Effect of Stabilization on the Quality Characteristics of Rice-Bran Oil

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The effect of acid, heat and cold stabilization of rice-bran on the quality characteristics of rice-bran oil obtained thereof were studied. Acid and heat stabilizations were found to be equally effective as far as the control of free fatty acids is concerned. The iodine value (90–92.2), saponification value (186–188) and butyro-refractometer reading (56–58) of oils obtained from the stabilized rice-bran were very much similar to unstabilized/control samples: IV (90–92.2), SV (188) and BRR (56.0). However, the Bellier turbidity temperature could not be read, due to the presence of residual wax, even up to 70°C. The fatty acid composition of oils obtained from stabilized rice-bran and determined by gas-chromatography showed the presence of myristic (1.2–3.3), palmitic (18.0–20.3), stearic (0.5–1.2), oleic (34.0–43.9), linoleic (31.0–35.7), linolenic (2.3–3.7) and arachidic (0.5–2.8%) acids. With the fatty acid composition they resembled control oil samples. There was no effect of stabilization on the PFA quality standards/characteristics of rice-bran oil. The effect of the chilling of rice-bran over oil extractability and oil content has also been studied.

Rice is one of the major cereal crops of India. Recently rice-bran, a by-product of rice, has been proven to be quite remunerative since it is a new source of edible oils. But it suffers from the drawback of high lipase activity (1). If lipase activity is not controlled immediately, it will produce a high FFA oil which is not fit for human consumption. Hence, work has been carried out, specially in Japan, to control lipase activity so as to produce edible grade rice-bran oil. Three well-studied major factors, moisture, temperature and pH, can control the lipase (2). Recently a simple method of chemical stabilization (HCl) has been reported by this Institute (3). So far no work has been reported on the quality characteristics of rice-bran oil obtained from rice-bran stabilized by different techniques. Hence, this study was aimed to observe the effect of stabilization on physico-chemical parameters, the fatty acid composition, and the oil extractability *vis a vis* chilling effect.

EXPERIMENTAL PROCEDURES

Fresh rice-bran of the Indian Gowrisanna rice variety was procured from the local sheller rice-mill. Acid stabilization of rice-bran was carried out using 40 ml of hydrochloric acid (E. Merck, 35%, GR) sprayed with an atomizer on 1 kg of rice-bran. Heat stabilization was carried out by keeping the bran in a hot air oven at 110°C, for 10 minutes. Cold stabilization of the rice-bran was achieved by keeping the bran in polythene bags at 0°C in a deep freezer. The bags were removed from the freezer and allowed to attain room temperature before the analysis. The free fatty acids percentage, the Iodine value, the saponification value, the Butyro-refractometer reading and the Bellier turbidity temperature were carried out following the AOCS's (4) procedures. Rice-bran oil was extracted using solvent hexane on soxhlet apparatus for eight hours. The solution was dried over anhydrous sodium sulfate and filtered. The solvent was removed by a vacuum flash evaporator. Oils were transformed into fatty acids methyl esters by a transesterification procedure using sodium methoxide in methanol (5). Gas-chromatography of methyl esters was carried out using a gas-chromatograph (CIC Baroda model) equipped with a flame ionization detector and a stainless steel column of 10 feet × 1/8 inch packed with 15 percent diethylene glycol succinate on chromosorb-w (80–100 mesh). The column temperature was 185°C; the isothermal and the nitrogen (carrier gas) flow rate was 25 ml/min. Hydrogen was used as a fuel gas. Identification of peaks was made by injecting known standards and quantitation by the triangulation method. The dewaxing of the raw rice-bran oil was done by centrifugation of the oil and decantation using a centrifuge (Remi T23 model) at 3500 RPM. Dewaxed oil was subjected for neutralization by a diluted aqueous sodium hydroxide solution. All the values in Tables 1, 2 and 3 are the average of six replications.

RESULTS AND DISCUSSION

Physico-chemical characteristics—namely, the free fatty acids percentage, the iodine value, the saponification value, the butyro-refractometer reading and the Bellier turbidity temperature of rice-bran oil—have been determined to assess the effect of acid and heat and cold stabilization of rice-bran on the quality characteristics. The free fatty acid content of the oil obtained from the untreated rice-bran or control increased from 4.8 to 20.3% (Table 1) within a 7-day period. The corresponding oils from rice-bran which was stabilized by acid and heat and cold showed an increase only from 4.8 to 4.8, 5.0 and 6.2 respectively. In fact, there was no increase of free fatty acids in the oil obtained from acid-stabilized rice-bran. All of these oil samples were neutralized and the FFA brought below the required limit of 0.25% (6) as stipulated under the prevention of Food Adulteration (PFA) Act, 1954 of India. The dewaxed and neutralized oil samples were taken for other estimations. The iodine value (90–92.2), the saponification value (186–188) and the butyro-refractometer reading at 40°C (56–58) fell well within the range of PFA specification (6) for all the samples stabilized by the three techniques stated above. However, little change may be seen for acid-stabilized rice-bran oil with respect to IV, SV and BRR. The Bellier turbidity temperature could not be read even up to 70°C for all the samples (Table 1) due to the presence of residual

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TABLE 1

Effect of Stabilization on Physico-Chemical Characteristics of Rice-Bran Oil

Periodicity/ stabilization	Raw oil % FFA	Dewaxed and neutralized oil % FFA	Iodine value	Saponification value	BRR n^D40	Remarks
Control						
1.5 hr analysis	4.8	0.15	92.2	188.0	56.0	Bellier turbidity temperature could not be read in any of the sample even up to 70°C.
24 hr analysis	9.7	0.13	92.0	188.0	56.0	
7 days analysis	20.3	0.23	90.0	188.0	56.0	
4 hr analysis						
Acid-stabilized	4.8	0.15	92.2	186.0	56.0	
Heat-stabilized	4.8	0.13	90.0	188.0	58.0	
Cold-stabilized	5.0	0.13	90.0	188.0	56.0	
7 days analysis						
Acid-stabilized	4.8	0.15	92.0	186.0	56.0	
Heat-stabilized	5.0	0.16	90.0	188.0	58.0	
Cold-stabilized	6.2	0.14	90.0	188.0	56.0	
PFA range (6)		>0.25	90–105	180–195	51–66.4	

TABLE 2

Effect of Stabilization on Fatty Acid Composition of Rice-Bran Oil

Fatty acid	Control	Acid-stabilized	Heat-stabilized	Cold-stabilized
$C_{14:0}$	4.2	3.3	1.7	2.5
$C_{16:0}$	18.5	20.3	19.6	18.0
$C_{18:0}$	1.0	1.2	0.7	0.5
$C_{18:1}$	40.8	34.0	42.3	41.5
$C_{18:2}$	30.5	35.7	31.3	31.0
$C_{18:3}$	2.4	2.7	2.3	3.7
$C_{20:0}$	2.6	2.5	2.1	2.8

TABLE 3

Effect of Chilling on the Oil Extractability of Rice-Bran at Different Moisture Levels

Moisture percent	Oil percent Control	Chilled at 0°C (24 hr)	Enhanced extractability percent	Enhanced percent
Unstabilized				
10.5	18.1	19.6	8.2	1.7
15.0	18.0	21.3	18.3	3.9
20.0	16.5	18.0	9.0	1.9
Acid-stabilized	19.5	19.5	0.0	0.0
Heat-stablized	18.0	18.5	2.7	0.5

wax, which is insoluble in the alcoholic medium specified under the tests (4).

The fatty acid composition of acid and the heat- and cold-stabilized rice-bran oils (Table 2) has been determined to assess the effect of stabilization. The quantitative trend of fatty acids of control led and stabilized rice-bran oils remained the same except the marginal difference in the quantity of individual acids. Palmitic, linoleic and oleic acids were found to be in the increasing order. Oil obtained from acid-stablized rice-bran showed a higher amount of linoleic acid compared to the control sample. This may be due to the bound lipids which were released during the acid treatment and travelled into the oil during extraction. Bound lipids are normally rich in unsaturated fatty acids. Consequently the relative weight percentage of oleic acid has come down compared to the control sample.

The effect of chilling on the oil extractability of rice-bran at different moisture levels (Table 3) was studied with the idea that cells are broken down when they are

frozen due to the water crystals, thereby releasing the lipids at a faster rate compared to the normal cell. Chilling had nearly no effect on the oil extractability or oil percentage in the case of acid- and heat-stablized rice-bran.

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