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EDIBLE RICE BRAN OIL

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Pakistan imports 0.8 million tonnes of vegetable oil worth Rs. 8 billion to meet the requirement of the country. The rice bran which is a by-product of rice processing industry can furnish 51718 tonnes of edible oil after stabilization, extraction, degumming, winterization, refining, bleaching and deodorization. The oil yield on laboratory scale is 18.7%.

Key words : Extrusion stabilizer, Degumming, Winterization.

Introduction

Pakistan exports rice [1] and rice bran as a by-product of rice processing industry can be utilized for the production of edible oil like Japan which is producing more than 0.1 million tonnes of edible bran oil per year [2]. The other rice producing countries in the world such as USA, South Korea, Philippines, Thailand, India etc. are also making efforts to produce edible rice bran oil.

The lipolytic enzymes [3] in the bran create the major problem. These enzymes begin to act as soon as the rice is polished. As a result of the enzymatic activity the bran oil (triglycerides) is hydrolysed with the liberation of free fatty acid (FFA) at the rate of 1.0% per hour at 25°. As much as 4-6% free fatty acids has been reported even in the oil extracted from the bran of freshly processed rice bran [4]. The FFA content in the oil extracted from stored bran is unusually high resulting in abnormal refining losses rendering the recovery process uneconomical. It is, therefore, necessary that for the recovery of oil only fresh bran is used. This again is a problem as collection of fresh bran from each processing site running into hundreds and spread all over the country is a gigantic task. Evidently the rice bran oil recovery presents technology problems on account of the presence of lipolytic enzymes and logistics problems as the paddy processing facilities are spread all over the paddy growing areas in the country. However, keeping in view all the problems the fresh rice bran can be secured by carrying out the process of stabilization to control FFA.

The FFA of rice bran is controlled by heating the bran for a short time at specific temperature in a specially designed machine named as an extrusion stabilizer which is locally designed, fabricated and operated successfully. Stabilization as well as pelleting of bran is carried out in the same machine. The pelleted bran can be stored for two weeks prior to extraction and subsequent steps of refining to make the oil fit for edible purposes.

Materials and Methods

Oil extraction of stabilized bran. The inactivation of lipolytic enzymes in fresh rice bran containing moisture was carried out in a continuous extrusion stabilizer having a capacity of 60 kg/hr. The hopper was used for feeding the bran which was conveyed to the automatically controlled heated portion at 140° with the help of a worm. The bran was pushed through a sieve at the end to produce pellets of dimensions 11-27 mm length and 5.8 mm diameter.

The soxhlet was used for 3 hr to extract oil (9.35 g) by hexane (150 ml) out of two separate samples of fresh rice bran powder and pellets (50 g each).

Refining and bleaching of degummed/dewaxed oil. The crude oil (100 gm) containing 2 ml of 4% oxalic acid was warmed and stirred in round bottom flask at 60° for 15 mins. The gummy material was separated by a Roto Stiper Centrifuge No. 290 before the removal of wax by using acetone (500 ml), cooled to 5° and repeated the process of centrifugation to obtain oil (98.5 g). The oil was further refined by heating it at 60° with 7.0 ml of 20% NaOH solution for 10 mins. The oil on separation from the solid mass was washed to get refined oil (90 g) which was bleached by heating and stirring on a water bath for 1/2 hr, in the presence of activated fullers earth (1.8 g) and charcoal (0.5 g). It was filtered before the process of deodorization by steaming under reduced pressure.

Physico-chemical values of the refined oil. The FFA, saponification and iodine values of refined and bleached rice bran oil were determined according to BSS No. 684 (1958). The colour of the oil was determined by Lovibond Flexible Optic Tintometer No. 5365. The same physico chemical values of South Korean bran oil were also determined for comparative studies.

Results and Discussion

The rice paddy consists of rice husk (25%), rice bran (8.0%) and rice (67.0%). The rice bran obtained as a result of rice polishing can be utilized for the production of 51718 tonnes of refined oil worth approximately. Rs. 827.5 million. The rice bran contains (18.7%) oil on laboratory scale but oil yield (15.0%) has been considered commercially for the total production of edible oil in Pakistan (Fig. 1).

The stabilization of fresh rice bran was carried out by a new extrusion stabilizer, which is better than the previous one [5]. The results of FFA of untreated and treated samples are shown in (Table 1) and also by a graph (Fig. 2). These results

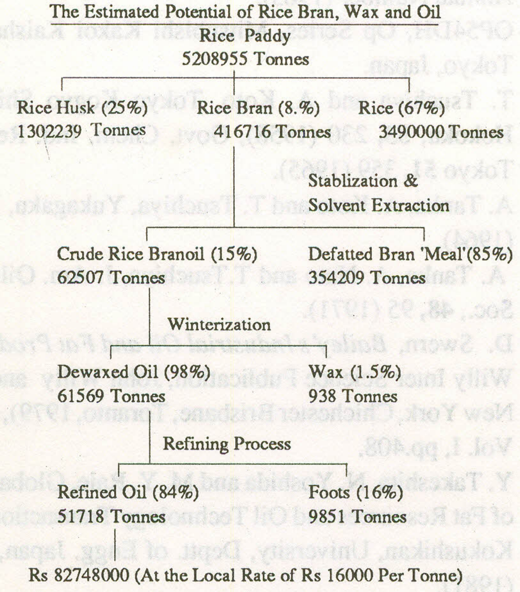

Fig. 1. The estimated potential of rice bran, wax and oil.

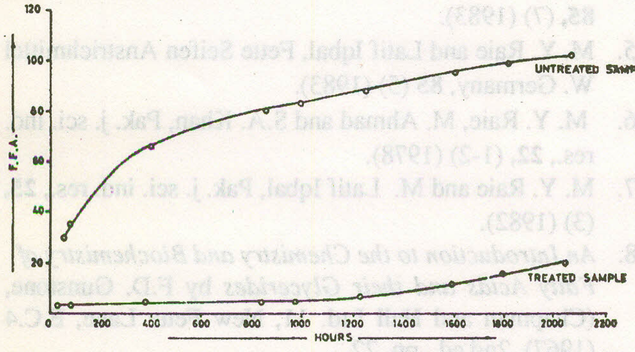

Fig. 2. The graph shows the fatty acids of untreated and treated samples.

show that increase of FFA depends upon the time factor even after stabilization. The stabilized rice bran shows FFA (5.4%) as compared to blank sample (83.0%) after 1000 hr. i.e. 42 days which is a reasonable period to store and process the bran further to get an oil for edible purposes. The stabilization is an essential step to control FFA not only to decrease oil losses but also useful in the subsequent processes of refining and bleaching consequently to affect the economics of the process.

TABLE 1. FREE FATTY ACIDS OF STABILIZED AND UNSTABILIZED OF RICE BRAN

S. No.	Time interval (hrs)	Free fatty acid of bran powder (untreated) (%)	Free fatty acids of stabilized pellets (treated) (%)
1.	50	29.0	4.6
2.	75	35.0	4.6
3.	390	66.0	4.9
4.	865	80.0	5.0
5.	1000	83.0	5.4
6.	1250	88.0	7.0
7.	1600	95.0	12.8
8.	1800	99.0	16.7
9.	2045	102.0	21.6

The stabilization and pelleting of bran is processed in the same machine. The material in the form of pellets have certain advantages i.e. the density of the material is increased from 0.38 gm^3 to 0.88 cm^3 and 5.5 timesless solvent is needed for the extraction of oil. It is evident that material can easily be transported to solvent extraction plant and thus remove the logistics problem in addition less hexane is required in the extraction process and a smaller solvent extraction plant is needed. All of which reduce the investment cost. It has also been observed that the oil yield (18.7%) on laboratory scale is the same in case of bran powder and pellets. It reflects the satisfactory percolation rate of solvent through pellets formed under the specific operational conditions of the extrusion stabilizer. The defatted bran can be used for cattle and poultry feed.

The oil is degummed and dewaxed by the use of oxalic acid [6] and acetone [7] respectively. The centrifugal separator can be used for the isolation of solid from the liquid on a large scale. The waxy material [9-11] occurs as esters of ferulic acid with certain triterpene alcohols. Ferulic acid esters can have antioxidation properties. The oil on refining, bleaching and deodorization can be used for edible purposes. The bran oil has been widely accepted by oil industries as having the composition of an excellent salad oil and a base for hydrogenated products [12]. The physico-chemical values of the locally prepared oil have been determined and compared with South Korean bran oil (Table 2). According to Pakistan Standard Specifications the FFA should not be more than (0.25%) whereas the FFA of South Korean and local bran oil is 0.14% and 0.18% respectively. So the local bran oil is as good as Korean bran oil.

The fatty acid composition of rice bran oil [13] is compared with cottonseed oil [14], soybean oil [15], olive oil [16] and sunflower oil [17]. The quality of bran oil is evaluated by the presence of essential fatty acids i.e. linoleic acid and arachidonic acid which are precursors of prostaglandins found in accessory genital glands, seminal plasma and lung tissue of the human body [18]. The local bran oil of Basmati and Irri-6 contains linoleic acid 29.3% and 30.5% respectively as compared to olive oil and sunflower oil having linoleic acid 10.9% and 32.0% respectively. The linoleic acid is much higher in bran oil than in olive oil and it is slightly less than sunflower oil. So the importance of bran oil can be realized as compared to other conventional edible oils.

Table 2. The Physico-Chemical Values of Locally Prepared and Korean Rice Bran Oil.

S. No.	Physico-chemical values	Local oil	Korean oil
1.	Free fatty acids (%age)	0.18	0.14
2.	Colour: yellow	4.1	3.8
	red	0.3	0.3
3.	Saponification number	201.0	199.0
4.	Iodine number	103.0	106.0

The whole process reflects that three industries are involved for the production of edible rice bran oil i.e. rice processing industry where the stabilization would be carried out by coupling stabilizer with a bran producing unit, the transportation of pellets to the solvent extraction for the recovery of oil and lastly the refining, bleaching and deodorization of bran oil.

Conclusion

The rice bran is one of the most important agro-industrial waste material in the country. Its utilization for the production of edible oil is the need of Pakistan not only to save partially the foreign exchange spent on the import of edible oil but also to meet the requirement of the country.

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