

**Technologies Available
With
CSIR-Indian Institute of Chemical Technology, Hyderabad**

1. ENZYMATIC DEGUMMING OF RICE BRAN OIL

Rice bran oil has a balanced fatty acid profile with presence of a host of minor constituents with proven nutritional benefits such as gamma oryzanol, tocotrienols, tocopherols and squalene. At the same time, rice bran oil differs from other vegetable oils because of its higher content of free fatty acids along with unusually high content of wax, unsaponifiable constituents, polar lipids including glycolipids, and coloring materials. The majority of the nutritional components present in rice bran oil are being destroyed or removed during traditional alkali refining. Chemical refining of rice bran oil generally results in losses considerably higher than those encountered in other vegetable oils.

Refining losses can be considerably reduced using physical refining. The important prerequisite for successful physical refining is to keep the phosphorus content in the oil < 5 ppm. The presence of phosphorus-containing components cause color fixation in the final oil during its exposure to high temperatures of physical refining. Water degumming is the simplest method for removing phospholipids (lecithin) from vegetable oils. However, only hydratable phospholipids can be removed during water degumming leaving 80 to 200 ppm of phosphorus in the oil, depending upon the type and the quality of the crude oil due to the presence of non-hydratable phospholipids. Enzymatic degumming is the answer for all the problems as the phospholipase catalyzes the conversion of non-hydratable phospholipids also into water-soluble lyso-phospholipids, which are then removed by centrifugation, yielding degummed oil low in phosphorus.

Advantages of the Process:

The enzymatic degumming process can be adapted in the existing refineries with minor modifications in the degumming process. Phosphorus level in the pre-treated rice bran oil to be sent for physical refining could be brought down to 0 to 5 ppm after degumming, bleaching and dewaxing. Water wash is not necessary after enzymatic degumming and hence oil loss in washing step can be avoided. The oil loss during enzymatic degumming process is lower compared to the conventional phosphoric acid degumming. The gums obtained in enzymatic degumming are about 1 to 1.5% against 2-4% in the conventional degumming. The oil content of the enzymatic degumming from gums is only 20 to 30% compared to 50-60% in the conventional gums. Thus there is a saving of about 1 to 1.5%

of oil during the enzymatic degumming depending on the content of phospholipids in the oil. The enzymatic degumming process does not alter the fatty acid composition of the rice bran oil. The oryzanol present in crude rice bran oil remains almost intact during the enzymatic degumming. The enzymatic degumming is an eco-friendly process, as it does not generate effluent water.

Major Raw Materials: Crude rice bran oil, phospholipase A1, sodium citrate buffer solution.

Brief Process Description: The crude rice bran oil is treated with phospholipase A1 solution in well defined conditions and centrifuged for the separation of the hydrolyzed gums from the degummed oil. The degummed oil is dried in a vacuum drier and used for further refining steps. The degummed oil if refined in a well maintained physical refining unit will produce good quality edible rice bran oil.

Scale of Demonstration: Any commercial scale operation

Product Specifications: Phosphorus content in the dewaxed oil after enzymatic degumming and bleaching: less than 5 ppm,

By-products: Lyso lecithin

Net Profit for processing of oils by enzymatic degumming in comparison to phosphoric acid degumming is Rs. 325/- per ton. In a plant having 100 tons per day capacity the net profit is Rs.32500/- per day. Moreover, one third of the gums are converted into fatty acid, that are collected along with the deodorizer distillate. This brings extra revenue. In this process, water wash is not required and it reduces load on environment.

Phosphoric acid degumming does not bring down the phosphorus content of the oil to the desired limit and results in further losses in bleaching and dewaxing steps. These will add more profits for enzymatic degumming.

2. UPGRADED & BLEACHED WAX FROM CRUDE RICE BRAN WAX

Wax is a by-product during dewaxing of certain oils such as corn, sunflower and canola. However, rice bran is a good source for wax. Crude rice bran oil contains upto 6% of waxes. Presently huge quantities of crude rice bran wax are being accumulated in oil refineries and have to be sold off at nominal or very low prices. There is a need to upgrade crude rice bran wax to enhance its value as it contains large amounts of triglycerides (20 to 70%), free fatty acids (1 to 20%) and some resinous material (5 to 15%). Upgraded and bleached waxes may have considerable potential for use in various industries.

Applications: Rice bran wax can be used in several formulations used in paper coating, thermal transfer recording materials, surface coatings (pigment dispersant and thermal transfer ink composition preparations), toner compositions for electro statographic image formation process, PTTE coated silicone rubber rolls, candles, water proofing, polish (floor, furniture and shoe), binder for manufacture of fuel briquettes from industrial and agricultural wastes, cosmetics (cold creams or fragrance sticks, hair conditioners, lipsticks etc.), carbon paper, printing inks, adhesives, lubricant for PVC or ABS compositions, food emulsions, egg, fruit and vegetable coatings, pharmaceuticals, plasticizing material in chewing gum etc. Rice bran wax may also be used as a substitute for the imported wax like carnauba.

Major Raw Materials: Crude rice bran wax, organic solvent, bleaching agent

Brief Process Description: In the first step the crude wax is upgraded by removing the oil and resinous matter selectively using an organic solvent. The upgraded wax is further bleached chemically to obtain odorless light yellow wax.

Scale of Operation: 2 kg crude wax / batch

Product Specifications:

	M.P. (°C)	A.V.	S.V.	I.V.
Bleached Rice Bran Wax (IICT-H)	79-80	0-5*	75-90	8-15
Rice Bran Wax (FDA specifications)	75-80°C	20 (Max.)	75-120	20 (Max.)
Carnauba Wax	83-86°C	3-8	72-85	8-12

*Depending on the AV of crude wax

By-products: Resinous matter, rice bran oil with about 4 to 5% of soft wax

CSIR-IICT Product Cost:

1 Kg of Upgraded & Bleached RB Wax @ Rs. 200/- (against Rs 400/-)

(Raw Materials: Crude RB wax, Rs. 195/-; Solvents & reagents, Rs. 100/-
Processing Cost including utilities & manpower: Rs. 35/- & Recovered Oil: Rs. 130/-)

3. TRIACONTANOL / OCTACOSANOL (POLICOSANOL) FROM CRUDE RICE BRAN WAX

The major components of the defatted rice bran wax are wax esters constituted of even numbered chain length homologues from C₄₄ to C₆₀. The wax esters are formed from very long chain fatty acids (C₂₂ and C₂₄ are major) and fatty alcohols (C₃₀, 25 to 30%; C₂₈, 10-15%). Hence triacontanol and octacosanol can be prepared from the defatted rice bran wax.

Applications: The fatty alcohol fraction prepared from rice bran wax, which is usually called as triacontanol is useful for stimulating growth in a wide variety of plants, including agricultural crops such as corn, soybean, wheat, rice and tomatoes. Formulations are prepared by dissolving the triacontanol in organic solvents and then adding the solution to water with an emulsifying agent. Oral and parenteral preparations containing 0.5-5% of a mixture of higher fatty alcohol formulations were reported to be useful for the treatment of hypercholesterolemia and hyperlipoproteinemia. Octacosanol can block the formation of cholesterol in the liver. In addition to preventing the formation of cholesterol, octacosanol can also help to clear the blood of "bad" cholesterol that is already present.

Raw Materials: Crude rice bran wax, alkali and organic solvent.

Brief Process Description: The process involves aqueous saponification followed by extraction of fatty alcohol mixture from the soap using an appropriate organic solvent. The fatty alcohol mixture thus obtained contains about 25 to 30% of triacontanol and 12-15% octacosanol. This was further subjected to sequence of crystallizations using different organic solvents to enrich the octacosanol content from 15% to 25%. The residual soap after extraction of fatty alcohols is the source for long chain fatty acids (C₂₂ and C₂₄).

Scale of Demonstration: 1- 2 kg defatted wax / batch

Product Specifications: White color solid with 15 to 25% of octacosanol in the fatty alcohol mixture. However, specifications may be tailor made as per the requirement of the client.

By-products: Soap of long chain fatty acids.

CSIR-IICT Product Cost:

1 Kg of Triacontanol @ Rs. 250/- (against Rs 1500/-)

(Raw Materials: Crude RB Wax: Rs. 145/-; Solvents & Reagents: Rs. 140/- Processing Cost including utilities & manpower: Rs. 125/- & Recovered Oil & soap: Rs. 160/-)

4. ENRICHMENT OF TOCOPHEROLS & PHYTOSTEROLS FROM DEODORIZER DISILLATES OF VEGETABLE OILS

Deodorizer distillate (DOD) is a by-product obtained during the refining of vegetable oils and is a good source for the isolation of phytosterols and tocopherols. Deodorizer distillate generally contains about 35-40% triglycerides, 40-50% fatty acids, 4-10% sterols and 3-8% tocopherols. Isolation of tocopherols and phytosterols from DOD results in value addition to by-products of vegetable oil processing industry.

Applications: Phytosterols exhibit several pharmaceutical and nutraceuticals applications. Tocopherols are natural antioxidants. Alpha- and gamma tocopherols exhibit strong vitamin E and antioxidant activities respectively.

Major Raw Materials: Deodorizer distillate of soybean oil and sunflower oil (with minimum 5% of tocopherols and phytosterols each) and methanol.

Brief Process Description: The DOD is converted to fatty acid methyl esters by esterification and transesterification process in presence of catalyst. Fatty acid methyl esters are distilled out from the esterified product using short path distillation unit and both tocopherols and phytosterols are enriched to required purity using crystallization and distillation techniques.

Scale of Demonstration: 2 to 4 kg/batch of DOD

Product Yield and Specifications:

Tocopherols (Mixture of alpha, gamma and delta tocopherols): 60-70% pure with 4% Yield of Soya DOD.

Phytosterols (Mixture of Campesterol, stigmasterol and betasitosterol): 95% pure with 6% Yield.

By-products: Fatty Acid Methyl Esters (75% yield)

CSIR-IICT Product Cost:

1 Kg of 60-70% Pure Tocopherols @ Rs. 2200/- (against Rs. 3500/-)

By-Products:

1. Phytosterols (>95% purity, 1.25 Kg, 6% yield of soya DOD) @ Rs. 1200/- per Kg (against Rs. 2500/-)
2. Fatty Acid Methyl Esters (17.5 Kg, 75% yield of Soya DOD 25 kg) @ Rs. 60/- per Kg (against Rs. 95/-)

(Raw Material: Soya DOD, Rs. 2500/-; Processing Cost including Solvent, Catalyst, Utilities & Manpower: Rs. 2500/- & Recovered By-products i.e. Phytosterols & Fatty Acid Methyl Esters: Rs. 2800/-)