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RESEARCH PAPER

OPEN ACCESS

COMPARITIVE ANALYSIS OF HEAT DEGRADATION OF ORYZANOL IN RICE BRAN OIL, MUSTARD OIL AND SUNFLOWER OIL BY MICROWAVE AND PAN HEATING

AMAN PAUL^{1*}, DORCUS MASIH¹, JUSTIN MASIH², PRIYANKA MALIK³

ABSTRACT

Rice Bran Oil, Mustard Oil and Sunflower Oil are commonly used oils in India. Rice Bran Oil is a rich source of oryzanol; on the other hand Mustard Oil and Sunflower oil have oryzanol in trace amounts. The present study was conducted to evaluate the comparative heat stability of oryzanol in the three vegetable oils, during pan heating and microwave heating. Rice Bran Oil, Sunflower Oil and Mustard Oil samples, 500ml each were taken, 100ml was poured in five different containers which were heated for 0, 2, 4, 6 and 8 hours at 180°C on hot plates as well as microwave oven. During heating the temperature was monitored throughout the process. The determination of oryzanol in all three oil samples were done by double beam UV-Visible spectrophotometer. The average oryzanol percentage of Rice Bran Oil market samples was 1.279, Mustard Oil market samples was 0.093 and Sunflower Oil market samples was 0.154. Chemical analysis showed that pan heating was a better way of retaining the oryzanol content in Rice Bran Oil, Mustard Oil as well as Sunflower Oil even after 8 hours of heating.

KEY WORDS:

Rice Bran Oil; Sunflower Oil; Mustard Oil; Oryzanol; Pan Heating; Microwave Heating.

INTRODUCTION

India is the second largest producer of paddy after China and contributes to 23% of total world production of paddy. Japan contributes just 2% of the world

production of paddy and produces dozens of high value chemicals and nutraceuticals from the derivatives of paddy, but unfortunately in India the potential of rice bran oil as cooking oil still remains largely untrapped (Sharma,

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2002). Traditionally rice bran oil has been used for frying food, due to its oxidative stability and flavor; it is now considered as a good substitute for vegetable oils (Sayre *et al.*, 1985; Goenka, 1987).

Rice bran oil is a rich natural source of γ -oryzanol, containing up to 3,000 mg/kg (Saunders, 1985). In Japan, it is used as natural antioxidant in foods, beverages and cosmetics (Scavariello and Arcellano, 1998). Oryzanol was first isolated from soap stock obtained from rice oil refining. Oryzanol or γ -oryzanol is a mixture of sterol esters of ferulic acid (Seetharamaiah and Prabhakar, 1986). This antioxidant compounds was first isolated in 1955 by Kaneko and Tsuchita. γ -oryzanol, a mixture of phytosteryl ferulates comprises 3 major components; cycloartenyl ferulates, 24-methylenecycloartanyl ferulate and campesteryl ferulate (Xu and Godber, 1999).

The presence of oryzanol in all oils is estimated by Spectrophotometry, using a UV-Visible Dual Beam Spectrophotometer, to determine the presence and concentration of nutraceuticals components. The concentration of γ -oryzanol is determined at 314.5nm, using heptane as a solvent (Seetharamaiah and Prabhakar 1986).

The physiological properties of γ -oryzanol such as having the superoxide dismutase-like antioxidant activity and hypocholesterolemic effects in animal models and human subjects were later reported (Hundermer *et al.*, 1991; Kahlon *et al.*, 1992, 1996; Gerhardt and Gallo, 1998; Visser *et al.*, 2000).

Sunflower oil and Mustard oil are two commonly used oils for cooking purposes in India. Sunflower has high linoleic acid content and is commonly used for frying snacks (San-Jaun and Villamide, 2001). While high levels of essential amino acid and there good bioavailability makes mustard oil a nutritious choice even for low income groups (Clandinin *et al.*, 1981). The presence of oryzanol in mustard oil, sunflower oil, poppy seed oil and niger oil was detected during the spectrophotometric analysis of different oil seeds (Ravikumar *et al.*, 2008).

Many researches have been conducted regarding the nutritional profiling of rice bran oil during heating, but no significant research has been done to compare the oryzanol degradation in rice bran oil during pan and microwave heating techniques. Mustard oil and sunflower oil have oryzanol, though in very less amounts, no significant data is present about the oryzanol contents of these two oils. So keeping the above points in view, this research was conduct with the following objectives,

1. To determine the Oryzanol content of locally available brands of Rice Bran Oil, Sunflower Oil and Mustard Oil.
2. To study correlation between the extent of oryzanol degradation by pan and microwave heating.

MATERIALS AND METHODS

Procurement of Raw Materials- Fortune Sunlite Refined Sunflower Oil samples were procured from Easyday Shopping Mall (Gurgaon), RRO Premium

Mustard Oil (Kachi Ghani) samples were procured from Big Bazaar Shopping Mall (Allahabad) and Amrut Rice Bran Oil samples were procured from Maheshwari Solvent Extraction Limited (Gondia). Analytical grade n-heptane was procured from Qualikems Fine Chemicals Limited.

Equipments used- Electrical Hot Plate, Microwave Oven (with temperature probe), Double Beam UV-Vis Spectrophotometer, etc. were used to conduct the research.

- 1. Electrical Hot Plate-** M.K.M. 1000W Hot Plate was used for pan heating of the oil samples.
- 2. Microwave Oven-** LG LMV1813ST model with attached temperature probes was used for microwave heating of the oil samples. It can work on ten power levels with wattage of 1100W. 500W power level was used in the experiment.
- 3. Double Beam UV-Vis Spectrophotometer-** Systronics AU-2701 Double Beam UV-Vis Spectrophotometer was used to estimate the oryzanol content of prepared oil samples.

Preparation of Samples- 500ml each of Rice Bran Oil, Sunflower Oil and Mustard Oil samples were taken, 100ml was poured in five different containers which were heated for 0, 2, 4, 6 and 8 hours at 180°C on hot plates as well as microwave oven. During heating the temperature was monitored throughout the process.

Oryzanol Determination Using Double Beam UV-Vis Spectrophotometer- The determination of oryzanol for all the three sources of sample viz. Rice Bran Oil, Sunflower Oil and Mustard Oil was done

using UV-Visible spectrophotometer. Before using, the spectrophotometer was properly adjusted to a zero reading filling both the sample cuvette and the reference cuvette with n-Heptane. Then filtration of the oil sample through Whatman filter paper no. 2 at ambient temperature was carried out. Followed by weighing accurately approximately 0.02g of the sample so prepared into a 25mL volumetric flask, made up to the mark with n-Heptane. Then a cuvette was filled with the solution obtained and the extinction was measured at the wavelength of maximum absorption near 315nm, using the same solvent as a reference (Seetharamaiah and Prabhakar, 1986; CODEX-JOINT FAO/WHO FOOD STANDARDS PROGRAMME, 2007).

Statistical Analysis- Correlation Coefficient tool was used to relate the associativity of the thermal degradation of oryzanol by the two methods (Gupta, 1997).

RESULTS AND DISCUSSION

ORYZANOL CONTENT OF LOCALLY AVAILABLE BRANDS OF RICE BRAN OIL, SUNFLOWER OIL AND MUSTARD OIL

Rice Bran Oil- The average percentage oryzanol of Amrut brand Rice Bran Oil procured from Maheshwari Solvent Extraction Limited (Gondia) was 1.279. The results were in accordance to the literature provided in CODEX, 1999.

Sunflower Oil- The average percentage oryzanol of Fortune Sunlite Refined brand Sunflower Oil procured from Easyday

Shopping Mall (Gurgaon) was 0.154. The results were in accordance to Ravikumar *et al.*, 2008.

Mustard Oil- The average percentage oryzanol of RRO Premium brand Mustard Oil procured from Big Bazaar Shopping Mall (Allahabad) was 0.093. The results were in accordance to Ravikumar *et al.*, 2008.

CORRELATION BETWEEN THE EXTENT OF ORYZANOL DEGRADATION BY PAN AND MICROWAVE HEATING

Rice Bran Oil (RBO) - Average percentage oryzanol in Rice Bran Oil was 1.279 which altered to 1.215, 1.174, 1.146 & 1.219 after 2, 4, 6 & 8 hours of pan heating, while to 1.233, 1.212, 1.187 & 1.167 after 2, 4, 6 & 8 hours of microwave heating.

The oryzanol content of the pan heated RBO samples remains appropriately same and this is an indicative of its stability during the normal heating conditions employed in the study. Similar results were discussed by Nandini, 2009. The oryzanol content of microwave heated RBO samples were significantly lower compared to unheated oil. This could probably due to the effect of heat treatment given by microwave radiations since antioxidant compound such as γ -oryzanol is sensitive to heat. Similar results were discussed by Roselina *et al.*, 2011. The comparative effect of pan and microwave heating is shown in figure 1.

Statistical analysis showed that the correlation coefficient of the study was

found to be 0.679856, as shown in table 1.

Mustard Oil (MO) - Average percentage oryzanol in Mustard Oil was 0.093 which altered to 0.082, 0.074, 0.066 & 0.075 after 2, 4, 6 & 8 hours of pan heating, while to 0.082, 0.073, 0.064 & 0.057 after 2, 4, 6 & 8 hours of microwave heating.

The oryzanol content of the pan heated MO samples remains appropriately same and this is an indicative of its stability during the normal heating conditions employed in the study. Similar results were discussed by Nandini, 2009. The oryzanol content of microwave heated MO samples were significantly lower compared to unheated oil. This could probably due to the effect of heat treatment given by microwave radiations since antioxidant compound such as γ -oryzanol is sensitive to heat. Similar results were discussed by Roselina *et al.*, 2011. The comparative effect of pan and microwave heating is shown in figure 2.

Statistical analysis showed that the correlation coefficient of the study was found to be 0.851107, as shown in table 2.

Sunflower Oil (SO) - Average percentage oryzanol in Sunflower Oil was 0.154 which altered to 0.135, 0.113, 0.100 & 0.124 after 2, 4, 6 & 8 hours of pan heating, while to 0.144, 0.130, 0.120 & 0.109 after 2, 4, 6 & 8 hours of microwave heating.

The oryzanol content of the pan heated SO samples remains appropriately same and this is an indicative of its stability during the normal heating conditions employed in the study. Similar results were discussed by Nandini, 2009. The oryzanol content

of microwave heated SO samples were significantly lower compared to unheated oil. This could probably be due to the effect of heat treatment given by microwave radiations since antioxidant compounds such as γ -oryzanol is sensitive to heat. Similar results were discussed by Roselina et al, 2011. The comparative effect of pan and microwave heating is shown in figure 3.

Statistical analysis showed that the correlation coefficient of the study was found to be 0.734336, as shown in table 3.

CONCLUSION

The average oryzanol percentage of Amrut Rice Bran Oil market samples was 1.279, RRO Premium Mustard Oil (Kachi Ghani) market sample was 0.096 and Fortune Sunlite Refined Sunflower Oil was 0.154. The correlation coefficient for pan as well as microwave heating in the case of Rice Bran Oil, Mustard Oil and Sunflower Oil were 0.679856, 0.851107 and 0.734336 respectively. Chemical analysis showed that pan heating was a better way of retaining the oryzanol content in Rice Bran Oil, Mustard Oil as well as Sunflower Oil even after 8 hours of heating.

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Table 1: Correlation of Oryzanol degradation between Pan and Microwave heating for RBO

	Pan Heating	Micro-wave Heating
Pan Heating	1	
Microwave Heating	0.679856	1

Table 2: Correlation of Oryzanol degradation between Pan and Microwave heating for MO

	Pan Heating	Micro-wave Heating
Pan Heating	1	
Microwave Heating	0.851107	1

Table 3: Correlation of Oryzanol degradation between Pan and Microwave heating for SO

	Pan Heating	Micro-wave Heating
Pan Heating	1	
Microwave Heating	0.734336	1

Figure 1: Comparative heat degradation of rice bran oil oryzanol through pan and microwave heating

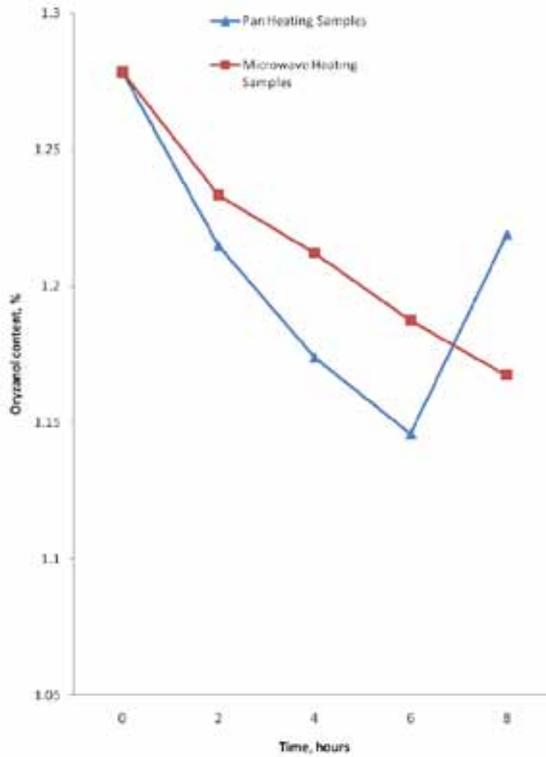


Figure 2: Comparative heat degradation of mustard oil oryzanol through pan and microwave heating

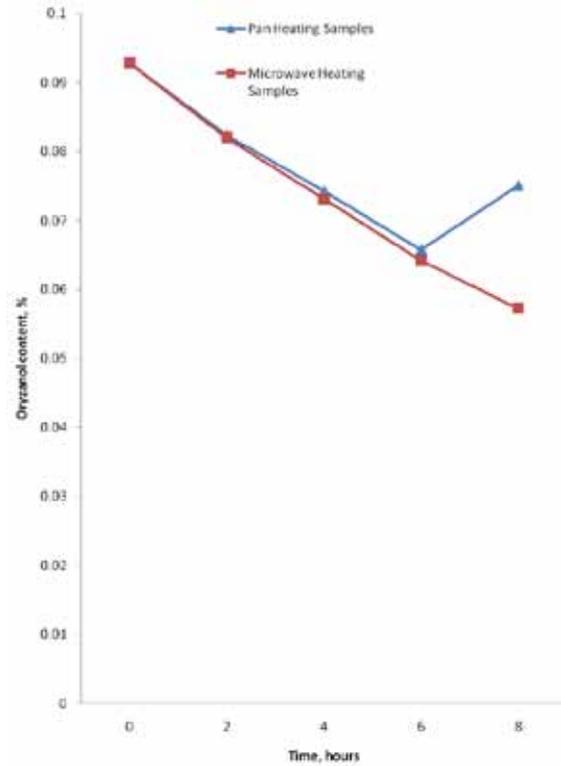


Figure 3: Comparative heat degradation of sunflower oil oryzanol through pan and microwave heating

