

RICE BRAN OIL: A HEALTHY ALTERNATIVE OF INDIAN OIL INDUSTRY

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ABSTRACT

Rice bran oil (RBO) is obtained from the outer layer of the rice, called rice bran, produced during polishing in milling industries. RBO is known as a miracle oil due to its unique properties among vegetable oils. Different types of oil extraction methods are used to produce RBO. Recently many researchers have developed various non-conventional methods that are more efficient and eco-friendlier than conventional oil extraction. The non-conventional method provides non-toxic, anti-inflammatory, antioxidative, anti-diabetic and anticarcinogenic compounds to RBO. In addition, rice Bran Oil contains a balanced source of MUFA, PUFA, and numerous antioxidants like tocopherols and tocotrienols, which have various health benefits.



INTRODUCTION

Rice (*Oryza sativa L*) is used as a staple food all over the world. China and India are the most dominating rice-growing countries, with almost 50% of world rice production. Rice is a good source of minerals, carbohydrates and vitamins. After the milling process, it consists of around 70% rice as main product and byproducts like 20% of husk, 8% bran and 2% germ (Van Hoed et al., 2006). Recently, researchers have observed that rice bran contains numerous health benefits, including antioxidant, anti-inflammatory, anticarcinogenic, and anti-diabetic properties, preventing bad cholesterol and providing good cholesterol. Depending upon the variety and milling process, almost 10-26% of oil can be obtained from rice bran oil (RBO). The compound oryzanol is the unique antioxidant present in the rice bran. In addition, RBO is a good source of phytochemicals such as γ -oryzanol, phytosterol, tocotrienol, squalene, polycosanols, phytic acid, ferulic acid and inositol hexa-phosphate (Khatoon and Gopalakrishna, 2004; Ardiansyah et al., 2006; Sakia and Deka, 2011).

Table:1 Properties of Rice Bran Oil

Parameters	Values
Food energy per 100 g	3,700 kJ (880 kcal)
Smoke point	232°C (450°F)
Iodine value	99-108
Acid value	1.2
Saponification value	180-190
Unsaponifiable	3-5

Table:2 Phytonutrients and Fatty Acid Composition of Rice Bran Oil

Compound	Composition (%)
γ -oryzanol	0.9-2.9
Tocopherol	0.10-0.14
Saturated fatty acid	22.5
Palmitic	21.6
Stearic	2.1-4.7
Arachidic acid	1.0
Myristic	0.30-0.39
Monounsaturated fatty acid	44.0
Oleic acid	42.6
Palmitoleic acid	0.19
Polyunsaturated fatty acid	33.6
Linoleic acid	28.0
Linolenic acid	0.8
n-3 polyunsaturated fatty acid	0.5
n-6 polyunsaturated fatty acid	33.1

CHARACTERISTICS OF RICE BRAN OIL

- Most balanced fatty acid composition.
- RBO is most suitable for deep frying and stir-frying among vegetable oil due to its high smoke point (232°C).

- The oil absorbed by food is relatively less (15%), the features making it perfect over other cooking oil.
- It has a long shelf life because less polymer creates during frying, providing better taste and flavour to food.
- It contains a number of phytonutrients and fatty acids, which makes it healthier.

RICE BRAN OIL MARKET

During 2019-2020, the global rice bran oil production was 1.8 million tons. The market is projected to reach 2.01 million tons by 2026. The major producers of rice bran oil are India, China, Japan and Thailand. India produces 9.5 lakh tons, and China produces 2 lakh tons of rice bran oil. India exported about 9,500 tons of RBO in 2017-2018; out of this, Punjab's share was over 6500 tons. Thailand is the largest exporter of RBO, followed by India.

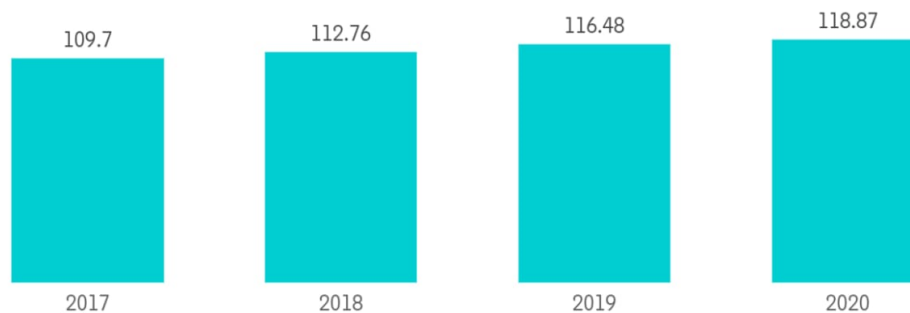


Fig: 1 Rice Bran Oil Market: rice production volume (in Million Metric Tons), India, (2017-2020).

METHODS OF RBO EXTRACTION

Following are the two rice bran oil extraction methods:

1. CONVENTIONAL METHOD

The conventional method mainly uses solvent and cold pressure techniques for rice bran oil extraction. Conventional oil extraction methods are mostly used for commercial purposes. However, several drawbacks have been found because of its high flammability, toxic effect, low-quality RBO production and most hazardous to the environment. It is of two types:

1.1 Solvent Extraction Process

Because of its high recovery rates, the Solvent extraction method using hexane is the most common commercially used oil extraction method. Though using this method, poor quality RBO is produced due to its toxic effect. The most commonly used solvent is hexane,

but ethanol and isopropanol have also been used for oil extraction. Almost 92% oil can be obtained from hexane and 42.7-99.9% oil from rice bran by using ethanol at 60-90°C. RBO yield will be increased in increasing temperature from 40°C to 60°C using hexane to bran 2:1 and isopropanol to bran 3:1 ratio.

1.2 Mechanical Pressing

Mechanical pressing oil extraction is one of the most traditional methods without involving solvents or chemicals. Thus, it makes the process cheaper and less laborious. The main advantages of this method are the chemical-free, safe, and highly nutritive end product. Mainly two types of cold pressing methods are screw press and hydraulic press. Among these, the screw press is more efficient and produces higher oil than the hydraulic press. About 80-85% of oil can be obtained by using this method.

2. NON-CONVENTIONAL METHOD

There are also different types of non-conventional methods of RBO extraction. Such as supercritical oil extraction, subcritical fluid method, enzyme-assisted aqueous extraction, and ultrasonic-assisted. Many researchers have developed various non-conventional, more efficient and eco-friendly methods than conventional oil extraction.

2.1 Super Critical CO₂ extraction

There is no use of chemical solvent in this method, which helps prevent chemical contamination. The supercritical CO₂ extraction method of RBO extraction is faster and more efficient than conventional methods of RBO extraction. This method, CO₂ is used as a supercritical fluid with high pressure and temperature above critical levels (31°C and 71 atm). Around 19.2%-20.4% yield can be obtained at 60°C temperature, 200 bars for 30 minutes. By combining Sc- CO₂ and ultrasound extraction methods, better yield with high nutritive value can be obtained. However, this method is quite expensive.

2.2 Sub-critical fluid method

This method is relatively cost-effective and hazard-free. Thus, it was found to be better than supercritical CO₂ RBO extraction. The water is used below the supercritical temperature and pressure for oil extraction. Propane and butane solvents are used due to their low critical temperature and pressure. Almost 89.11% to 91.42% RBO may be obtained by using these solvents.

2.3 Enzyme-Assisted Aqueous Extraction

Enzyme Assisted Aqueous Extraction method has been considered an eco-friendly oil extraction method. This process degrades the cell wall by an enzyme reaction to extract oil. Around 92.63% RBO can be obtained through enzymatic extraction.

REFINING IN RICE BRAN OIL

After extraction of RBO, the crude oil needs to undergo some stabilization processes to refine the oil to inactivate the enzymatic and lipid oxidation. This process helps prevent the alteration of nutritive composition like fat and other valuable bioactive compounds of RBO. There are mainly two types of refining processes - chemical and physical refining. The mostly alkali-based chemical refining process is used to modify the phytosterols profile and helps colour retention. On the other hand, the physical process helps retain more vitamins and some other phytochemicals.

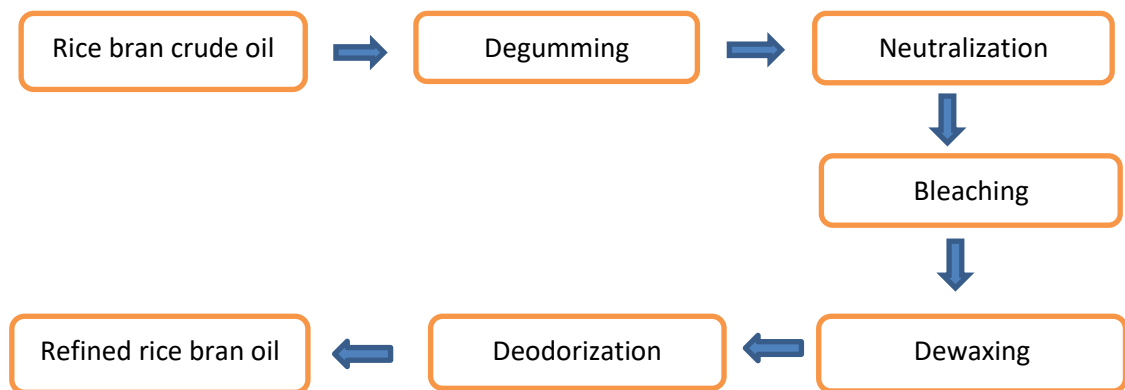


Fig:2 Flow diagram of rice bran oil refining.

Table:4 Physical properties of crude and refined rice bran oil

Properties	Crude rice bran oil	Refined oil
Moisture	0.5-1.0%	0.1-0.15%
Density (15°C)	0.913-0.920	0.913-0.920
Refractive index	1.4672	1.4672
Iodine value	85-100	95-104
Saponification value	187	187
Unsaponifiable matter	4.5-5.5	1.8-2.5
Free fatty acids	5-15%	0.15-0.2%
oryzanol	2.0	1.5-1.8
Tocopherol	0.15	0.05

DIVERSIFIED USE OF RICE BRAN OIL

RBO is known as the wonder oil because of its unique fat composition and valuable nutritive value. Due to its various health-desirable attributes, RBO is used in food, pharmaceutical, chemical, cosmetic, etc.

1. FOOD USES

1.1 Cooking oil

RBO is extensively used as an edible oil in many Asian countries. RBO is generally used as vegetable oil because of its balanced fat composition, high oxidation stability, cooking quality and shelf life. Relatively stable in high temperatures due to its high smoke point. During deep frying, less than 15% RBO is absorbed by the food, and these unique characteristics make it popular in restaurants and food industries.



Fig:3 Rice Bran Oil

1.2 Bakery Industries

RBO is also used in the bakery industry due to its lipid creaming and shortening ability, making the product crunchy and lubricative in texture (Zhou et al., 2011). In bakery making, RBO shortening may decrease the use of butter, and it is used in various products like cakes, cookies, bread, puff pastry, pies etc.

1.3 Milk and Milk Products

Rice bran oil is used as a quality parameter in the milk industry. RBO stabilizes the oxidation reaction in whole milk powder to improve the flavour (Nanua et al., 2000). The addition of RBO in milk reduces the oxidation without alteration of flavour.

1.4 Meat Industry

Meat products with high animal fat increase the risk of obesity and hypertension. Using RBO instead of fat in meat industries lowers the fat composition and makes it healthier for consumers. (Yum et al., 2018).

2. NON-FOOD USES

2.1 Polymers

Rice bran oil is used to make biodegradable polymers. It may be a very degradable and perfect substitution for petroleum polymers. RBO provides more durability, and flexibility within polymers than commercially used polymers.

2.2 Lubricant and Biofuel

Lubricants and biofuel from RBO are more eco-friendly than petroleum oils due to their better degradability, renewability, and low toxicity. Vegetable oil has a low fire point, high lubricity, and fewer evaporative losses.

2.3 cosmetics

Rice bran oil is an excellent ingredient in the cosmetic and stationery industries. Products like sunscreen, anti-ageing lotions, nail polishes, lipsticks, and hair conditioners are produced by RBO. The γ -oryzanol in RBO protects the skin from UV light and acts as a hair growth stimulator.

2.4 Pharmaceutical Uses

RBO is great in the pharmaceutical and chemical industries. The significant level of chemical compounds and their unique effects are an important component of pharmaceutical use. RBO helps to decrease the bad cholesterol by 7% in the human body. It is also used in animal diets. RBO contains many antioxidants, which help in many ways in humans and animals.

CONCLUSION

Rice Bran Oil contains a balanced source of MUFA, PUFA, and numerous antioxidants like tocopherols and tocotrienols, which have various health benefits. Nowadays, RBO has become more popular as cooking oil and the physician's most prescribed vegetable oil than other cooking oil. RBO has hypoallergenic properties, better frying quality and oxidative stability than other cooking oils. RBO is a component of various industries like food, non-food and pharmaceutical industries because of its unique properties and nutritive value. It works well against different diseases and protects humans against several health ailments.

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