Available online at www.sciencedirect.com

ScienceDirect

Procedia Food Science 6 (2016) 204 – 207

Procedia Food Science

International Conference of Sabaragamuwa University of Sri Lanka 2015 (ICSUSL 2015)

Comparison of oxidative stability of sesame (*Sesamum indicum*), soybean (*Glycine max*) and mahua (mee) (*Madhuca longifolia*) oils against photo-oxidation and autoxidation

WKUS Walallawita[a], D Bopitiya[b], S Sivakanthan[c], NWIA Jayawardana[d], T Madhujith[e]*

[a]*Department of Applied Nutrition, Wayamba University of Sri Lanka, Kuliyapitiya, 60200, Sri Lanka*
[b]*Industrial Technology Institute, Colombo 00700, Sri Lanka,*
[c]*Department of Agricultural Chemistry, Faculty of Agriculture, University of Jaffna, Jaffna 40000, Sri Lanka.*
[d]*Department of Agricultural Systems, Faculty of Agriculture, Rajarata University of Sri Lanka, Puliyankulama 50000, Sri Lanka*
[e]*Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Peradeniya 20400, Sri Lanka.*

Abstract

Lipid oxidation is one of the major causes of food spoilage. This study was conducted to evaluate and compare the oxidative stability of sesame (*Sesamum indicum*), soybean (*Glycine max*) and mahua (*Madhuca longifolia*) against photooxidation and autoxidation. Stability of oils against photo-oxidation and autoxidation was determined by exposing the oils to florescent light over 28 days and storing the oils at an elevated temperature (60 °C) for 28 days, respectively. The level of oxidation was determined by measuring peroxide value (PV), thiobarbituric acid reactive substances (TBARS), conjugated dienes (CD) and conjugated trienes (CT). Sesame oil exhibited the strongest oxidative stability against both photo-oxidation and autoxidation while Mahua oil exhibited the least stability highest both photo-oxidation and autoxidation as measured by primary oxidative products. However, Mahua oil showed the strongest stability against both photo-oxidation and autoxidation as measured by secondary oxidative products. In conclusion, higher oxidative stability was shown by the Mahua oil than sesame and soybean oils for photooxidation and autoxidation.

* Corresponding author. Tel.: +94 713412171
E-mail address::madujith@yahoo.com

Peer-review under responsibility of International Conference of Sabaragamuwa University of Sri Lanka 2015 (ICSUSL 2015).
doi:10.1016/j.profoo.2016.02.050

Peer-review under responsibility of International Conference of Sabaragamuwa University of Sri Lanka 2015 (ICSUSL 2015).

Keywords: Oxidative stability; autoxidation; photo-oxidation; sesame oil; Mahua oil

1. Main text

1. Introduction

Quality and stability of edible oils influence its acceptability and suitability for consumption. Stability of oils against oxidation is an important indicator of the quality and shelf life of edible oils. Lipid oxidation involves a succession of chemical reactions leading to the production of low molecular weight off flavor compounds leading to loss of consumer appeal, nutritional quality and safety. During processing and storage, edible oils undergo autoxidation or phto-oxidation depending on the type of environmental conditions that they are exposed to and more importantly the type of oxygen present. Triplet oxygen induces autoxidation while singlet oxygen induces photo-oxidation. Oxidation leads to generation of a wide array of undesirable compounds some of which are detrimental to health[1].

Mahua oil which has been used for culinary purposes in Sri Lanka many a decade ago currently remains as an underutilized oil. It is extracted from seeds of *Madhuca longifolia.* Oil is pale yellow in color with a plastic consistency. Mahua oil has very high medicinal value thus it is used in traditional medicine such as Ayurvedic medicine. Currently, it is also used for manufacturing laundry soaps and detergents. It is used as cooking oil in various tribal region of India and also used in the manufacture of Vanaspati[2]. Sesame (*Sesamum indicum*) oil rich in monounsaturated fatty acids is considered to be a healthy oil. It is resistant to oxidative deterioration compared to most other plant oils and is important due to its medicinal effects. Sesame oil contains lignans which act as antioxidants[3]. Soybean (*Glycine max*) oil extracted from soybean oil is rich in polyunsaturated fatty acid (PUFA) and as result highly susceptible for oxidation[4].

The studies on oxidative stability of mahua oil as edible oil is very much limited. Therefore, the aim of this study was to compare the oxidative stability of mahua oil with another two edible oils with relatively high content of unsaturated fatty acids namely sesame and soybean oils. This study could help to make a comparison among three oils for their suitability for processing such a deep frying.

Materials and Methods

Sesame, soybean and mahua oil were obtained from local market in Sri Lanka. The stability of these oils against autoxidation was evaluated using the Schaal oven test[5]. Briefly, thoroughly mixed oil samples (50 mL) were placed in 5 mL open glass vials and stored in a Schaal oven maintained at 60 °C for 28 days. The oil samples were drawn on day 1, 3,5,7,14,21 and 28. The stability of oils against photo-oxidation was evaluated by exposing the oils to fluorescent light for 28 days. The photo-oxidation study was performed by transferring 50 mL of oil samples into open glass vials (5 mL) and placing them in a tightly closed plastic container fitted with a fluorescence bulb (10 W) and maintaining in the container up to 28 days. The oil samples were drawn at the same intervals mentioned above. The two set of oil samples drawn was analyzed for Peroxide Value (PV)[6], 2-tert Thiobarbaturic Acid Reactive Substances (TBARS)[7], Conjugated Dienes (CD) and Conjugated Trienes (CT)[8]. Each assay was done three times from the same extract in order to determine their reproducibility and results are shown as mean ± SD. Statistical analysis was performed using the SAS 9.1.3 version.

2. Results and Discussion

The percent increment in the measured chemical parameters: PV, CD, TBARS and CT was determined for photo-oxidation and autoxidation after (Table 1). In the photo-oxidation study, the highest percent increase in PV was shown by mahua oil while sesame oil showed the least increase in PV and CD. These two parameters are indicative of the production of primary oxidative products. Therefore, it is obvious that primary oxidative products are generated faster in mahua oil during photooxidation than soybean and sesame oils. However, it showed the least percent increment of TBARS and CTs which indicates a slow production of secondary and tertiary oxidative products in mahua oil.

Table 1. Percent increment of chemical parameters of oils subjected to photo-oxidation and autoxidation during 28 days

Oil	Photo-oxidation				Autoxidation			
	PV	CD	TBARS	CT	PV	CD	TBARS	CT
Sesame	4.39[c]	1.34[c]	7.46[a]	0.22[b]	0.92[b]	0.83[b]	5.69[a]	8.90[b]
Soybean	5.44[b]	3.04[a]	2.14[b]	0.74[a]	2.20[a]	0.87[b]	4.23[b]	10.55[a]
Mahua	7.31[a]	2.02[b]	1.87[c]	0.06[c]	2.36[a]	0.92[a]	1.56[c]	0.71[c]

Values with different letters in the same column imply significant differences ($p<0.05$). Abbreviations; PV, peroxide value; CD, conjugated dienes value; TBARS, thiobarbituric acid reactive substance value; CT, conjugated trienes value.

In the autoxidation study, the highest percent increase of PV and CD was shown by mahua oil while sesame oil showed the least increase of PV and CD during autoxidation. Sesame oil showed the highest percent increment of TBARS and soybean oil showed the highest percent increment of CT which indicates rapid production of secondary and tertiary oxidative products.

The presence of PUFAs and natural antioixdants influence the oxidative stability of the oils during processing and storage. When the fatty acid composition of three oils is compared, the percent PUFA (mainly linoleic) is lesser in mahua oil than sesame and soybean oils. Sesame oil contains 35-50% of PUFA, mainly linoleic acid and natural antioxidants namely, lignans (sesamin and sesamolin) and tocopherols (mainly γ-tocopherol)[3]. Soybean oil contains high proportion of PUFAs such as linoleic (56%) and α-linolenic (8%) and antioxidants such as sterols and tocopherols[4]. Mahua oil contains PUFAs such as linoleic (15.2%) and arachidic (1.2%) and sterols and tocopherols[9]. It is evident that oxidative stability of oils could be predicted partially using fatty acid composition of the oils[10]. Variations of the quantity and the type of natural antioxidants contribute to the differential oxidative stability of the edible oils. Even though the crude oils contain natural antioxidants, the presence of natural antioxidants in the final processed oil depends on the processing methods such as refining which removes natural antioxidants. Therefore the antioxidant content of the oils depends on the processing methods employed as well as the severity of the conditions used in the processing. In conclusion, among the three oils tested, highest oxidative stability was exhibited by the mahua oil, thus mahua oil is more resistant for oxidation than sesame and soybean oils during processing and storage.

References

1. Choe E, Min DB. Mechanisms and factors for edible oils oxidation. *Compr Rev Food Sci Food Saf* 2006;**5:**169-186.
2. Sunita M, Sarojini P. *Madhuca Lonigfolia* (Sapotaceae): A Review of Its Traditional Uses and Nutritional Properties. *IJHSSI*

2013;**2**(5):30-36.
3. Kamal-Eldin A, Appelqvist L. The effects of extraction methods on sesame oil stability. *J Am Oil Chem Soc* 1995;**72**(8):967-969.
4. Medina-Juarez LA, Gamez-Meza N. Effect of refining process and use of natural antioxidants on soybean oil In: Ng T, editor. *Soybean: Biochemistry, Chemistry and Physiology*, InTech;2011.p.435-462.
5. Fennema OR. *Principles of food science, Part 1*, Food chem, Marcel Dekker Inc.; 1976.
6. Damaso H, Antonio PG, Isabel MMM. A Rapid Spectrophotometric Method for the Determination of Peroxide Value in Food Lipids with High Carotenoid Content. *J Am Oil Chem Soc* 2001;**78**(11): 1151-1155.
7. AOCS. American Oil Chemists' Society. Official method Cd 19-90. 2-Thiobarbituric acid value. Direct method. In: Firestone D, editor. *Official Methods and Recommended Practices of the American Oil Chemists' Society*, 5th ed. Champaign; 1998. p.3.
8. Besbes S, Blecker C, Deroanne C, Lognay G, Drira NE, Attia H. Quality characteristics and oxidative stability of date seed oil during storage. *Food Sci Technol Int* 2004;**10:**333-338.
9. Dhara R, Bhattacharyya DK, Ghosh M. Analysis of Sterol and Other Components Present in Unsaponifiable Matters of Mahua, Sal and Mango Kernel Oil. *J Oleo Sci* 2010;**59**(4):169-176.
10. Przybylski R, Gruczynska E, Aladedunye F. Performance of Regular and Modified Canola and Soybean Oils in Rotational Frying. *J Am Oil Chem Soc* 2013;**90**:1271–1280.