Asian Journal of Biological and Life Sciences | Original Research

Effect of physico-chemical changes in Sesame (*Sesamum indicum* L.) Seeds due to Storage

Chitra Bhattacharya[1]*, Bhawana Pandey[1], Seema Paroha[2]

1 Bhilai Mahila Mahavidyalaya, Hospital Sector, Bhilai (C.G.)
2 Project Coordination unit, All India Coordination Project, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.), India.

Submitted : 06.09.2013 Accepted : 07.10.2013 Published : 31.12.2013

Abstract

Sesamum is widely spread world and is cultivated for its edible seed and oil. It was made to determine the differences in physicochemical properties of Sesame varieties with different seed coat colours viz white, black, and brown and to assess the possible physicochemical changes after one year of storage. Some of the important physicochemical characters were taken in the present study viz. specific gravity, refractive index, free fatty acid, iodine value, saponification value, unsaponificable matter and peroxide values. These varieties exhibited the same pattern after one year of storage with an increase of 1.38%, in white, 2.10% in brown and 2.50% in black seeded sesame, Iodine value is a useful parameter in studying oxidative rancidity of oils since higher the unsaturation remained almost unchanged after one year of storage in all the three varieties. Saponification value of oils obtained from the fresh harvest samples ranged from 194 to 172 highest was found in black variety and while lowest was found in white variety. But the saponification value increased in stored sample by 9.8% in white 8.2% in black and 5.2% in brown seeded variety, contained in unsaponificable matter have antioxidant is decreases and Peroxide value increased considerably after one year of storage. These data indicates that the physicochemical characteristics of sesame seed reduces after one year storage.

INTRODUCTION

Sesame (***Sesamum indicum***), (common name Til) is a flowering plant in the genus *Sesamum*. It is widely spread over tropical region around the world and is cultivated for its edible seed and oil. With about 70% of the world's sesame seeds processed into oil and meal.[11] It cultivate extensively from tropical to temperate regions of the world, sesame seed contain on an average 2030% of protein and 50% of oil, rich in unsaturated fat.[13] The most abundant fatty acids in sesame oil are oleic acid (41 45%) and linoleic acid (37 42%).[10] The edible oils are concentrated source of energy, which act as vehicle for important vitamins and provide essential fatty acids. Fatty acid composition of 165 varieties of different oil seed from various countries was analyzed. High quantities of unsaponifiable matter (1.4-2.5%) present in the sesame oil. Sesamol a phenolic antioxidant is formed from sesamolin under certain processing conditions and gives an excellent protection to oil against rancidity.

MATERIAL AND METHODS

Experimental Site, Material & Techniques: The present investigation was carried out at biochemistry laboratory of Project Coordination unit, All India Coordination Project (Sesame and Niger), Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P). Sesame varieties each of three different seed coat colour viz, white, brown and black were harvested during year 2009 as well as these samples were used for some physicochemical parameter to predict the role of change of seed deterioration. The sesame varieties selected as study material were as per details given, White seed (PunjabTil-1), Brown seed (RT-54) and Black seeded (Thiliothama) variety.

Specific gravity: The specific gravity (SG) of the extracted oil was determined by the ratio of the mass of the specific volume in pycnometer to mass of an equal volume of water, at the temperatures of 40 ºC in water bath. [12] The formula used to calculate the SG was,

$$SG_t = \frac{c - a}{b - a} \times D_0$$

Where, **a** (empty pycnometer), **b** (mass of filled pycnometer), **c** (mass of oil filled pycnometer), D_0 (density of water (0.9922g/ml).

Refractive index 28ºC: The refractive index of oil sample was determined using Abbe's Refractometer, sample chamber was calibrated with a drop of water, after which a drop of the sample was added into the sample chamber and closed. The adjustment knob was turned until the light and dark field crossed the cross bar then readings were taken. [14]

Estimation of Free Fatty Acids in Plant Sample: By this method, low (0.0-0.25), medium (0.26-0.99), and high (1.0 and above) FFA levels in fatty oils may be distinguished. Quantitative method is determining the FFA contents of oils and fats by titration against standard alkali solution in the presence of phenolphthalein indicators**.** 1 ml oil with 20 ml neutral solution of 95% ethanol was boiled and titrated with 0.1N alkali (KOH, NAOH) in the presence of phenolphthalein indicator. The titrate value recorded and FFA (%) calculated using the following formula. [03]

$$\text{FFA \%} = \frac{2.303 \times \text{N of KOH} \times \text{Titrate value (ml)}}{\text{Weight of oil sample (g)}}$$

Determination of Iodine Value of Oil: Estimation of iodine value form sesame oil were done through titration method by

using 0.1N sodium thiosulphate solution until yellow solution turns almost colourless. [19]

$$\text{Iodine number} = \frac{(B - S) \times N \times 12.69}{\text{(g) sample}}$$

Where, **B** (blank), **S** (thiosulphate sample), **N** (normality)

Saponification Value: Saphonification value of sample was determined by using alcoholic KOH (form blank by taken 50ml of alcoholic KOH) and connect air condenser, boil the flasks for 1 hrs, then after cooling the flasks, add 1ml of indicator and titrate against 0.5N HCl until the pink colour just disappears.[19]

$$\text{S. value} = \frac{28.05 \times (\text{titre value of blank} - \text{titre value of sample})}{\text{Weight of sample (g)}}$$

Determination of Peroxide Value: Oxidative oxygen was taken up by the fat with the formation of peroxides. The degree of peroxide formation and the time taken for the development of rancidity differs among oils by using titration method.[19]

$$\text{Peroxide value} = \frac{S \times N \times 100}{\text{(g) Sample}}$$

Where, **S** (ml $Na_2S_2O_3$-Test-Blank), **N** (normality of $Na_2S_2O_3$)

Unsaponificable matter : To determine the unsaponificable matter (USM), the oil sample was saponified with alcoholic potassium hydroxide 0.5 M, the USM was extracted into diethyl ether in a separating funnel, the solvent was evaporated and the USM dried in oven at 105ºC and weighed to calculate the percentage of USM using following formula. [12]

$$\% \text{ UNS} = \frac{P}{M} \times 100$$

Where, **P** (mass of the extracted USM in gm), **M** (mass of the oil sample saponified)

Statistical Analysis by Mean: The data recorded for quality characters were subjected to the following analysis. Mean is calculated by the following formula: $\mathbf{X} = \sum \mathbf{Xi} / \mathbf{n}$ Where, $\sum \mathbf{Xi}$ (Summation of all the observations), **n** (Total number of observations).

RESULT

The experimental results of the present investigation have been presented under the following heads.

Specific Gravity: Specific gravity of sample was decreased after one year storage.

Free Fatty Acid Content: Free Fatty Acid value increased considerably after one year of storage [black seed colour variety (1.9%-2.50%) followed by brown (1.3% -2.10) and white (1.1% - 1.38)] (Fig 1).

Iodine Value: Iodine value remained decreased after one year of storage in all the three varieties.

Peroxide Value: Peroxide value increased after one year of storage by (white 1.22 to 3.20, black 1.27 to 3.97and brown 1.18 to 4.10) (Fig 3).

Refractive index 28º C: After one year storage of three varieties of sesame seeds value was almost unchanged.

Unsaponificable Matter: Unsaponificable value was almost unchanged after one year storage (black, brown, white seed).

Saponification Value: Saponification value of sample increased in stored sample by 9.8% in white 8.2% in black and 5.2% in brown seeded variety (Fig 2).

DISCUSSION

The aim of this investigation was to determine the differences in physicochemical properties of Sesame varieties with different seed coat colours *viz* white, black and brown and to assess the possible physicochemical changes after one year of storage. Mean Performance for Different physicochemical Traits.

Specific Gravity: Oil of white seeded variety (0.920) exhibited highest specific gravity were as lowest was recorded by brown seeded (0.908). Some authors have stated that the specific gravity suitable for edible oils range from 0.8800 to 0.9400 [17] and for oils used for fuel from 0.8200 to 1.0800 at 15.6°C. [5] For fuel,

Table 1. Effect of storage for one year on physico-chemical characters of sesame varieties with different seed coat colours

S. No.	Parameter	2009 Sesame seed coat colours			2010 Sesame seed coat colours		
		White	Black	Brown	White	Black	Brown
1.	Specific gravity 28º C	0.92	0.916	0.908	0.913	0.915	0.962
2.	Refractive index 28º C	1.469	1.453	1.448	1.478	1.449	1.403
3.	Free Fatty acid content (%)	1.10	1.90	1.30	1.38	2.50	2.10
4.	Iodine value (g/100 g oil)	120	107	115	107	102	100
5.	Saponification Value (mg/100 g oil)	172	194	189	192	210	200
6.	Unsaponificable matter (%)	2.0	1.5	1.2	1.8	1.2	0.90
7.	Peroxide value (m.eqv.kg)	1.22	1.27	1.18	3.20	3.97	4.10

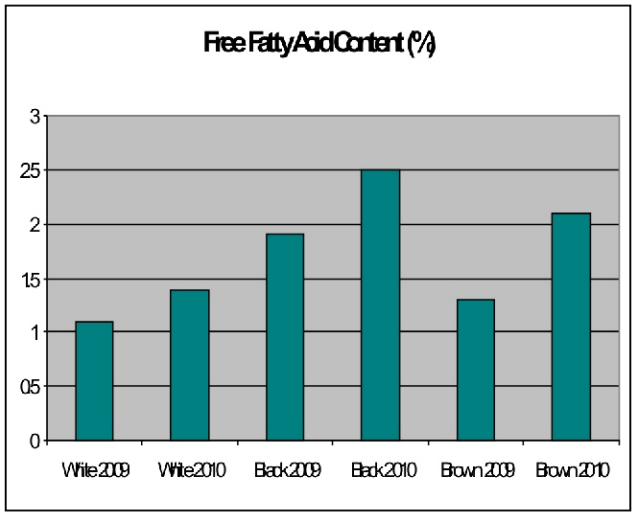

Fig 1. Free Fatty Acid content in fresh (2009) and stored samples (2010) of varieties with different seed coat colours.

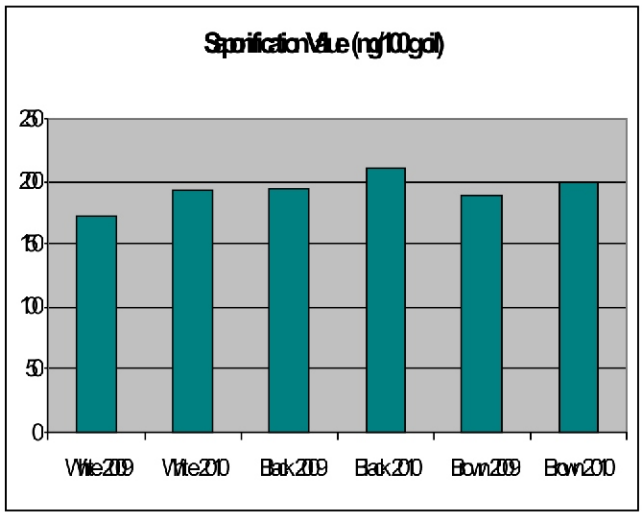

Fig 2. Saponification value in fresh (2009) and stored samples (2010) of varieties with different seed coat colours.

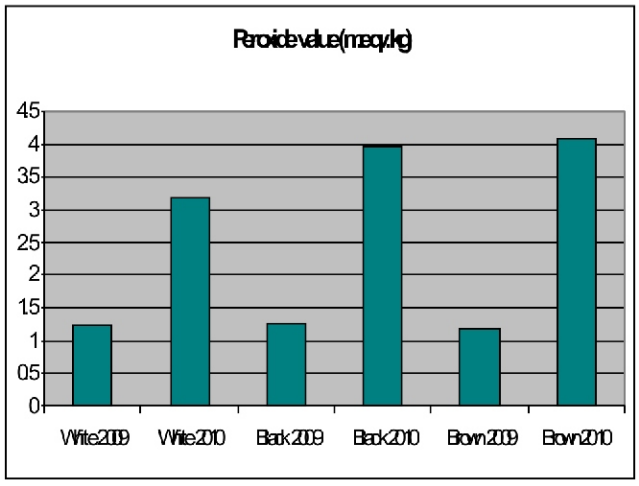

Fig 3. Peroxide value in fresh (2009) and stored samples (2010) of varieties with different seed coat colours.

oils that are denser contain more energy.

Free Fatty Acid Content: Free Fatty Acid value increased considerably after one year of storage [black seed colour variety (1.9% -2.50%) followed by brown (1.3% -2.10) and white (1.1% - 1.38)].[18] These processes cause enzyme inactivation i.e. denaturation of protein and nucleic acids.[16] Damage of seed during storage is inevitable and decrease of quality greatly depends on temperature and relative air humidity in storage, seed moisture content, duration of storage, type of seed and initial quality of seed.[7]

Iodine Value: Iodine value is a measure of the degree of unsaturation in oil. Iodine value is a useful parameter in studying oxidative rancidity of oils since higher the unsaturation the greater the possibility of the oils to go rancid. Iodine value remained decreased after one year of storage in all the three varieties.

Saponification Value: Many edible oils have saponification values between 193 and 200[15] and high saponification value (around 300) are useful for soap making.[1] In the current harvest samples saponification value ranged from 194 to 172 highest was found in black variety and while lowest was found in white variety. But the saponification value increased in stored sample by 9.8% in white 8.2% in black and 5.2% in brown seeded variety.

Unsaponificable Matter: These minor substances of the oil contained in unsaponifiable matter have antioxidant[9] and other health benefits in animals and in human subjects and useful in softening the skin.[8] Sesame oils have high unsaponifiable fractions and from this they are known in cosmetics as having efficacy on dry and damaged skins.[2, 6]

Peroxide Value: Peroxide value increased considerably after one year of storage by (white 1.22 to 3.20, black 1.27 to 3.97and brown 1.18 to 4.10). Rancidity is brought about by the action of air (oxidative rancidity). In oxidative rancidity oxygen is taken up by the fat with formation of peroxides. The degree of peroxide formation and the time taken for the development of rancidity differ among oils.

CONCLUSION

The aim of this investigation was to determine the differences in physicochemical properties of Sesame varieties with different seed coat colours *viz* white, black and brown and to assess the possible physicochemical changes after one year of storage. The fresh harvest during the year 2009 was evaluated for various physicochemical traits. The same samples were stored for one year and were again evaluated for same biochemical parameters to predict the rate of seed deterioration during storage in one year. It is evident from the results that the maximum FFA content was found in black seed colour variety followed by brown and white (1.1%) in the fresh samples. These varieties exhibited the same pattern after one year of storage with an increase of 1.38%, in white, 2.10% in brown and 2.50% in black seeded sesame. Moisture content, Specific gravity, Refractive index and Iodine value remained almost unchanged after one year of storage in all the three varieties. Saponification Value increased in stored sample by 9.8% in white 8.2% in black and 5.2% in brown seeded variety. Peroxide value increased considerably after one year of storage in white from 1.22 to 3.20, black from1.27 to 3.97 and in brown from 1.18 to 4.10.

ACKNOWLEDGEMENTS

I would like to thank the Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur, (M.P.). I would like to thank Dr. Seema Paroha, Scientist Biochemistry, Project Coordination unit, All India Coordination Project (Sesame and Niger), JNKVV, Jabalpur (M.P.) and Dr. Anjana Sharma, Dean faculty of Rani DurgavatiVishwavidyalaya.

REFERENCES

1. Alabi D A. *Parkia biglobosa,* an endangered species. International Conference proceedings on lost crops and Trees in Africa. Res. 1993: 3: 262-285.

2. Alvarez A M R, Rodríguez M L G. Lipids in pharmaceutical and cosmetic preparations. *Grasasy Aceites.* Res. 2000: 51(1-2): 74-96.

3. AOCS. In R. E. Walker, Official methods and recommended practices of the American Oil Chemists Society. Res.1989.

4. Cox H E, & Pearson D. Determination of Peroxide Value. Analysis of Foods Chemical publishing Co Inc New York. Res. 1962: 421.

5. C S G. Specific gravity and viscosity of liquids. Computer Support Group, Inc.and

6. CSG Network.com. Online, www.csgnetwork.com Html. Res. 2008.

7. Dhellot J R, Matouba E, Maloumbi M G, Nzikou J M. Extraction chemical composition and nutritional characters of vegetable oils: Case of *Amaranthus hybridus* of Congo Brazzaville. Afr. J. Biotechnol. Res. 2006: 5(11):1095-1101.

8. Elius S G & Copeland L O. The effect of storage conditions on canola *(Brasica napus L.)* seed quality. J. of Seed Technol. Res. 1994: 18: 21-22.

9. Goreja W G, Shea Butter. The nourishing properties of Africa's best-kept natural beauty secrets. TNC International Inc. Res. 2004.

10. Gunstone F D, Hersl of B G, Eneh F U, Ozumba A N, Igwo-Ezikpe M N. Physico-chemical and Antioxidant Properties of *Moringa oleifera* Seed Oil Pakistan Journal of Nutrition. Res. 2000: 10(5): 409-414.

11. Kang M H, M K, Bang J K, Kim D H, Kang C H, Lee B H. Varietal difference of lignan contents and fatty acids composition in Korean sesame cultivars. Korean J. Crop Sci. Res. 2000: 45(3): 203206.

12. Kang M H, Choi J S, Ha T Y, Chemical properties of sesame seed cultivated in Korea and China. Food Sci. Biotechnol. Res. 2003: 12(6): 621624.

13. Kazadi, Minzangi, Archileo N, Kaaya, Frank, Kansiime & Bashwira, Samvura. Oil content and physicochemical characters of some wild oilseed plants from Kivu region of Congo. African Journal of Biotechnology.Res.2011:10(2):189-195.

14. Mohammed N, Alyemeni A Y, Basahy & Hassan Sher. Physico-chemical analysis and mineral composition of some sesame seeds (*Sesamum indicum* L.) grown in the Gizan area of Saudi Arabia Journal of Medicinal Plants Research. Res. 2011: 5(2): 270-274.

15. Ogbunugafor H A, Enehl F U, Ozumba A N, Igwo-Ezikpe, M N. Physico-chemical and Antioxidant Properties of *Moringa oleifera* Seed Oil Pakistan Journal of Nutrition. Res. 2011: 10(5): 409-414.

16. Pearson D, Churchill Livingstone, Edinburgh. The Chemical Analysis of Foods. 7th Edn., U.K. Res. 1981: 488-496.

17. Reuzeau C, Goffner D & Cavalt G. Relations between protein composition and germination capacity of sunflower seeds. Seed Science. Res.1992: 2: 223-230.

18. ToolBox. Specific gravities for some common fluids and liquids as acetone, alcohol, turpentine, oil and more. Engineering toolbox. com, online,www.engineeringtoolbox.com/specific-gravityliquid-fluids d_294.html (2005).

19. Trawatha S E, TeKrony D M & Hildebrand D F. Relationships on soybean quality to fatty acid and C_6 aldehyde levels during storage. Crop Sci. Res.1995: 35: 1415-1422.

20. William & Horowiz, (ed). Determination of Iodine Value of Oil: Official methods of Analysis of AOAC Association of Official Analytical Chemists Washington 12th Ed 1975: 488.