.0
SC-2	120.6	120.4	119.8	119.2	118.3	118.1	117.6	116.8
SC-3	115.4	115.2	115.4	114.3	114.2	114.0	113.7	113.1
SC-4	107.1	107.4	107.1	106.8	106.2	105.7	104.2	103.9
SC-5	101.7	100.8	100.4	100.2	98.2	98.0	97.8	97.3
C	95.6	95.4	95.3	95.1	94.8	94.6	94.3	94.1

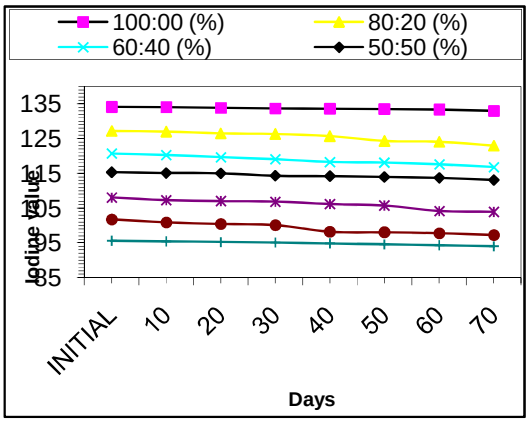

Fig. 1. Graphical represents of Shelf stability study - Iodine value.

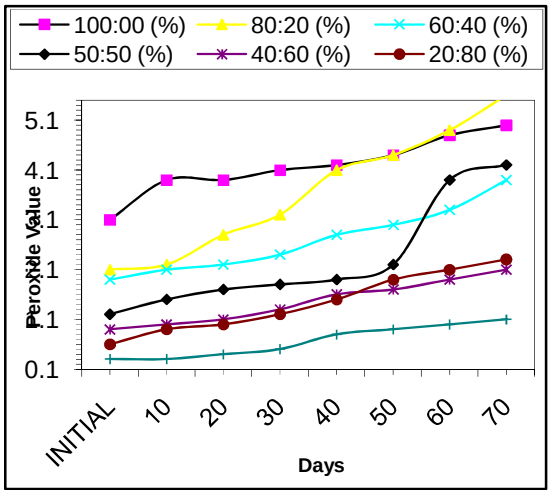

Fig. 2. Graphical represents of Shelf stability study - Peroxide value.

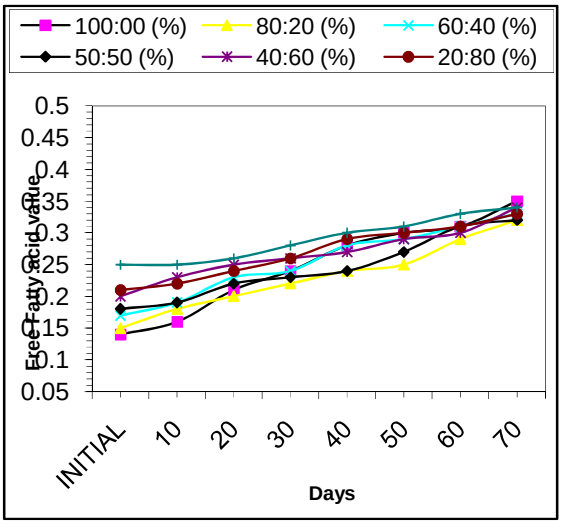

Fig. 3. Graphical represents of Shelf stability study - Free fatty acid content.

Table 3: Shelf stability: Peroxide value.

SAMPLE	INITIAL	10(Days)	20(Days)	30(Days)	40(Days)	50(Days)	60(Days)	70(Days)
S	3.1	3.9	3.9	4.1	4.2	4.4	4.8	5.0
SC-1	2.1	2.2	2.8	3.2	4.1	4.4	4.9	5.6
SC-2	1.9	2.1	2.2	2.4	2.8	3.0	3.3	3.9
SC-3	1.2	1.5	1.7	1.8	1.9	2.2	3.9	4.2
SC-4	0.9	1.0	1.1	1.3	1.6	1.7	1.9	2.1
SC-5	0.6	0.9	1.0	1.2	1.5	1.9	2.1	2.3
C	0.3	0.3	0.4	0.5	0.8	0.9	1.0	1.1

Table 4: Shelf stability: free fatty acid content.

SAMPLE	S:C(%)	INITIAL	10(Days)	20(Days)	30(Days)	40(Days)	50Days)	60(Days)	70(Days)
S	100:00	0.14	0.16	0.21	0.24	0.28	0.30	0.31	0.35
SC-1	80:20	0.15	0.18	0.20	0.22	0.24	0.25	0.29	0.32
SC-2	60:40	0.17	0.19	0.23	0.24	0.28	0.29	0.31	0.33
SC-3	50:50	0.18	0.19	0.22	0.23	0.24	0.27	0.31	0.32
SC-4	40:60	0.20	0.23	0.25	0.26	0.27	0.29	0.30	0.34
SC-5	20:80	0.21	0.22	0.24	0.26	0.29	0.30	0.31	0.33
C	00:100	0.25	0.25	0.26	0.28	0.30	0.31	0.33	0.34

Table 5: Shelf study -Initial & 70 days Fatty acid composition.

	Palmitic Acid		Steric Acid		Oleic Acid		Linoleic Acid		Linolenic Acid	
SAMPLE	Initial	70 days	Initial	70 days	Initial	70 days	Initial	70 days	Initial	70 days
S	10.7	10.8	3.9	3.9	22.8	22.8	50.8	50.8	6.8	6.7
SC-1	10.9	10.7	3.8	3.5	23.9	23.9	50.6	50.5	5.8	5.7
SC-2	11.0	11.2	3.7	3.6	25.6	25.6	50.1	50.0	5.3	5.3
SC-3	11.3	11.5	3.5	3.1	25.9	25.9	49.8	49.6	4.9	4.9
SC-4	11.5	11.3	3.4	3.0	28.3	28.3	49.5	49.1	3.5	3.5
SC-5	12.3	12.2	3.0	2.9	30.0	30.0	49.2	49.0	2.9	2.5
C	13.2	13.1	1.0	0.9	35.9	35.9	48.9	48.2	0.9	0.8

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. Fatty acid composition in Shelf Stability (at room temperature) linolenic acid content for pure soybean oil is (6.8), and Soybean oil, Corn oil composition linolenic acid content (5.8), (5.3), (4.9), (3.5), (2.9) and for pure corn oil (0.9) (Table 5).

After 70 days storage of these blends in different composition linolenic acid content for pure soybean oil is (6.7), and Soybean oil, Corn oil composition linolenic acid content (5.7), (5.3), (4.9), (3.5), (2.5) and for pure corn oil (0.8) (Table 5).

It is indicated that, when soybean oil blended with corn oil there is decrease in value of linolenic acid content. After 70 days also linolenic acid content shows decrease comparing to initial stage of blending. The blend of Soybean oil with the corn oil shows good stability.

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