

Study the effectiveness of refined soybean oil in vacuum.

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Abstract

The shelf life of edible oil is one of the major problems in the edible oil industries. The rates of reactions in auto-oxidation schemes are dependent on the hydrocarbon structure, heteroatom concentration, heteroatom speciation, oxygen concentration, and temperature. This ultimately leads to decrease in nutritional quality, increase in toxicity, development of off-Odor and altered texture and color. Recently the soybean oil is recovered by solvent extraction process. After refining the oil is stored in storage tanks. Here the peroxide value of oil increases due to air present. By providing vacuum to the storage tanks, the peroxide value of oil can be maintained.

Keywords: soybean oil, vacuum, peroxide value, oxidation reaction.

1. Introduction

Production of vegetable oils that meet the global standard of consumption of the cosmetics and specialty food industries is a multi-step process which involves procurement of raw materials, extraction, refining and packaging. The inability of the oil to remain stable due to the presence of acyl-lipids such as monomeric, dimeric and oligomeric triacyl glycerols, and sterols like cholesterol (animal sterols) and phytosterols (plant sterols) which can oxidize through the exposure to air or presence of moisture at high temperature to form lipid oxidation products with initial reaction products known as hydroperoxide and later form compounds such as

aldehydes, ketones, alcohols carboxylic acids which has great consequences.

Lipid oxidation causes food spoilage, deterioration of important qualities in vegetable oil, rancidity of the vegetable oil and reduces the organoleptic characteristics of the fried food which have negative effects on the taste, color and odor of vegetable oil. Cholesterol oxidation products (COPs) have received much attention due to their biological effects such as cytotoxicity, atherogenicity, sterol metabolism interference, mutagenicity, carcinogenicity and absorption of compounds which poses health risk to human if consumed in large quantities.

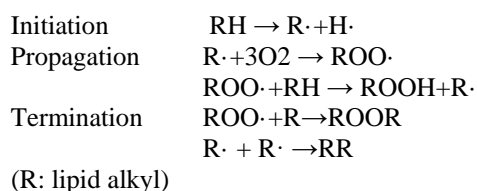
Though, phytosterols oxidation products have not show any evidence of genotoxic effect but unstable due to the presence of unsaturated fatty acid content which may combine with oxygen on exposure to air and it reduces cancers if properly treated. Methods of improving stability of vegetable oils against oxidation include hydrolysis, hydrogenation process in the presence of nickel catalyst and indirect addition of antioxidant reduces the degree of unsaturation and promotes the quality of vegetable oil with storage period [3].

2. Mechanisms of autoxidation reaction

Different chemical mechanisms, autoxidation and photosensitized oxidation, are responsible for the oxidation of edible oils during processing and storage depending upon the types of oxygen. Two types of oxygen can react with edible oils. One is called atmospheric triplet oxygen, $^3\text{O}_2$, and the other is singlet oxygen, $^1\text{O}_2$. $^3\text{O}_2$ reacts with lipid radicals and causes autoxidation, which is a free radical chain reaction. The chemical properties of $^3\text{O}_2$ to react with lipid radicals can be easily explained by the molecular orbital of the oxygen. The $^3\text{O}_2$ in the ground state with 2 unpaired electrons in the $2p\pi$ anti

bonding orbitals has a permanent magnetic moment with 3 closely grouped energy states under a magnetic field and is called triplet oxygen. ³O₂ is a radical with 2 unpaired orbitals in the molecule.

It reacts with radical food compounds in normal reaction conditions according to spin conservation. Photosensitized oxidation of edible oils occurs in the presence of light, sensitizers, and atmospheric oxygen, in which ¹O₂ is produced. Oxidation of edible oils is influenced by an energy input such as light or heat, composition of fatty acids, types of oxygen, and minor compounds such as metals, pigments, phospholipids, free fatty acids, mono- and diacylglycerols, thermally oxidized compounds, and antioxidants. Many efforts have been made to improve the oxidative stabilities of oils by systematic studies on the effects of these factors [8]. Autoxidation of oils, free radical chain reaction, includes initiation, propagation, and termination steps:



3. Experimental details

3.1 Materials and procedure

In this experiment, refined soybean oil (star oils) was taken in two conical flasks. In both the flask 500 ml of refined soybean oil was taken, named as A and B. the flask A was stored in atmosphere (same as oil is stored in storage tanks in industries) and flask B was stored to vacuum. Peroxide value of oil was determined every 5 days.

3.2 Determination of peroxide value.

Weigh 5 gram sample in conical flask + 30 ml reagent acetic acid chloroform solution +0.5 ml saturated KI solution shake for few min + 30 ml Distilled Water + indicator starch , titrate with 0.01 N Na₂S₂O₃ solution.

End point:- Violet to Colorless.

$$PV = \frac{BR \times N \text{ of } 0.01 \text{ N Na}_2\text{S}_2\text{O}_3 \times 1000}{Wt \text{ of sample}}$$

3.3 Parameter and specifications

Following are the parameters and specifications for refined soybean oil.

Parameters	Specifications	A	B
Physical Appearance	Clear and Free from Suspended Matter and Separated Water	Clear	Clear
Odour	Bland	Bland	Bland
Colour I' Cell	Max 3 unit	1.8 unit	1.8 units
Refractive Index at 40 ⁰ C	1.4649-1.4710	1.4670	1.4650
Free Fatty Acid	Max 0.10	0.01562	0.1577
MIV%	Max 0.1	0.0091	0.0092
Iodine Value	120-141	131.375	129.53
Saponification Value	189-195	192.58	192.58
Unsaponifiable Value	Max 1.5	0.84	0.84
Acid value	Max 0.2	0.142	0.142
Phosphorous	-	194.72 ppm	194.72

Table1.1: Parameters and specifications of two samples.

Where,

A= Oil stored at atmosphere

B= Oil stored at vacuum

3.4 Observation and graph

Following are the observation table of our experiment.

Period	A	B
0	1.3065	1.3065
5	1.9094	1.5086
10	2.7846	1.8752
15	3.9091	2.3810
20	4.7771	3.2135
25	6.0091	4.5712
30	6.9281	5.3218

Table1.2: Peroxide values of both the samples.

Where,

A= Oil stored at atmosphere

B= Oil stored at vacuum

Following are the graph of the above table.

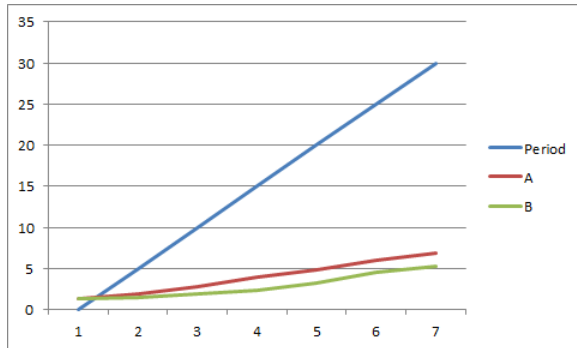


Fig1: Graph of peroxide values of our experiment.

Where,

A= Oil stored at atmosphere

B= Oil stored at vacuum

4. Conclusion

As the air is not present in flask B, the oxidation reaction is slower, but in flask A, it was exposed to atmosphere oxidation reaction was at faster rate. From the above experiment, it is clear that oil which was kept at vacuum (B) has undergone less oxidation reaction as compared to oil which was kept at atmosphere (A).

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