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Review on Rice Bran Extract

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Abstract

The goal of this study is to examine the creative strategies for converting rice bran into a desirable food ingredient that have been presented in recent decades based on bioprocessing, thermal, or physical treatments. The principal by-product of rice grain processing is rice bran (Oryzasativa). It is produced in vast amounts all over the world and includes a high concentration of vital minerals and bioactive chemicals with important health benefits. Despite this, its usage in the food business is limited because to its oxidation sensitivity, instability, and lack of technological compatibility. In addition, this review considers the most recent research on both in vivo and in vitro investigations to show the health-related impacts of pre-treated rice bran.

In addition, a brief explanation of rice bran arabinoxylans is offered in this regard. Finally, the use of rice bran in the food business as well as the key technological issues are briefly discussed.

Other Health-Promoting Properties

Because rice bran contains a diverse spectrum of bioactive compounds, its effects on oxidative stress are now being investigated. In obese Zucker rats fed a diet supplemented with RBEE, Justo et al. Found a reduction in microvascular inflammation. Furthermore, Perez-Ternero et al. investigated the effects of RBEE supplementation in the diet of Wistar rats, finding that an increase in the concentration of phenolic compounds in the blood resulted in inactivated superoxide generation. Other studies have looked into the many impacts of rice bran supplementation in various forms. For example, brown rice bran fermented with Aspergillus oryzae. Which caused apoptosis in human acute lymphoblastic leukaemia cells, or the anti-stress and anti-fatigue benefits of Saccharomyces cerevisiae fermented rice bran, or the improved health of mice fed a high-fat diet containing rice bran extract. Furthermore, a high-fibre diet has been shown to modify the metabolites produced by the human colon microbiota. Zhang et al. observed a significant probiotic impact on colonic bacteria related with diabetes after in vitro gastrointestinal digestion of isolated rice bran dietary fibre.

Properties	Extract	Outcome
Hypolipidemic	rice bran enzymatic extract (RBEE)	Increase HDL and decrease cholesterol improved endothelial function
	trans-ferulic acid,	Lower cholesterol levels
	y-oryzanol	Decrease LDL and VLDL
	tocotrienol rich fraction (TRF) isolated from rice bran oil	HMG CoA activity decreases results decrease in cholesterol
Hypoglycaemic	y-oryzanol	Increase insulin production and decrease glucose level in type 2 diabetics
	phenolic acids-ferulic acid	decrease in blood glucose levels and a rise in plasma insulin levels Hepatic glycogen synthesis and glucokinase activity were considerably higher
	Red rice extract (orzyanivara)	Reduce blood glucose level
	Black rice extract (orzyasativa L Indica	Reduce blood glucose level
Immunomodulatory	Glycoprotein obtained from rice bran	Proliferation of splenic lymphocytes
	Methanolic extract of red brown black rice bran	Suppression of interferon gamma or interleukin 6 ,interleukin 1 alpha , TNF alpha

	Feruloyated oligosaccharide	Dose dependent suppressed TNF alpha , IL -1 ,IL -6, NO
Skin protection	ferulic acid	Removes wrinkles ,damaged skin cells, free radicals and act as anti-ageing
	gamma-oryzanol , and phytic acid	increase skin moisture
	tocopherol and tocotrienol	Keep skin fresh and vibrant
Hair growth	rice bran supercritical CO2 extract (RB-SCE)	Hair growth promoting capacity
	linoleic acid, policosanol, -oryzanol, and –tocotrienol	hair follicles has increased substantially decrease hair loss

APPLICATION IN DRUG DELIVERY SYSTEM

SOLUBILISER

Self-Nano emulsifying drug delivery systems (SNEDDS), for example, are a popular formulation technique for improving the aqueous solubility and oral bioavailability of weakly water-soluble drugs. The use of biorefinery wastes, such as rice bran oil, could help improve medicine solubilization and absorption while also attaining long-term angry-food waste valorization.

The oral bioavailability of fenofibrate, a BCS class II chemical, was studied using four SNEDDS formulations that differed in oil (rice bran oil and corn oil) and surfactant type (Kolliphor RH40 and EL). Drug solubilization was investigated in vitro using the static digestion model prior to in vivo oral administration of the SNEDDS in rats, followed by an ex vivo permeability examination of the predigested SNEDDS using the non-everted gut sac model. Within the different SNEDDS formulations, there was no substantial variance in solubilization capacity. The ex vivo permeability data of the predigested SNEDDS, on the other hand, matched well with the in vivo bioavailability data, indicating the advantages of rice bran oil with Kolliphor EL as the surfactant in improving fenofibrate oral absorption. The findings suggested that valorizing agricultural by-products like rice bran oil could help improve the oral performance of LbDDS in the case of fenofibrate while also maximising the use of agricultural by-products through the creation of new sustainable value chains in the pharmaceutical industry. [11]

CONTROLLED RELEASE

Scientifically, phytosterols, -tocopherol, and -oryzanol are significant health-promoting components discovered in cold-pressed rice bran oil (CRBO). The goal of this work was to use a niosome delivery method to encapsulate CRBO. Water soluble CRBO niosomes with a diameter of 200 nm were created, which were stable at 4 °C for up to four weeks and had an encapsulation efficacy of >80%. In vitro digestion allowed for CRBO niosome regulated release till the small intestine phase.

This is the first study to show a spherical morphology of CRBO niosomes and the location of CRBO, to our knowledge. With 25, 50, and 100 g ml-1 of in vitro digested CRBO niosomes, M0, M1, and M2 macrophage phenotypes were induced. M1 and M2 marker gene analyses were used to obtain gene expression profiles for each macrophage cell. After CRBO stimulation, changes in M0, M1, and M2 macrophage gene expression profiles occurred, which were visualised using main component analysis (PCA). The results demonstrated that M1 macrophages converted to M0 in a digested CRBO niosome dose dependent way, whereas M0 and M2 macrophages did not. According to our findings, CRBO niosomes can revert M1 pro-inflammatory macrophage conversions back to resting M0 macrophages. Furthermore, this research indicated that CRBO niosomes, which contain rice phytosterols and a co-surfactant, could be used as fabricating materials to distribute and control the release of oil soluble bioactive components for water soluble functional ingredient applications in the future. [12]

Stabilizer (antioxidant)

Gamma-oryzanol (GO), a combination of ferulic acid esters, has recently piqued interest as a natural antioxidant produced from rice bran oil, which is commonly used to preserve food and pharmaceutical raw materials, as well as a sunscreen in cosmetic formulations. Its utility, however, is limited by its rapid decomposition. The incorporation of antioxidants in supramolecular structures is a recently proposed method for increasing antioxidant stability and efficiency (nanoparticles, cyclodextrins, liposomes, etc.). We investigated the use of GO in -cyclodextrin-based Nano sponges, which have been popular in recent years for their capacity to encapsulate a wide range of compounds to reduce side effects and protect them from degradation. DSC, XRPD, and membrane diffusion runs were used to characterise the inclusion complex, which was produced in a 1:1 w/w ratio. The photo degradation of GO when exposed to UVA or UVB was shown to be inhibited when it was embedded in Nano sponges. In vitro research on pig ear skin demonstrated a certain accumulation of GO when entrapped in the host structure, while in vivo experiments on porcine ear skin revealed a certain accumulation of GO when entrapped in the host structure.

Rice husk extract prepared by acid and alkali pretreatment extraction (AAPE) includes bioactive components and has anti-inflammatory properties. This study looked at the phenolic composition of rice husk extract and the mechanism of silver nanoparticle (AgNP) generation utilising AAPE rice husk extract. Under the following circumstances, stable and spherically formed AgNPs with a size of 15 nm were prepared: 0.001 M $AgNO_3$, 10 times diluted AAPE rice husk extract, pH 10, and 60 minutes at 25 °C. The production of AgNPs was aided by synergistic effects among phenolic acids, which acted as efficient reducing agents (due to their numerous hydroxyl groups) and excellent dispersants , enhancing the NPs' stability. Caffeic acid (CA) has been shown to generate AgNPson its own and is thought to be the most important molecule for decreasing Ag^+ during rice husk extract production. The creation of AgNPs generated utilising CA in rice husk extracts is postulated as a feasible mechanism and reaction process. [13]

Property	Extract	Drug loaded dosage form	Outcome
Solubilizer	1)Rice bran oil - y-oryzanol 2) Tocotrienol rich fraction (TRF) isolated from rice bran oil	Lipid-based drug delivery systems (LbDDS), such as self-Nano emulsifying drug delivery systems (SNEDDS) Emulsified and formulated in hard or soft gelatine capsule	enhancing the aqueous solubility and oral bioavailability of poorly water-soluble compounds responsible for Sustained delivery action
Controlled release	Cold-pressed rice bran oil (CRBO).	Nio some delivery method to encapsulate CRBO	Increase stability at 4 °C And had an encapsulation efficacy of >80%.
	Phenolic acid fraction and ferulic acid	Nano supension using nanoparticles for oral administration	Achieved sustained release formulation result in increased bioavailability
Antioxidant	Gamma-oryzanol (GO), in combination with ferulic acid	nanoparticles, liposomes	increasing antioxidant stability
	phenolic acids from Rice husk extract	Synthesis of silver nanoparticle (AgNP)	Act as efficient reducing agent

Application in food industry

The inclusion of a food by-product into a traditional or new food product composition is the most essential stage in the recovery of food by-products. The primary goal is to increase the value of the finished product by improving nutritional or sensory qualities. Colour, taste, smell, and texture are all attributes. The latter functions are crucial as well. The so-called "clean label" status can achieved using recovered materials. Rice bran offers yet another benefit. Its suitability for gluten-free product processing is a benefit. These Products are frequently of poor sensory quality, yet have a high monetary worth. Furthermore, functional qualities are a key factor to consider when incorporating these by-products into a food formulation. Because RB is a plant-based substance, it is high in dietary fibres. Ingredients that make up this product the latter molecules have the potential to contribute to the overall picture. Rice bran functionality in terms of water (WBC) and oil binding (OBC) capabilities. Furthermore, the protein fraction seen in RB (12–16 %), has the capacity to jellify. stabilising actions such as emulsifying and foaming

The techno-functional qualities of rice bran are interesting for the food business, according to Capellini et al., and they can be improved utilising certain alcoholic solvents. In addition, Shi-Wen et al. reported significant findings on the functional characteristics of rice bran stabilised using various methods Microwave and dry heating treatments are both effective, with the latter somewhat better than the former. In terms of WBC, OBC, emulsifying capabilities, and long-term stability, the former is superior.

Because of its sensitivity to oxidation and subsequent off-flavour production, it is highly recommended to stabilise rice bran or extract the oil before using it as an ingredient. This is easily accomplished by employing thermal and non-thermal techniques. Sairam et al.Investigated the effects of adding various concentrations of defatted rice bran (DRB) to bread in order to improve its nutritional profile. Total dietary fibres, AOC, and bread shelf life increased without affecting sensory qualities. Total dietary fibres, AOC, and bread shelf life increased without affecting sensory qualities. In light of this, Al-Okbi et al. Created corn flakes and tortilla chips by varying the amount of rice bran in the original recipe, observing an improvement in the final product's organoleptic and rheological properties as the protein level was reduced.Premakumari et al. also attempted to generate high fibre content ready mixes by substituting a varied quantity of previously stabilised RB for traditional cereal flours and evaluated their general acceptability with 20 semi-trained panel members. The key finding was that a substitution of at least 25% did not degrade the quality of the conventional recipe. Furthermore, Younas et al.Made cookies utilising both heat and acid-stabilized RB, fine-tuning the recipe with a 10% RB replacement. The RB solid exhaust can still be used as a low-fat content ingredient because RB oil is considered a high added value product. For example, Charunuch et al used DRB at a variable rate for extruded breakfast cereal manufacturing. Meanwhile, Alfaro et al. used purple and brown rice bran oils to create an oil-in-water emulsion with acceptable stability and oxidative protection. However, due to a paucity of industrial-scale or pilot-scale investigations, the application of pretreatment rice bran in food preparation via bioprocessing, thermal, and physical treatments is currently limited. Furthermore, rice protein can be separated to create foods with high protein content and, as a result, high functionality.

Functional property	Outcome
Water absorption capacity Oil binding capacity	• Relevant water retention (>3 g water/g) • High oil retention due to insoluble dietary fibres (>3 g oil/g)

Jellification	• Jellying of hot water solution at 10–18% RB concentration
Emulsion stability	• Formation (41–57%) and stabilization of oil in water emulsion (39–74%)
Foaming stabilization	• Low foam formation, but conjointly to other foaming agents is a good stabilizer
Protein solubility.	• High solubility (around 50%) at acidic (3) and basic (8) pH

Conclusion

Rice bran is a significant industrial by-product with significant "hide" value. In terms of nutritional properties, its components include a wide spectrum of bioactive substances that have been investigated in recent years. Furthermore, using cutting-edge food-related technology, the quality parameters of RB may be further improved, making it a valuable and long-term resource for promoting a healthy diet. Indeed, significant efforts have been made to incorporate this component into commonly consumed food products, primarily baked pastries.

The importance of adding RB, in its many forms, in the diet was then suggested by a number of health-promoting qualities. However, the mechanism of action that underpins its beneficial effects should be investigated further. In this approach, it's critical to emphasise that foods and their components should not be viewed as primary weapons in the fight against illness. Finally, many sorts of creative food products, such as novel beverages or dairy products with high nutritional and sensory attributes, can be investigated, assisting in the development of a more sustainable food system.