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Rice Bran Solutions & Expectations

The food price predicament

More protein ways than one

A new protein is born

Rice bran follows the whey protein footsteps

Nature's best in hybrid meat foods

The ultimate goal now within reach

The best tasting vegetable protein
Rice Bran: Solutions and Expectations
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The food price predicament
Never before has food been such a global issue. On both sides of the spectrum are overweight and obese people sharing the planet with chronically malnourished and hungry populations. From whichever angle this issue is observed, the bottom-line is how to produce more food from less land, reduce waste and improve equal access to wholesome food at less price volatility.

Possible looming food shortages are now somewhat conveniently pushed aside by governments because of the current financial crisis. There are now so many political and financial issues that it is unsurprising governments don't have the stomach to tackle future food shortages. For now it seems that food security has moved to the back burner.

Erratic weather patterns can rather quickly cause havoc in harvest yields. It doesn't take much to create an imbalance when projected crop yields of wheat, corn, soy and rice do not meet the needs of the world population. The pressure on resources is intensifying. Not only by soaring populations, but also because of desertification, droughts, floods, land grabbing and lack of GM progress.

According to projections by the United Nation's Food and Agricultural Organization (FAO), consumers worldwide will face at least 10 more years of high food prices after the current economic downturn has subsided. Even affluent countries such as the U.S., in 2013 will have a total of some 48 million people living on Government issued food stamps and food donations, now renamed SNAP (Supplement Nutrition Assistance Program). This dynamic change is stressing economies all over the world, has exacerbated hunger and sparked political unrest in poorer countries.

The forces driving up the cost of food and functional ingredients includes rising energy prices, which trickle down and increase the cost of everything else, as well as strong demand for meat and dairy in developing countries like China, India and the Philippines. The cost of livestock feed, together with competing demand from agricultural biomass to manufactured biofuels, has played havoc on the pricing of staple commodities and specialty crops.

The world population in 1950 was about 2.5 billion, less than the anticipated 3 billion increases expected by 2050. And while developed countries accounted for close to one-third of the world's population in 1950, they will have only 15 percent of the total by 2050, since nearly all expected population growth will occur in the developing world. The combined population of China with 1.34 billion people in 2011, and India with 1.1 billion, will reach 2.5 billion people in 2012. While China's population will rise slightly, India's is expected to increase by almost 50 percent. Together, the two countries will have over 3 billion people by 2050 and will account for one-third of all people on Earth.

With the planet's population growing by some 80 million people a year, and the quality of life in developing countries improving, the demand for food is expanding. It is safe to predict that meeting the needs of some 9.4 billion people expected to be living on planet Earth in 2050 will require some heroic efforts.

How many more years can political inaction continue if even highly affluent countries such as the U.S. and UK have increasing millions of people living off food stamps and receive emergency food supplies from food banks? Yet, another 2 billion+ people will join planet earth by 2050. Every single day another 210,000 more mouths need to be fed. The challenges ahead to manage food security are very complex and of unimaginable immense magnitude.

There is little doubt that a new approach is needed to the way food is grown and shared while securing affordability and ecological sustainability. Of course, the argument can be made that the world
will be able to grow sufficient food for future generations and that inequality is not a matter of sufficient food but rather shameful waste.

It is indeed true that a very large amount of food is wasted between harvest and mouth. Ill-harvest, poor storage, hoarding, political maneuvering, processing, point of sale inefficiencies and last but not least waste by consumers are all guilty parameters that food does not reach actual consumption. As a side note it can also be stated that the greater the affluency of society, the higher the food waste. Want examples? How about 42 percent of bread sales being thrown away by UK consumers?

Fortunately governments are backpedaling on mandated use of biofuels. Taking food from the mouth and putting it into a car, is not something that is sustainable. It does make sense to limit the use of crop-based biofuels such as corn ethanol and instead try to make the economics work to produce biofuel harvested from inedible waste.

**Rice bran follows the whey protein footsteps**

However large the world’s population becomes, it will represent the opportunity of a lifetime for suppliers of functional ingredients, particularly rice bran. The opportunity definitely applies to all ingredient suppliers, but especially for nutritious ingredients that are currently ignored but yet widely available at favorable yield-cost ratios.

Soon the world of ingredient portfolio will include a variety of rice bran ingredients, including rice bran protein, rice fiber, rice oil, and hypoallergenic rice lecithin aimed at delivering better tasting foods with a superior nutritive profile compared to many other ingredients in the market today.

Rice bran refers to the outer bran and germ of the white rice kernel and is a by-product of rice milling. Historically, rice bran was considered a waste product with little value because active enzymes caused rapid lipid degradation. However, the introduction of innovative lipase deactivation resulting in lipid stabilization has allowed rice bran to move up into a higher hierarchy of the food chain.

The nutritional value of rice bran can further be exploited through processing to obtain macro- and micro-ingredients such as protein. Innovative technologies are being developed to create concentrated forms of functional rice bran protein ingredients ranging from 35% concentrate to 90% isolate. Rice bran protein hydrolysate, for instance, can be synonymous with great tasting nutrition from a whole grain source. It should be noted however that the definition of functional claims, including whole grain, can differ in various countries.

Rice bran is a high source of protein, oil, carbohydrate, prebiotic fiber with a number of micronutrients like vitamins, minerals, antioxidants and phytosterols. To turn rice bran into a functional food ingredient or dietary supplement, it is essential to stabilize the bran: specifically its’ hydrolyzing and oxidizing enzymes present in the bran must be inactivated to prevent their interaction with the oil fraction. This deactivation will prevent enzymatically catalyzed hydrolytic and oxidative degradation of the oil fraction which is responsible for objectionable odors and flavors. There is some confusion that rice bran stabilization technology somehow prevents lipid oxidative rancidity over time. This is not really true because stabilization technology will not prevent secondary oxidative breakdown of lipids. Stabilization may eliminate initial attack on lipids, but stabilization cannot prevent secondary oxidative degradation of oil over time due to normal product aging.
Once successfully stabilized, the rice bran can serve not only as a main dietary nutrient throughout the food chain but also as an all-natural functional ingredient in formulated beverages, food and meat products, along with structured extruded components for (hybrid) meat, meat-free, and hypoallergenic (gluten-free) bakery products. Especially rice milk will emerge as a major contender to challenge the hegemony of soy milk.

**A new protein is born**

Recent technological advancement has resulted in a rice bran protein with very promising attributes. Still at its exploratory phase this ingredient being developed at the RiceBran Technologies rice protein plant in Montana, U.S. containing 40% of premium protein together with dietary fibers and complex carbohydrates. Rice bran protein excels in a high PDCAAS in which especially the high lysine content is noteworthy; a rather unique property for a cereal origin product. The same is true for its arginine content. It is well documented that arginine is considered rate-limiting for protein synthesis and boosts the release of a variety of bioactive compounds. For example, arginine stimulates the synthesis of creatine which is important for sports performance as well as muscle maintenance of the elderly. This amino acid is also a precursor of nitric oxide that improves vasodilation while also promoting the release of growth hormone. Come to think of it, rice bran protein is higher in arginine than any of the known proteins such as derived from whey, casein, soy, potato, lupin and pea. These unique favorable properties allow for a wide range of food, beverage and meat applications including emulsion and foam stabilization in products such as whole grain rice milk, prepared food, gluten free baked products, sports performance, weight management, and structured extruded meat analog chunks and fibers.

As a matter of fact, there is great similarity in the journey of rice bran and dairy whey. Both protein sources were considered worthless by-products with very little or no value added applications. In just 50 years dairy whey has transited into a very valuable source of protein that often is dubbed “the new white gold”. Besides generally considered the king of protein, whey also hosts bioactive compounds very much the same way the bioactive micro-ingredients of rice bran protein are now being unraveled. Hence it is expected that rice bran protein will potentially follow the same journey, as the world urgently needs to source ingredients that can build value throughout the entire food chain.

**Performance nutrition**

Looking into the crystal ball it can be expected that ultimately whey protein and rice bran protein will be blended to create nutritionally superior performance ingredients delivering fast and semi-fast protein sources for applications such as – for example - clinical nutrition, performance nutrition and sarcopenia.

Rice bran protein ingredients deliver a solution to reduce glycemic index (GI). Low GI-foods do contribute only to small fluctuations in blood sugar and insulin, thereby maintaining consistent energy levels and help moderate spikes and dips in blood sugar. These rice bran attributes deliver long-term health benefits by reducing the risk of heart disease, onset of diabetes T2 as well as assisting in weight management.

For example: optimum muscle recovery is best facilitated immediately after training and for this purpose whey protein hydrolysate offer the “fast” solutions. If no immediate protein response is needed, intermediate or slow-digesting proteins like rice bran protein hydrolysate are more appropriate because they inhibit whole body protein breakdown: muscle glycogen depletion, fatigue, decreased performance and carbo-protein imbalance.

The main commercial name of stabilized rice bran for human consumption is RiBran, manufactured by RiceBran Technologies. Their portfolio of ingredients offers an entirely new category of natural, healthy, and multi-functional products that help manufacturers to formulate healthier foods. Essentially, rice
Bran is a unique ingredient composed of a complex matrix of insoluble fiber, a small portion of soluble fiber, non-allergen (hypoallergenic) high quality protein and trans-fat free healthy oils. As such, the ingredient can be used without the concerns of spoilage and loss of heat-sensitive nutrients, including maintenance of high levels of phytosterols, gamma oryzanol, tocopherols and tocotrienols.

The unique combinations of rice protein, rice fiber, rice oil with antioxidants and co-factors deliver long-term energy burn. In addition, clinical studies have shown rice bran and its derivatives aid in cholesterol and blood sugar management. A special mention needs to be made for rice lecithin that now is commercially manufactured in Brazil. Rice lecithin is hypoallergenic and as such will fill an immediate gap for foods that need to eliminate soy lecithin. It is expected that chocolate-based products such as the Cadbury and Hershey label will probably introduce allergen-free products in which rice lecithin can play an important part.

**More protein ways than one**

Rice bran from which the crude oil is removed, is called defatted rice bran. This ingredient can be considered a good starting point for the manufacturing of premium rice protein ingredients. It can be expected that ultimately a rice bran protein functional ingredient delivering a range of approximately 40% to 60% protein as well as complex carbohydrates and water-soluble rice fiber. Premium rice bran protein ingredients will be enzymatically treated and subsequently dried powder targeting foods, beverages and performance nutrition.

For now, the 40 percent rice bran protein ingredient manufactured using a technology delivering benefits of being dairy-free, nut-free, gluten-free and moreover hypoallergenic. Not many functional protein can make these claims. In principle, ultimately technology can be designed to follow hexane using a chemically-driven intervention method, or an all-natural process to concentrate or isolate the rice bran protein fractions. Whatever the case all these parameters appeal to modern consumers who especially have a very positive perception of rice and rice ingredients.

**The ultimate goal now within reach**

In the day and age of climate change and global warming together with a rapid growing world population, it will become essential to develop food solutions that are ecologically responsible. Rice bran and its spin-off ingredients such as rice bran protein have an excellent sustainability index with low to zero environmental footprint. But perhaps the greatest achievement is the knowledge that rice bran protein will have the potential to become the first protein source ever that can be cultivated, grown, harvested and turned into premium protein in the rice growing countries such as Thailand, Vietnam, China, Indonesia and Philippines. For the first time ever, these rice growing regions can become self-supporting in high quality vegetable protein. This feature will save much needed foreign exchange to finance expensive imports; money that now will allow countries to pursue deeper debt reduction which will create upsides for building a better infra-structure for the regional food industry.

**The best tasting vegetable protein**

In terms of organoleptical observations, rice bran protein hydrolysate has a bland flavor that is clearly
superior to soy protein isolate with no lingering off-taste nor odor. Additionally, rice bran protein can also be designed to maintain some moderate amounts of soluble dietary fiber while maintaining high digestibility. The flavor profile of rice bran protein does not reverse and thus will allow the development of products with a long and stable shelf life. The presence of the soluble fiber fraction provides for a certain degree of pectin-like properties which is beneficial in product that require mouthfeel fine-tuning, such as youghurt, puddings and aerated foods. And it helps that rice bran protein has strong properties to stabilize foams in aerated products.

Rice bran protein promises to have a wide range of new product attributes:

- Hypoallergenic
- Gluten Free
- Non-dairy
- Non-GMO
- No Anti-nutritional Factors
- Bland Flavor Profile

**Rice bran oil performance**

Rice bran is especially rich in saponifiable and unsaponifiable lipids including tocopherols, gamma-oryzanol and sterols. These lipids are naturally hydrolyzed by lipase during milling, but the new technology of stabilizing basically inactivates the lipase and subsequently prevents breakdown of triglycerides to glycerol and free fatty acids. This process greatly delays oxidation and onset of rancidity, though as previously stated, it will not entirely stop the degradation due to prolonged product aging. Either way, the innovative technology creates a functional rice bran with significantly extended shelf life.

With its gamma oryzanol-rich rice oil, rice bran holds a plethora of bioactive compounds that slowly start to unravel several functional and nutritive applications for food, processed meat, cosmetics and pharmaceuticals. The oryzanol that remains in the rice oil has a very high anti-oxidative value. Rice bran protein is probably the most environment-friendly and sustainable pathway toward multi-grain formulated snacks and cereal foods. Diets rich in whole grains and other plant foods but low in saturated fat and cholesterol may help reduce the risk of heart disease as well as promote a healthy digestive system.

Rice bran oil is generally considered to be on the higher end of the quality spectrum of vegetable oils in terms of color, cooking stability, cooking temperature, fatty acid composition and high levels of antioxidants, including tocotrienols and phytosterols. Along with oleic and linoleic fatty acids, these compounds are linked to lower cholesterol levels. This explains why premium formulated nutritive foods such as –for example- sold under the Herbalife label features rice fiber as a prominent ingredient. The same is true for the high smoke point values of 230°C (475°F) of rice bran oil, which makes it ideally suitable for deep fried foods because it prevents the breakdown of fatty acids at elevated temperatures. This function is mostly due to the free fatty acid (FFA) contents and lesser to the fatty acid composition (FAC) content of rice oil. Surely a main advantage the fast food companies are interested in now that nutritive labeling is on the verge of becoming mandatory.

Clean label and reduced sodium trends are popular for now and will spur growth for ingredient innovations, which will ultimately end up in healthier foods. The number of food and beverages marketed
on a whole grain platform will further dominate new product launches. New released scientific data shows that a diet rich in whole grain has beneficial effects on bioavailability for heart health in general and cholesterol in particular. For example, recombining 89 percent white rice flour and 11 percent micronized stabilized rice bran will recreate original whole grain properties, bringing back the rice bran and germ which safeguards the presence of dietary fiber and other bioactive components. As such, rice bran can be a small step towards big dietary changes.

Rice fiber
Besides the presence of phyto micronutrients and scores of antioxidants, rice bran is also increasingly using bioscience and technology to maintain the purity of the nutrition of nature.

Rice fiber is a carbohydrate polymer with three or more monomeric units. The characterizing elements of fiber: they are neither digested nor absorbed in the human small intestine. Hence, fibers belong to the following categories:

- Edible carbohydrate polymers naturally occurring in food and beverages
- Edible carbohydrate polymers that have been derived from food sources by enzymatic, physical or chemical treatment or processing
- Fibers should have a beneficial physiological effect and well-researched for long-term use and benefit.

This new ingredient category fits the important all-natural foods label, especially considering the need to enhance the much needed dietary health profile. RiceBran Technologies is the world leader in manufacturing these premium rice bran ingredients.

Highly versatile, rice bran fiber is an emerging functional ingredient that can assist in improving texture, color, while it incorporates easily in many foods, including baked goods, nutri-bars, structured meat-free products and processed meats. Rice bran and its spin-off ingredients arrived at the world scene just the right time. Not only will rice bran be needed to meet world dietary demands in the future, modern consumers now also consider (rice bran) fiber intake more important than calorie and sodium reduction.

Unquestionably there is a strong consumer trend that achieving recommended daily fiber intake levels are moving to the number one priority. Geographically speaking, this trend started in the U.S. followed by strong UK demand while now also siphoning into mainland Europe. RiceBran Technologies is ideally positioned to make cost-effective and great tasting (naturally derived) dietary rice fiber available that perform in a wide range of formulated food products.

Rice bran and healthy living
Beyond its potential applications in the food chain, rice bran has many bioactive extracts and components that show potential in health foods, cosmetics and pharmaceuticals. Peer-reviewed studies have signaled that consumption of stabilized rice bran can play a role in maintaining a healthy lifestyle where glucose regulation, inflammation and cholesterol become important.

Rice bran extracts are also being positioned as natural performance enhancing supplements to create lean muscle mass for explosive sports, such as power lifting. Increased intake of whole grains and bran, in particular, may reduce the incidence of hypertension. Compelling indications show that rice bran and its fractionated extracts or compounds will move beyond the explorative stage within a few years and develop into nutrition-based products that support healthy and active lifestyles.

Arthritis is especially targeted since it is a debilitat-
Arthritis is an inflammation of the joints that can develop into a chronic condition involving swelling, pain and restricted movement. Osteoarthritis or rheumatoid arthritis may result from a deregulation of pro-inflammatory cytokines as well as COX and LOX enzymes.

Steep increases in the number of people affected with arthritis will no doubt develop into a global health issue, not to mention the high costs associated with it. Pharmaceuticals that are currently used to lessen the burden of arthritis conditions are non-steroidal anti-inflammatory agents like ibuprofen and aspirin. However, prolonged use of these over-the-counter drugs can have negative side effects. Rice bran extracts may turn out to show strong promise for safe and effective nutritional aids that help alleviate the symptoms associated with arthritis. There is little doubt that specially formulated lifestyle foods targeting the growing numbers of arthritis sufferers will become an important new category.

Biorefinery or biofractioning
Coproducts obtained during rice milling and rice bran further processing offer practical solutions to a wide variety of applications—particularly rice hulls for use outside the scope of food and nutraceutical usage. Rice hulls are an obvious by-product of rice milling and have high fiber content. Current and future usage of rice hulls is only limited by the imagination, but in principle show potential for applications such as:

- A source for fuel conversion as inexpensive energy
- Natural filtration medium for fruit juices and organic wines
- Carrier for animal pharmaceuticals
- Bedding for animals
- Horticulture mixes enhancements

There is more to come since rice bran by-products also have strong potential as further investments in bio-refinery or refractioning technology, like the extraction of high value silica, comes to age. With the planet’s population growing rapidly and the standard of living in developing countries improving, the demand for food and meat is growing exponentially. It is safe to predict that providing wholesome nutrition for about 9.4 billion people in 2050 may require at least 50 percent more food and meat than is being produced today. To meet these needs, functional ingredients suppliers need a dynamic vision for the future and find ways to enhance the profitability of the entire value chain. One key to meeting this challenge is finding new and novel ways to utilize what is commonly considered waste material like rice bran.

Rice Bran Protein: An intriguing solution
Rice bran protein is a hypoallergenic, cold-water functioning and performing solution that boosts...
stabilizing and texturizing properties. It also offers cost optimization that helps food formulators upgrade to a clean label and additive-free positioning for their products. Rice bran protein offers instant viscosity-modulation properties, stability and texture to a broad range of processed food and meat products. The powdered functional ingredient rapidly hydrates and disperses in water without lumping to deliver a unique harmonization with other support ingredients, such as added protein and starch. Its process tolerance ensures good resistance to a wide pH spectrum, shear and heat variations during processing.

Rice bran has a slight nutty, honey-like flavor that allows the richness and diversity of flavors to prevail in a range of quality convenience foods. Food and meat processing today is confronted with a number of health considerations and emerging challenges: sodium reduction, fat replacement, meat protein alternatives, protein fortification and green-label messaging. Rice bran provides at least some of the answers.

In its very basic condition rice bran is a cost-effective option for use as a “functional filler” in processed meat products and a stable source of fiber in whole grain foods such as cereals, crackers and batters. Rice bran is also used as a fermentation accelerator, which can generate prebiotic claims. Rice bran ingredients such as rice bran protein hydrolysate is increasingly seen as a cost-effective way to create or prepare transfat-free foods, ranging from “healthy” cream dressings to batter and breading systems for coated foods.

The ingredient has solid authenticity and is globally recognized, ranking among the most consumer-friendly ingredients. Rice bran's natural origin will become a significant marketing tool as the trend towards clean and environmental-friendly labeling intensifies. Already popular in dietary supplements and functional foods, rice bran is now increasingly crossing over into mainstream foods.

Rice bran protein offers cost-effective functional properties like enhancing and stabilizing meat emulsions and coarse-ground meats, such as burgers and patties. Equally important, the ingredient has a friendly eco-footprint and environmental image that is reflected in label declarations on food packaging. Because rice bran protein retains moisture, it improves the shelf life of meat products, enhances the nutritional profile, and adds fiber. Both soluble and insoluble fibers are naturally present in rice bran, making it likely to become the choice ingredient for products targeting a health-conscious niche. Along with helping meat processors develop healthier formulations, the use of rice bran protein can generate significant cost savings, compared with expensive alternatives such as soy protein and mustard flour.

Nature’s best in hybrid meat foods

From a technological point of view, the stabilizing properties are also very interesting and have shown capabilities in a wide range of further processed meat products. In most cases, adding a relatively small percentage allows this all-natural ingredient to wholly or partially replace materials commonly used, such as carrageenan, soy protein, modified polysaccharides and starches, while eliminating chemical-sounding E-numbers on labels which concerns more consumers. The combination of these ingredients, while maintaining its all-natural origin, results in its ability to control purge in formulated meat products, increase water retention,
and improve cooking yields throughout the thermal processing cycles. There is no need to mention confusing E-numbers or chemically sounding names on product labels. To sum up: rice bran is a label-friendly, ecological sound healthy ingredient that provides low-cost sustainable nutrition and applications for a rapid increasing world population. U.S. harvested rice bran is self-affirmed GRAS, non-GMO, all-natural, hypoallergenic, kosher-parve, halal. It is expected that in the future rice bran stabilization facilities will be build in the major rice producing regions like China, Vietnam and Thailand.

From moisture management to being an unimposing carrier in seasoning blends, the ability of rice bran to outperform other ingredients while maintaining similar water activity levels is unparalleled. Subsequently, rice bran can be considered an essential ingredient for moisture management and nutrition across a wide variety of applications, while delivering high quality, great taste and least-cost options.

**Rice Bran Oil**

Rice bran oil is considered the world’s healthiest oil and has also the uniqueness of remaining unaffected at high heating temperatures. As such, rice bran oil is heart healthy with an ideal fat composition:

- Approximate fatty acid percentage by weight*-
  - Saturated fat 24.0 %
  - Mono-unsaturated fat (MUFA) 34.0 %
  - Poly-unsaturated fat (PUFA) 42.0 %

*It should be noted however that the fatty acid composition (FAC) will vary and is slightly different depending on the geography of where rice is grown.

The American Heart Association considers rice bran oil as the most versatile and balanced, including cholesterol-reducing properties attributed to gamma oryzanol and beneficial in management of high-fat induced hyperlipedemina.

The crude rice bran oil is composed of 88 percent neutral lipids, 4 percent unsaponifiables, and 2-4 percent free fatty acids. The essential fatty acids contain both Omega 3 (<1%) and 6. The unsaponifiable fraction is of great interest since these include a mixture of naturally occurring antioxidant compounds, such as vitamin E and gamma oryzanol.

Rice bran oil has hypocholesterolemic influence with decreased Low Density Lipoprotein (LDL). This effect is due to the presence of high concentrations of unsaponifiables including phytosterols, oryzanols and tocotrienols. The potent antioxidative properties of gamma oryzanol also act as a protective agent against UV light. The ferulic acid present in oryzanol prevents or slows down skin damage or aging. Also, the presence of tocotrienols has a very positive effect on skin and can be considered a first line of defense as they neutralize or stabilize the free radicals generated in the skin when exposed to UV rays. Because these compounds can penetrate the skin quickly and get absorbed rapidly, they can help in skin repair. Gamma oryzanol contains ferulic acid esters and is known to be a very effective anti-oxidant even at high temperatures. It has been demonstrated that gamma oryzanol is four times as effective as vitamin E inhibiting cellular oxidation.

**Oil extraction**

Rice bran oil is unique in the world of edible oil in that it contains many high value phytonutrients such as gamma oryzanol, tocopherols, tocotrienols and other phytosterols. Hexane is primarily utilized when extracting oil from rice bran as it is the most economic solvent choice. However, short chain alcohols like ethanol or even supercritical CO2 extraction can also be used. In general terms, alcohol extracted rice oils and supercritical extracted rice oils tend to yield higher amounts of unsaponifiable compounds in the oil fraction. However, this comes at a significant increase in costs as alternative extraction methods and solvents are much more expensive. A more cost effective approach to maximizing phytonutrients in rice oil can be found by utilizing alternative processing techniques downstream in the extraction processing stages.
The recovery and yield of phytonutrients in rice oil can be greatly influenced by the method of downstream processing, i.e. chemical neutralization followed by absorptive bleaching and steam distillation (deodorizing) versus using alternative approaches such as physical refining.

During conventional oil processing, highly desirable fractions like tocopherols, tocotrienols and oryzanols are removed as by-products of acid/base reactions or as volatiles stripped out during steam distillation.

As an alternative to aggressive and market objectionable chemical neutralization, physical refining eliminates the chemical neutralization step in favor of “physically” removing impurities such as free fatty acids, by using carefully controlled steam distillation conditions. For markets that are sensitive to the use of harsh chemicals, physical refining is the preferred method of oil processing. A properly designed and operated rice bran oil facility utilizing modern physical refining technology can easily produce rice oils that have significant levels of gamma oryzanol and other advantageous phytonutrients, thereby maximizing value including market desirability by increased consumer awareness.

**In conclusion**
Consumers are increasingly looking at what is inherently good about a food product rather than focusing on negative content such as fat. Rice bran ingredients from RiceBran Technologies are ideally suited for foods, beverages and meat products to create positive all-natural and wholesome nutritional advantages.

In addition, rice bran ingredients are associated with positive nutrition meaning that the unique protein properties are perceived very favorable by consumers as contributing to wellness while avoiding allergenic responses.

RiceBran Technologies guarantees ingredients that have a very fast processing trajectory between rice harvest from the paddy fields to component stabilizing while maintaining its all-natural characteristics and functional properties.

All these advantages combined make the ingredients of RiceBran Technologies excellent choices for improving the nutrition while decreasing or maintaining costs in foods like structured vegetable protein fibers for use in meat-free foods, nutri-bars, gluten-free foods, baked goods and dry-blended beverage powders.

**Rice bran Protein: Properties Overview:**
- Hypoallergenic
- Excellent protein digestibility
- Antioxidative performance
- Moisture management
- Gluten-free
- Dairy-free
- Thermo stable
- Non-dusting
- Easy dispersible
- High solubility
- pH stable
- Salt tolerant
- Improve nutritional profile
- Long shelf life
- Protein-interaction synergism
- Bland taste and flavor profile
- Light tan color
- Low to zero environmental footprint
- Ecologically sustainable
- All essential amino acids for growth and muscle maintenance
- Least cost protein solution
- Positive label-friendly & consumer awareness
Rice bran protein is an innovative all-natural source of premium vegetable protein, synbiotic fiber, and heart-healthy oil. This is nature in its purest form with nothing added and nothing taken away.

Rice bran protein, which is gluten free and hypoallergenic, contains not only essential vitamins and minerals, but also a wide variety of antioxidantss and co-factors.

Our world urgently needs this multifunctional transitional protein with unique organoleptic properties, delivering high-value ecologically sustainable protein nutrition.