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Studies on the Effect of Antioxidants on the Stability of Sesame (*Sesame indicum* linn.) Seed Oil During Storage

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Abstract

The oil extracted from sesame seed kernel was stored in white plastic containers using different antioxidants like Butyl hydroxy anisole-BHA, Butyl hydroxy toluene-BHT and propyl gallate-PG at various percentages (0.01-0.05%) at room temperature for 12 months. The results were evaluated after 2-months in terms of free fatty acid (FFA), iodine value and peroxide value. It was observed that the rate of increase in free fatty acid (FFA), was appreciably lower in all the three oils stored with 0.02% BHA, BHT and PG than those of the oils containing other percentages of 0.01, 0.03, 0.04 and 0.05 of antioxidants. Among these three oils of sesame (0.02%) percentages of antioxidants, the rate of increase in free fatty acid (FFA) of the oil containing 0.02% of BHA was found to be the lowest (0.1372). The iodine values of the oils were not influenced by any antioxidants of any percentages. But the rate of increase in peroxide value of the oil containing 0.02% of BHA was also found to be significantly lower. Most significant differences in storage lives was observed in the stored oil containing 0.02% of BHA.

Keynotes: Antioxidant, Free fatty acid, Iodine value, Peroxide value. Storage life, Fat-oxidant.

Introduction

Sesame (*Sesame indicum* linn.) is one of the most important oil seed crops in Bangladesh. It occupies the second position among the oil seeds in respect of both acreage and production after mustard seed. Sesame is cultivated widely more or less in all the districts of Bangladesh. The climate and soil-texture of Bangladesh are quite suitable for its cultivation. Its seed contains 42-45% pale-yellow

coloured edible oil. The oil possesses a high degree of resistance to oxidative rancidity (Anon 1972). The bulk of the oil is utilized for edible purposes (Mowlah *et al* 1990). The oil is consumed largely as cooking, salad and also employed in sweetmeat making and in adulteration of ghee (Mattil *et al* 1964, Watt 1972). The oil is a high quality oil and is used in cooking fats, margarine and

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salad oils (Egan *et al* 1981). The oil is also used largely as an edible oil, table oils in salad dressing (Anon 1950).

The oil is used as shortening, salad and margarine (Gesses *et al* 1972). The oil is also used in the manufacture of soap, cosmetics, perfumes and pharmaceuticals products (Ninan 1989). At present Bangladesh is facing acute shortage of edible oils and she is compelled to import edible oils from abroad (Ali *et al* 1997). So sesame oil can play a vital role in bridging the vegetable oil gap in the country.

Though the oil is one of the chief sources of vegetable oil, yet the oil is not so popular in our country. There may be two reasons behind it, firstly, most of the people of our country are quite ignorant about the quality of the oil and secondly, the oils are not properly stored due to the lack of appropriate knowledge for which the oils lose their commercial gradation to a great extent.

The storage lives of the oil can be increased by using certain antioxidants. For the selection of the antioxidants the following important points must be taken into account. The antioxidants must have adequate potency, contribute no off-flavour or odours to the products in which they are used and the economically attractive when compared to other methods for inhibiting fat oxidant such as vacuum packaging, low-temperature, storage and others. The antioxidant formulation most commonly used in edible products contain

various percentages of BHA, BHT and propyl gallate. There are some other antioxidants like octyl gallate dodecyl gallate, tocopherols, which lack potency in most products compared to BHA, BHT and propyl gallate. There are also several sulphur-containing compounds such as thiodipropionate but their relative in effectiveness producing some off odour and flavour problems have been discouraged their use in food products.

Considering all the factors described above, we have used certain percentages of BHA, BHT and propyl gallate in our storage studies. Generally the quality of an oil is mainly characterized by the level of free fatty acids (FFA), peroxide value and iodine value. So in our studies we keenly observed the changes of these factors by using the antioxidant as oil stabilizers for preserving better oil quality.

Materials and Methods

Fresh and matured sesame seeds were collected from the local market. The seeds were then shelled manually and the kernels thus obtained were crushed into smaller particles in a glass mortar and dried in the sun for 2 consecutive days and then in the oven at a temperature of 105 °C for about ½ an hour to about 4-6% moisture. The moisture content in the fresh kernels was determined by IUPAC method (Anon 1979). The oil was then extracted with n-hexane in a Soxhlet apparatus for 8 hours because cold pressed oil shows less storage stability than corre-

sponding solvent extracted oil (Pominski *et al* 1970). The oil was recovered by the evaporation of the solvent under reduced pressure using a rotary vacuum evaporator. The oil thus obtained was then packed in twenty-six oz white plastic containers with different percentages (0.01-0.05) of antioxidants and then kept on a laboratory bench at room temperature exposed to light.

The percentage of free fatty acid (FFA) and peroxide value of the oils were determined by the standard AOCS method (Anon 1955). Hanus method was followed to determine the iodine value of the oils (Anon 1980). Storage lives of the oils were determined on the basis of organoleptic tests (Prasad *et al* 1959).

Results and Discussion

The changes in free fatty acid (FFA) of the sesame seed oil stored by using different percentages of antioxidants was represented in Table I. From Table I, it was found that the rate of increase in free fatty acid (FFA) of the oil stored with 0.02% of BHA remained low throughout the whole period of storage. Slight increase in free fatty acid (FFA) was noticed in the oils stored with other percentages of BHA 0.01, 0.03, 0.04 and 0.01, 0.02, 0.03 percentages of BHT. But the rate of increase in FFA was higher in all the samples containing propyl gallate of all percentages.

The changes of iodine values of the oils stored by using different percentages of antioxidants were shown in Table II. From the table it was observed that the iodine values were not influenced by any antioxidants.

The changes in peroxide values of the oils were depicted in Table III. It was noticed that the rate of increase in peroxide values were significantly lower when it was stored with 0.02% BHA. but the values were found to be higher in all other sample of BHA excepting the oil containing 0.02% of the same antioxidant. Higher peroxide values (7.4-8.9) were also found in all the samples containing PG of all percentages. But these values are slightly lower than those of the oils containing BHT of all percentages. The highest peroxide value (8.9) was attended by the oil stored with 0.05% of PG.

The storage lives of the oils was recorded in Table IV. It was observed that the differences in the storage lives of the oil stored with 0.02% of BHA were most significant. The oil stored with 0.01, 0.03, 0.04, 0.05% of BHA and 0.01, 0.02, 0.03 of BHT did not differ significantly from one another in respect of their storage lives. But the storage lives of the oils were not influenced by PG of any percentages.

Table I. Changes in FFA of sesame seed oil stored at room temperature.

Antioxidant (%)	Storage time in months						Rate of increase in FFA	Difference in rate of increase in FFA with respect to blank container	Remarks
	At start	2 months	4 months	6 months	8 months	10 months			
Blank									
--	1.1002	1.4050	1.7252	2.3584	3.1855	4.1957	5.2202	0.6866	--
BHA									
0.01	1.1002	1.3220	1.5866	2.1568	2.4506	2.8525	3.2425	0.3570	Less significant
0.02	1.1002	1.0675	1.0880	1.2025	1.3252	1.4941	1.8580	0.1372	Most significant
0.03	1.1002	1.1586	1.4225	1.9220	2.3528	2.7521	3.1552	0.3425	Significant
0.04	1.1002	1.1202	1.4730	1.9620	2.4895	2.8200	3.2012	0.3501	Less significant
0.05	1.1002	1.2008	1.5020	2.0905	2.5220	2.8624	3.2815	0.3635	Less significant
BHT									
0.01	1.1002	1.1225	1.2852	1.7526	2.0125	2.4528	3.2029	0.3668	Less significant
0.02	1.1002	1.0920	1.2035	1.5505	1.9820	2.4025	2.9528	0.3251	Less significant
0.03	1.1002	1.1025	1.3952	1.8024	2.4022	2.8115	3.3015	0.3665	Less significant
0.04	1.1002	1.1442	1.5021	2.1020	2.6118	3.1028	3.7810	0.4931	Not significant
0.05	1.1002	1.3515	1.9563	2.4650	2.9820	3.4038	3.8535	0.4752	Not significant
PG									
0.01	1.1002	1.2512	1.8510	2.2840	2.8728	3.2829	3.6987	0.4494	Not significant
0.02	1.1002	1.1500	1.6530	2.1005	2.5015	3.0020	3.4055	0.4000	Not significant
0.03	1.1002	1.3535	1.8525	2.3445	2.8210	3.4015	3.9050	0.4674	Not significant
0.04	1.1002	1.5625	2.0622	2.4550	2.9525	3.5020	4.1040	0.5006	Not significant
0.05	1.1002	1.6522	2.1625	2.6232	3.1516	3.7025	4.3025	0.5337	Not significant

Table II. Changes in Iodine value of sesame seed oil stored at room temperature.

Antioxidant (%)	Storage time in months						Rate of increase in iodine value	Difference in rate of increase in FFA with respect to blank container	Remarks
	At start	2 months	4 months	6 months	8 months	10 months			
Blank									
--	112.0	115.2	115.4	115.7	115.9	116.1	116.2	--	--
BHA									
0.01	112.0	115.2	115.3	115.2	115.1	115.2	115.2	-0.167 (0.01-B)	Not significant
0.02	112.0	115.0	115.2	115.3	115.2	115.3	115.3	-0.150 (0.02-B)	Not significant
0.03	112.0	115.1	115.3	115.4	115.4	115.3	115.5	-0.117 (0.03-B)	Not significant
0.04	112.0	115.1	115.2	115.2	115.3	115.3	115.4	-0.153 (0.04-B)	Not significant
0.05	115.0	115.2	115.2	115.3	115.4	115.5	115.5	-0.117 (0.05-B)	Not significant
BHT									
0.01	115.0	115.2	115.4	115.3	115.5	115.4	115.7	-0.100 (0.01-B)	Not significant
0.02	115.0	115.1	115.2	115.2	115.3	115.4	115.5	-0.117 (0.02-B)	Not significant
0.03	115.0	115.1	115.2	115.4	115.5	115.4	115.4	-0.153 (0.03-B)	Not significant
0.04	115.0	115.2	115.3	115.4	115.5	115.5	115.7	-0.100 (0.04-B)	Not significant
0.05	115.0	115.3	115.4	115.3	115.5	115.7	115.6	-0.117 (0.05-B)	Not significant
PG									
0.01	115.0	115.2	115.4	115.3	115.5	115.7	115.8	-0.100 (0.01-B)	Not significant
0.02	115.0	115.3	115.4	115.7	115.8	115.7	115.4	-0.153 (0.02-B)	Not significant
0.03	115.0	115.3	115.5	115.7	115.4	115.5	115.7	-0.100 (0.03-B)	Not significant
0.04	115.0	115.4	115.4	115.7	115.7	115.8	115.5	-0.117 (0.04-B)	Not significant
0.05	115.0	115.3	115.5	115.7	115.9	115.5	115.5	-0.117 (0.05-B)	Not significant

Table III. Changes in Peroxide value of sesame seed oil stored at room temperature.

Antioxidant (%)	Storage time in months						Rate of increase in peroxide value	Difference in rate of increase in FFA with respect to blank container	Remarks
	At start	2 months	4 months	6 months	8 months	10 months			
Blank									
--	1.2	2.7	3.7	4.8	5.7	6.8	9.4	--	--
BHA									
0.01	1.2	1.7	2.3	2.9	.8	5.5	6.6	-0.458 (B-0.01)	Significant
0.02	1.2	1.4	1.6	1.9	2.1	2.4	3.0	-1.056 (B-0.02)	Most significant
0.03	1.2	1.8	2.7	3.5	4.5	5.4	6.9	-0.410 (B-0.03)	Significant
0.04	1.2	2.0	2.9	3.7	5.2	6.6	7.5	-0.308 (B-0.04)	Less significant
0.05	1.2	1.9	3.0	3.8	5.5	7.2	8.2	-0.197 (B-0.05)	Not significant
BHT									
0.01	1.2	1.7	2.6	3.5	4.6	6.5	7.6	-0.299 (B-0.01)	Less significant
0.02	1.2	1.5	1.9	2.5	3.4	5.2	6.5	-0.480 (B-0.02)	Significant
0.03	1.2	1.9	3.1	4.0	5.0	7.3	7.8	-0.250 (B-0.03)	Not significant
0.04	1.2	1.7	2.9	4.1	5.2	6.4	7.8	-0.248 (B-0.04)	Not significant
0.05	1.2	1.8	3.0	4.3	5.3	6.5	8.0	-0.227 (B-0.05)	Not significant
PG	PG	PG	PG	PG	PG	PG	PG	PG	PG
0.01	1.2	1.8	3.2	4.1	5.2	6.7	7.8	-0.248 (B-0.01)	Not significant
0.02	1.2	2.0	2.9	3.7	5.2	6.4	7.4	-0.327 (B-0.02)	Less significant
0.03	1.2	2.2	3.2	4.3	5.5	6.8	8.2	-0.190 (B-0.03)	Not significant
0.04	1.2	2.4	3.6	4.8	6.2	7.7	8.7	-0.110 (B-0.04)	Not significant
0.05	1.2	2.6	3.8	5.8	6.8	7.9	8.9	-0.077 (B-0.05)	Not significant

Table IV. Storage lives of sesame seed oil (storage lives determined on the basis of organoleptic test)

Antioxidant (%)	Mean storage life in month	Difference in storage life with respect to blank container	Remarks
Blank			
	7.5	--	--
BHA			
0.01	8.5	1.0 (0.01-B)	Less significant
0.02	11.0	3.5 (0.02-B)	Most significant
0.03	9.0	1.5 (0.03-B)	Significant
0.04	9.0	1.6 (0.04-B)	Significant
0.05	8.5	1.0 (0.05-B)	Less significant
BHT			
0.01	8.5	1.0 (0.01-B)	Less significant
0.02	9.2	1.7 (0.02-B)	Significant
0.03	9.0	1.5 (0.03-B)	Significant
0.04	8.4	0.9 (0.04-B)	Not significant
0.05	8.3	0.8 (0.05-B)	
PG			
0.01	8.4	0.9 (0.01-B)	Not significant
0.02	8.3	0.8 (0.02-B)	Not significant
0.03	7.9	0.4 (0.03-B)	Not significant
0.04	7.9	0.4 (0.04-B)	Not significant
0.05	8.0	0.5 (0.05-B)	Not significant

Conclusion

Sesame seed is one of the chief sources of vegetable oil. As Bangladesh is facing acute shortage of edible oils, so it can bridge the vegetable oil gap in the country if proper step can be taken regarding its storage lives. Increasing of storage lives of an oil is necessary for its long time preservation. To find out the required percentages of a certain

antioxidant for the preservation of any oil is very essential. For increasing storage lives of sesame seed oil certain antioxidant may be used. In our experiment we observed that the development of rancidity was least when the oil was stored with 0.02% of BHA. So, it is suggested that sesame oils should be stored with 0.02% of BHA for preservation to keep better quality of oil.

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