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Short Communication

Comparison of Chemical Characteristics of High Oleic Acid Fraction of *Moringa oleifera* Oil with Some Vegetable Oils

F. Rahman[1*], M. Nadeem[1], M. W. Azeem[3] and Y. Zahoor[2]

[1]*Department of Dairy Technology, University of Veterinary and Animal Sciences, Lahore, Pakistan.*
[2]*Institute of Biochemistry and Biotechnology, University of Veterinary and Animal Sciences, Lahore, Pakistan.*
[3]*United Industries Ltd. Nishatabad, Faisalabad, Pakistan.*

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Abstract

Chemical characteristics of High oleic acid fraction (HOF) of *Moringa oleifera* oil (MOO) was compared with sunflower, soybean and canola oils. HOF of MOO was obtained by dry fractionation at 0°C. Iodine value and C18:1 in HOF increased from 61.55 to 82.47 points and 70.29% to 81.15%, respectively. Cloud point of HOF was 1.1°C as compared to 10.2°C in MOO. The induction period of HOF was greater than all the vegetable oils tested in this investigation. HOF can be used as a source of edible oil with better health attributes and superior storage stability.

Keywords: High oleic acid fration of *Moringa oleifera* oil; Fractionation; Vegetable oil

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Introduction

The ever increasing human population and diminishing food resources has led to the discovery of new sources of foods, the addition of 2-billion people by 2050 in Asian and African continents would have a high degree of effect of food security [1]. The physico-chemical characteristics of MOO have been extensively studied [2]. The results of a study performed in Malaysia showed that oil is edible with pale yellow colour, pleasant nutty flavour that can be used without processing; oil content of the seed was 35-40% as compared to soybean 20%, oil yield on per hectare basis was higher than soybean oil, the fatty acid composition of oil was almost similar to olive oil [3]. However, the oil becomes hazy at lower temperature which could limit its application as a salad oil. Further oils having a higher concentration of monounsaturated fatty acids have many health benefits and better storage stability [4]. Physico-chemical and nutritional characteristics of fats and oils can be significantly modified through fractionation [5]. Little information is available regarding physical and chemical characteristics of high oleic acid fraction of MOO. This study aimed to fractionate the MOO, compare with sunflower, soybean and canola oils on the basis of some physico-chemical parameters and oxidative stability in accelerated oxidation conditions.

Materials and Methods

Raw materials

Crude sunflower, soybean and canola oils (SFO, SBO and CO) were obtained from United Industries Ltd. Faisalabad, Pakistan. *Moringa oleifera* seeds were procured from a village of district Multan, oil was extracted by expressing the seeds in a laboratory scale expeller followed by solvent extraction with n-hexane. The chemicals used in this investigation were HPLC grade and obtained from Sigma Aldrich (St. Louis MO, USA).

*Corresponding Author Email: drfazal32@gmail.com

Fractionation of *Moringa oleifera* oil

Crude MOO was heated to 60°C, cooled down to 0°C in 2-hours, held for 3-hours, filtered over Buckner filtration assembly attached with a vacuum pump (600-mm Hg) [6]. The high oleic acid fraction (HOF) was transferred to amber bottle and preserve at -65°C till further usage in this investigation.

Experimental plan and analysis

Chemical characteristics of HOF were compared with SFO, SBO and CO. Free fatty acids, unsaponifiable matter, saponification value, iodine value, peroxide value and refractive index were determined by the standard methods [7]. Colour was checked in Lovibond Tintometer (Tintometer Corporation, Salisbury England). For the determination of fatty acid composition, 50 mg sample was weighed in a 11-mL screw-capped, 2-mL methanolic HCl (14%, Fluka) was added, mixed, capped and put in the heating block at 100°C for 1-hour with occasional stirring for the complete disintegration of oils. Tubes were cooled to room temperature, 2-mL deionized water and 2-mL n-hexane were added, vortex at 2200-rpm for 2-minutes, allowed to separate, the supernatant was dried over anhydrous sodium sulphate, transferred to GC-vials and 1-µl was injected into the GC through an auto sampler (Perkin Elmer, Boston, MA) fitted with RT-2560 column (Restek, Bellefonte, PA) attached with flame ionization detector (FID). The injection temperature was 220°C, flow rate of helium was 2.5mL/minute, total run time was 38 minutes and fatty acid methyl esters were identified and quantified by using internal standard Restek-35078 [8]. Schaal oven test was performed by the recommended method [7]. Induction period was determined on Rancimat (Metrohm-679) as prescribed in instruction manual Metrohm Corporation Switzerland [9].

Statistical analysis

The experiment was planned in completely randomized design, each treatment was replicated three times and each sample was analysed three times and data was expressed as Mean±SD (n: 3×3) through one way analysis of variance technique and significant difference among the treatments was made by Duncan's Multiple Range Test [10].

Results and Discussion

The results of physico-chemical characteristics, fatty acid composition of HOF, MOO, SFO, SBO and CO are presented in (Table-1 and 2).

Table 1. **Chemical Characteristics of HOF and Some Vegetable Oils.**

Parameters	MOO	HOF	SFO	SBO	CO
Free Fatty Acids%	1.17±0.05a	1.15±0.03a	0.59±0.03c	0.86±0.07b	0.39±0.04d
Colour (R+Y)	28±1.33c	30±1.35c	19±1.47d	42±1.95a	35±1.15b
USM%	1.22±0.09a	1.19±0.06a	1.27±0.09a	1.29±0.05a	1.121±0.04a
SV mg/gram	189±0.42a	185±4.12a	191±7.39a	194±6.11a	184±11.29a
I V	61.55±1.28e	82.47±3.18d	119.76±1.97b	133.45±1.71a	113.53±2.35c
RI	1.451±0.01e	1.458±0.01d	1.473±0.03a	1.468±0.01b	1.463±0.02c
Cloud Point °C	10.2±0.25a	1.1±0.30b	-12.4±0.20c	-10.5±0.40c	6.4±0.20d

Means of triplicate experiments; within the rows means denoted by a different letter are different (P<0.05).
MOO: *Moringa oleifera* oil HOF: High oleic acid fraction of *Moringa oleifera* oil
SFO: Sunflower oil SBO: Soybean oil
CO: Canola oil
USM: Unsaponifiable matter
SV: Saponification value
RI: Refractive index @ 40°C
IV: Iodine Value

Table 2. **Fatty Acid Composition of HOF and Some Vegetable Oils (mg/gram).**

Fatty Acid	MOO	HOF	SFO	SBO	CO
C16:0	6.42±0.28a	4.81±0.09b	6.39±0.15a	3.15±0.11d	4.23±0.04c
C18:0	6.64±0.19a	4.52±0.23e	1.94±0.04d	3.95±0.44c	2.24±0.04d
C18:1	70.29±1.16e	81.15±1.67a	45.19±1.33c	25.68±1.29d	55.82±1.65b
C18:2	2.11±0.14e	3.52±0.08d	47.16±0.72b	52.72±0.18a	24.79±0.82c
C18:3	5.71±0.22a	----	0.15±0.02c	5.84±0.52b	9.35±0.49a

Means of triplicate experiments; within the rows means denoted by a different letter are different (P<0.05)

Fractionation of MOO did not have any significant effect on free fatty acids, saponification value, colour and unsaponifiable matter (P>0.05). The iodine value and fatty acid composition of HOF was different from the MOO, SFO, SBO and CO as a function of fractionation. Iodine value increased from 61.55 to 82.47 points and oleic acid enhanced from 70.29% to 81.15%. C18:1 content of HOF was higher than SFO, SBO and CO (P<0.05) with no detection of C18:3. C18:2 content of HOF was 3.52% as compared to 47.16%, 52.72% and 24.79% in SFO, SBO and CO, respectively and absence of C18:3. The decline in C16:0 and enhancement of C18:1 in HOF also had health benefits because of the perceived hypercholesterolemic effect of C16:0 on blood plasma and uplifting of beneficial HDL cholesterol by C18:1 [11]. Fatty acid modification also had significant effect on refractive index of HOF. The refractive index was in the order of SFO < SBO < CO < HOF < MOO. The fatty acid compositions of fractionated fats were different from the parent feedstock [6, 12]. The cloud point of HOF 1.1^{o}C as compared to MOO 10.2^{o}C, the decline in cloud point of HOF can extend the use of use of fractionated MOO as a salad dressings and mayonnaise. The decrease in cloud point of HOF over the parent MOO can be connected to the modification of fatty acid composition as a function of fractionation. The results of peroxide value of crude oil stored at ambient temperature are given in Table-3. Peroxide value of HOF, SFO, SBO and CO increased during the storage period of 90-days, the classical increase in peroxide value of 3-months stored stuffs were in the order of MOO < HOF < CO < SBO < SFO. The oxidizability of C18:2 and C18:3 is 25 and 250 times greater than C18:1 [13].

The lower peroxide value to of HOF over SFO, SBO and CO could be strongly correlated to the lower oxidizability of HOF (R^2=0.985). The results of induction period and changes in peroxide value in the schaal oven test (63^{o}C for 5-days) are given in Fig. 1 and 2. The induction period of HOF was greater than all the vegetable oils tested in this investigation and was in the order of HOF > CO > SBO > SFO. In accelerated oxidation chamber, HOF generated the lower extents of peroxides as compared to other experimental samples. The higher induction period and lower peroxide value in the accelerated oxidation condition of HOF was due to its fatty acid composition and higher extents of phenolic and polyphenolic compounds. The total antioxidant capacity of HOF was 45% as compared to SFO 11%.

Table 3. **Peroxide Value (meqO_2/kg) of fresh, 3-months stored HOF and Some Vegetable Oils at Ambient Temperature.**

Oil Type	Fresh	90-Days
MOO	0.24±0.05i	1.45±0.22e
HOF	0.26±0.03i	1.87±0.09d
SFO	1.25±0.08f	6.37±0.24a
SBO	0.95±0.12g	5.19±0.12b
CO	0.55±0.04h	3.73±0.11c

Means of triplicate experiments; within the rows and columns means denoted by a different letter are different (P<0.05)

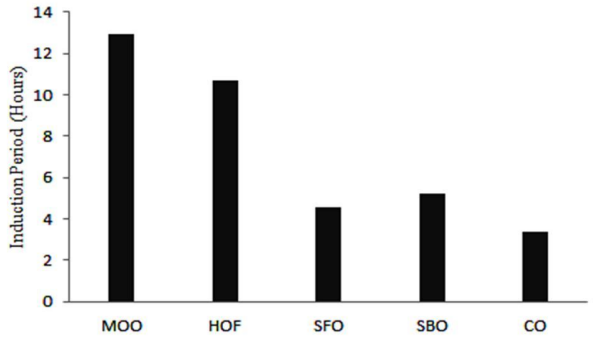

Figure 1. **Induction Period of HOF and Vegetable Oil**

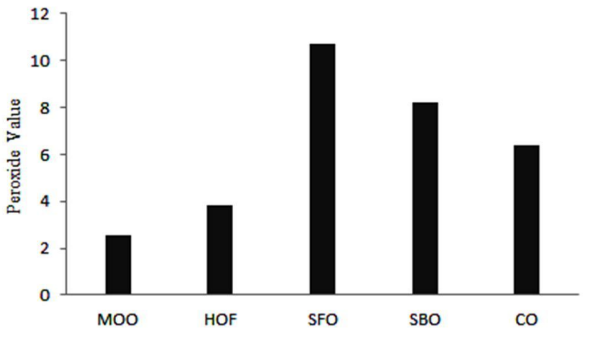

Figure 2. **Peroxide Value of HOF and Vegetable Oil in Schall Oven**

The enhancement in shelf life of vegetable oils and butter oil as a function of blending with *Moringa oleifera* oil has been described [2, 14]. Induction period measures the expected shelf life of fats and oils, the lower values are usually connected with inferior keeping quality.

Conclusion

Fractionation of MOO significantly enhanced oleic acid in high oleic acid fraction with higher iodine value and refractive index. The induction period of HOF was higher than SFO, SBO and CO with lower peroxide value in accelerated oxidation chamber. The superior fatty acid composition and better storage stability of HOF of MOO can serve as a potential source of edible oil.

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