FEATURE

Rice bran offers India an oil source

Rice bran oil, a byproduct of the rice milling industry, offers India a potentially sizeable domestic source of edible oil. However, there are a number of obstacles to India's fully achieving this production potential. In the following article, H.P. Gupta, president of The Solvent Extractors' Association of India, outlines the existing situation and prospects for rice bran oil in India. Further inquiries can be addressed to H.P. Gupta, c/o The Solvent Extractors' Association of India, 142 Jolly Makers Chamber No. 2, Nariman Point, Bombay-400021, India.

The spectre of a scarcity of edible oils has haunted India since the beginning of the 1970s. Since 1977, India has imported large quantities of edible oils to bridge the yawning gap between indigenous production and growing demand. Imports during the 1987-88 oil year are expected to have totaled 2 million metric tons (MT), involving massive expenditure of the country's scarce foreign exchange (Table 1).

India is the largest producer of rice in the world outside of mainland China (Table 2). With increased application of scientific research, extension of acreage and use of high-yielding variety seed, overall rice production in India has increased from 30.44 million MT in 1966-67 to around 60 million MT currently. Production is slated to increase further by the turn of the century.

Despite being a leader in rice production, the country still has a long way to go in the recovery of good quality rice bran to produce rice bran oil. If properly harnessed, rice bran—an important byproduct of the rice milling industry—can be used to augment the domestic edible oil supply. Even using conservative calculations, rice bran oil's potential in India is estimated to total 700,000 MT now and to reach a million MT by the turn of the century; current production is a little over 300,000 MT. Table 3 shows how production has grown over the past 18 years.

The term rice bran refers to the coating removed from brown rice during the process of milling. The bran constitutes nearly 8.5% of the total grain and is highly nutritious, being rich in lipids, protein, minerals and vitamins. It is a major source of oil, with the oil content varying from 12% to 25% depending on the quality of bran and the degree of polishing. In the rice milling industry in India, paddy rice is milled in two types of mills: country hullers and modern rice mills with rubber roll shellers and/or emery stone polishers.

There are approximately 100,000 hullers throughout the country in rural areas. These huller mills do not produce extractable rice bran and the rice recovery is less than at the more modern mills. There are about 20,000 modern rice mills in India, with an average capacity of about 2 MT per hour. In some areas, paddy is parboiled before milling. Parboiled paddy, when milled, produces better quality bran which has higher oil content and lower free fatty acids than rice that is not parboiled.

The potential availability of rice bran and rice bran oil is explained in the following numbers:

- Present production of paddy—80 million MT, with 25% (20 million MT) reserved for hand pounding. This leaves 60 million MT available for organized milling.
- Potential availability for rice bran is 5 million MT.
- The potential for rice bran oil is 0.75 million MT. Current production is 0.30 million MT. This leaves an unrealized potential of 0.45 million MT.

Such waste of unexploited rice bran oil is due to the operation of huller mills. The solvent extraction industry in India is already fully geared to process the entire potential; currently, it processes whatever quantity of extractable rice bran it can harness from the mills.

Currently, only 40% of the oil produced is used for edible purposes; the remainder is industrial grade and is used in the soaps and fatty acid industries. The quantity of edible oil can be further increased

TABLE 1

India's Edible Oil Imports

Oil Year (Nov.-Oct.)	Quantity (million metric tons)	Value (million rupees)
1978-79	0.321	4,800
1979-80	1.149	6,200
1980-81	1.074	5,160
1981-82	0.998	4,500
1982-83	1.150	5,070
1983-84	1.634	13,190
1984-85	1.368	11,220
1985-86	1.179	4,890
1986-87	1.497	6,677
1987-88	1.970	10,000

Source: Government of India.

TABLE 2

Production of Rice in Major Countries (in million metric tons)

Country	Paddy	Rice
China	155.111	103.397
India	89.579	59.800
Indonesia	34.104	22.736
Bangladesh	21.000	14.000
Thailand	17.500	11.667
Burma	14.000	9.333
Vietnam	13.780	9.187
Japan	12.838	8.559
Phillipines	8.346	5.565

Source: F.A.O.

if various constraints are removed. A major problem is the rapid deterioration of rice oil in the bran due to the presence of a lipolytic enzyme which is activated during the polishing operation. The enzyme attacks the fat, splitting off free fatty acids so swiftly that 50% to 70% of the oil is affected within 90 days; even in a matter of two to three days, over 10% of the oil can be ruined.

Another major problem is the fine physical nature of the bran which causes difficulties in many phases of solvent extraction. These include:

- In percolation extractors, fines tend to cause channeling and binding.
- In the total submergence-type extractors, fines inherent in the bran severely limit capacity.
- The rich miscella produced from all types of extractors is difficult to clarify.
- The large quantity of fines in the vapors from the desolventizers presents both operational and capacity problems.

Because of these problems, many operators run their plants at low capacity and others completely

(Continued on page 622)

TABLE 3

Rice Bran Processed and Rice Bran Oil Produced by SEA Members (in metric tons)

Year	Rice bran processed	Edible oil produced	Industrial oil produced	Total
1970-71	170,000	—	21,000	21,000
1971-72	220,000	—	30,000	30,000
1972-73	185,000	—	25,000	25,000
1973-74	165,000	—	24,000	24,000
1974-75	160,000	—	23,000	23,000
1975-76	265,000	—	36,000	36,000
1976-77	540,000	—	70,000	70,000
1977-78	566,000	—	80,000	80,000
1978-79	680,000	2,500	98,500	101,000
1979-80	786,500	2,450	110,400	112,850
1980-81	922,000	4,000	126,000	130,000
1981-82	1,060,000	10,000	140,000	150,000
1982-83	1,090,000	26,500	126,000	152,500
1983-84	1,300,000	23,000	160,000	183,000
1984-85	1,410,000	19,200	181,000	200,200
1985-86	1,472,700	32,850	185,050	217,900
1986-87	1,728,400	93,350	159,000	252,350
1987-88	1,940,500	118,600	159,400	278,000

Note: Nonmembers' figures are estimated at 10% of the above.
Source: The Solvent Extractors' Association of India.

TABLE 4

State Processing Capacity During 1987-88

State	Number of plants	Annual capacity (million metric tons)
Andhra Pradesh	57	1.43
Gujarat	49	0.24
Madhya Pradesh	45	0.67
Punjab	31	0.78
Maharashtra	32	0.28
Uttar Pradesh	31	0.69
Karnataka	22	0.36
Haryana	11	0.16
Tamil Nadu	12	0.11
Orissa	8	0.12
West Bengal	9	0.10
Others	30	0.26
	337	5.20

Source: The Solvent Extractors' Association of India.

refrain from processing rice bran.

One of the first measures taken to combat these problems was sterilization of the bran at elevated temperatures and moistures to retard the action of the enzyme sufficiently to permit storage of the bran with no rise in free fatty acid for reasonable lengths of time. Although proper sterilization resulted in deactivation of the enzyme, the problems linked to the fines were not eliminated and continued to present plant processing difficulties.

Now, the Expandolex process is the newest and best approach to the processing of rice bran, accomplishing both sterilization of the bran immediately after polishing to permit the production of edible quality oil by a simple solvent extraction technique and agglomeration of fines to eliminate problems in the extraction plant. Indian processors have started adopting this technology and it is hoped that in due course, a larger number of these machines will be installed, to result in increased production of edible rice bran oil.

Solvent extraction plants are scattered throughout the country and have a total capacity of about 5.2 million MT per year. Current utilization is only 41% of capacity (Table 4).

Measures need to be taken to remove obstacles to produce the maximum quantity of good quality rice bran and to increase extraction and production of edible rice bran oil in the coming years. These include:

- Huller mills should be converted into minirice mills so that they can produce extractable quality rice bran.
- Considering the national waste, no more huller mills should be installed and the operation of the existing units should be made uneconomical.
- There should be one national policy on the levy system and it should be the same for huller and sheller mills.
- Air separators should be compulsory in rice mills to produce better quality rice bran free from husks.
- More modern rice mills, preferably of 4 MT per hour capacity, should be set up in the major rice-producing areas.
- The enzymatic reaction should be arrested by a sterilization process, preferably the Expandolex process, within 72 hours of milling.
- Fiscal incentives should be offered to the rice milling and extraction industries for producing good quality extractable rice bran and edible rice bran oil.

TABLE 5

Rice Bran Oil Fatty Acid Composition

Fatty acid	Content (%)
Myristic	0.4 - 1.0
Palmitic	12.0 - 18.0
Stearic	1.0 - 3.0
C_{20}-C_{22} saturated	1.0
Oleic	40.0 - 50.0
Linoleic	29.0 - 42.0
Linolenic trace	1.0
Palmitoleic	0.2 - 0.4

The edible quality rice bran oil currently produced is primarily used as an oil mix in the hydrogenation industry. Only a negligible quantity is refined and sold for direct cooking purposes. Few modern miscella refining units have been installed in the country. Due to the inferior quality of crude rice bran oil, perfect refining has not been possible and problems of color fixation and incomplete dewaxing have persisted. In hydrogenation, these problems are not all that prominent because of mixing with other light-colored oils and because the finished product is marketed in the solid state.

Fatty acid data indicate that rice bran oil contains 15%–20% saturated fatty acids and 80%–85% unsaturated fatty acids (Table 5). The refined oil is pale yellow in color and possesses a good flavor. The other characteristics of the oil are shown in Table 6.

TABLE 6

Indian Standard Specification for Rice Bran Oil (IS. 3448-1984)

Sr. No.	Characteristics	Refined grade[a]	Grade I (Raw)[b]	Grade II (Raw)[c]
1.	Moisture and insoluble impurities present by weight (max)	0.10	0.5	1.0
2.	Colour in a 1 cm cell on the lovibond scale expressed as Y + 5R not deeper than	20.00 No dominant green colour	—	—
3.	Refractive Index at 40°C	1.4600 to 1.4700	1.4600 to 1.4700	1.4600 to 1.4700
4.	Specific Gravity at 30°/30°C	0.910 to 0.920	0.910 to 0.920	0.910 to 0.920
5.	Saponification Value	180 to 195	175 to 195	175 to 195
6.	Iodine Value (Wijs)	90 to 105	85 to 105	85 to 105
7.	Acid Value	0.5 Max.	20 Max.	Above 20
8.	Unsaponifiable matter present by wt (max.)	3.5	6.0	6.0
9.	Flash point, Pensky Martens (closed) °C (Min)	250	100	90

[a]Refined Grade (for direct edible consumption).
[b]Grade I (Raw) (for making refined oil and use in hydrogenation industry).
[c]Grade II (Raw) (for all other industrial uses other than making refined oil).

From Table 6 it is evident that the edibility of refined rice bran oil is comparable to other refined oils, including groundnut (peanut), cottonseed, soybean and rapeseed oils. Moreover, rice bran oil has better keeping qualities due to the presence of natural antioxidants (tocopherols). Chemical constants of this oil mentioned earlier are also comparable with a number of edible oils except for unsaponifiable matter, which is rather high due to the presence of wax. Work on the removal of wax is still continuing and the industry believes a completely wax-free refined rice bran oil will be available as an ideal cooking oil in the not-too-distant future.

Rice bran oil is seen as a superior oil, rich in vitamins and low in ingredients responsible for cholesterol. In Japan, rice bran oil is called the "heart oil" because the food cooked in it is found to be very delicious and the oil has a longer shelf life. I believe it will be of great advantage to the consumers if we can develop the use of rice bran oil as a high-grade refined liquid oil.

Unquestionably, rice bran oil can play a significant role in augmenting India's domestic vegetable oil supply. However, some hard decisions will have to be taken by the Indian government and its state governments to enable the solvent extraction industry to play its legitimate role in increasing the vegetable oil supply, thereby reducing dependence on imported oils and saving valuable foreign exchange. A planned program is of utmost importance for achieving the desired results and a time frame—perhaps by the end of 1990—should be set. The task is formidable but it is one that must be undertaken.