RiceBran Technologies

RiSolubles®
About RiceBran Technologies

- In the business of stabilizing and marketing rice bran and derivatives for 25+ years
- Corporate Office: Scottsdale, AZ
- US Segment Operations: CA, LA, MT & TX
- Brazil Segment Operations: Pelotas (RS)
- Primary Markets: Vegetable Oil, Contract Manufacturing, Food/Functional Ingredients and Animal Feed
- Products Distributed Globally
- Intellectual Property: Extrusion technology for stabilizing raw rice bran; process and use patents for rice bran derivatives
The Bulk of the Nutrition is in the Germ and Bran Layers

- **Oil**: ~26%
- **Protein**: ~20%
- **Fiber**: ~18%
- **Carbohydrate**: ~26%
- **Ash**: ~10%

**Degree of Milling**

- ~26% Bran
- ~10% Endosperm
- ~20% Degree of Milling

**Unlocking the Nutritional Value of Rice Bran**
Rice Bran Provides Balanced Nutrition

http://nutritiondata.self.com/

Rice, white, medium-grain, raw, unenriched

Serving size: 100 grams

**Nutrition Facts**

<table>
<thead>
<tr>
<th>Serving Size: 100 grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount Per Serving</td>
</tr>
<tr>
<td>Calories: 360</td>
</tr>
<tr>
<td>Calories from Fat: 5%</td>
</tr>
<tr>
<td>Fat: 1g, 1%</td>
</tr>
<tr>
<td>Saturated Fat: 0.5g, 1%</td>
</tr>
<tr>
<td>Trans Fat: 0g</td>
</tr>
<tr>
<td>Cholesterol: 0mg</td>
</tr>
<tr>
<td>Sodium: 1mg, 0%</td>
</tr>
<tr>
<td>Total Carbohydrate: 75g</td>
</tr>
<tr>
<td>Dietary Fiber: 0%</td>
</tr>
<tr>
<td>Sugars: 1g</td>
</tr>
<tr>
<td>Protein: 1g, 0%</td>
</tr>
<tr>
<td>Vitamin A: 60% + Vitamin C: 0%</td>
</tr>
<tr>
<td>Calcium: 1% + Iron: 4%</td>
</tr>
</tbody>
</table>

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

**Nutritional Target Map**

- **Fullness Factor:** 1.5
- **Carbs:** 1% of Total Calories
- **Fats:** 7% of Total Calories
- **Protein:** 92%

**Caloric Ratio Pyramid**

- **Estimated Glycemic Load:** 59
- **Vitamin A:** 0% + Vitamin C: 0%
- **Calcium:** 0% + Iron: 10%

**NutritionData's Opinion**

- **Weight loss:** 5 stars
- **Optimum health:** 5 stars
- **Weight gain:** 1 star

The good: This food is very low in Saturated Fat, Cholesterol and Sodium. It is also a good source of Magnesium and Phosphorus.

**Protein Quality**

- **Amino Acid Score:** 74

Rice bran, crude

Serving Size: 100 grams

**Nutrition Facts**

<table>
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<tr>
<th>Serving Size: 100 grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount Per Serving</td>
</tr>
<tr>
<td>Calories: 516</td>
</tr>
<tr>
<td>Calories from Fat: 17%</td>
</tr>
<tr>
<td>Fat: 21g, 21%</td>
</tr>
<tr>
<td>Saturated Fat: 4g, 21%</td>
</tr>
<tr>
<td>Trans Fat: 0g</td>
</tr>
<tr>
<td>Cholesterol: 0mg</td>
</tr>
<tr>
<td>Sodium: 5mg, 0%</td>
</tr>
<tr>
<td>Total Carbohydrate: 55g</td>
</tr>
<tr>
<td>Dietary Fiber: 2g</td>
</tr>
<tr>
<td>Sugars: 1g</td>
</tr>
<tr>
<td>Protein: 15g</td>
</tr>
<tr>
<td>Vitamin A: 5% + Vitamin C: 5%</td>
</tr>
<tr>
<td>Calcium: 0% + Iron: 10%</td>
</tr>
</tbody>
</table>

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

**Nutritional Target Map**

- **Optimum health:** 4 stars

**Protein Quality**

- **Amino Acid Score:** 37

The good: This food is very low in Cholesterol and Sodium. It is also a good source of Fiber, Thiamin, Riboflavin, Niacin, Vitamin B6, Pantothenic Acid, Iron, Magnesium and Phosphorus.

**Protein Quality**

- **Completeness Score:** 74

Adding other foods with complementary amino acid profiles to this food may yield a more complete protein source and improve the quality of some types of restrictive diets. Find foods with complementary profile.
Global production of rice bran is estimated at ~52 MMT per year

Raw rice bran is prone to rapid oxidation due to a lipase enzyme that destroys its nutritional and economic value

Major Uses
- ~90% animal feed
- ~9% for rice bran oil production (produces ~1.5 MMT crude RBO/yr)
- <1% human food consumption and cosmetics
Unlocking the Nutritional Value of Rice Bran Through Proprietary Stabilization

Fig. 1—Total free fatty acid in raw rice bran (A) and stabilized rice bran (B) stored at ambient temperature for 1 yr.
Unlocking the Nutritional Value of Rice Bran

Rice Bran Derivatives

Contract Blending/Packaging

Stabilization of Rice Bran for Animal

Proryza SRB and Animal SRB
Organic Rice Bran

Chiang Rai
Thailand

Organic Rice Bran
400 Tons

Organic Rice Bran Derivatives

Unlocking the Nutritional Value of Rice Bran
Unlocking the Nutritional Value of Rice Bran

Rice Bran Oil and Defatted Rice Bran

Irgovel (Pelotas, Brazil)

Capacity: 9,000 MT/month

Defatted Rice Bran

- Protein
- Carbohydrate
- Fiber
- Ash

Hexane Extraction

Crude RBO

Bi-Products Of Oil Refining

Refined RBO

Further Processing (i.e. Protein)

Human Food Ingredient

Animal Nutrition

Nutra

Horse

Oil

Unlocking the Nutritional Value of Rice Bran

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RBT Ingredients Tick all the Right Boxes

BALANCED NUTRITION

- gluten-free
- zero cholesterol
- low sodium
- vegan
- organic
- non-gmo
- no trans fats
- no major allergens
- sustainable
- locally produced
- no added sugar
- dairy free
- egg free
- whole grain
- minimal processing
- no preservatives
- soy free
- balanced nutrition
- natural
- environmentally friendly
- sustainably

Unlocking the Nutritional Value of Rice Bran

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Unlocking the Nutritional Value of Rice Bran
Some Key Bioactives in Rice Bran

- γ-Oryzanols – Family of ferulic acid esters of phytosterols and triterpene alcohols
- Phytosterols – i.e. β-sitosterol
- Tricin (methylated flavone)
- Tocopherols/Tocotrienols (Vitamin E)
- Ceramides – family of waxy lipid molecules
**Gamma-Oryzanols**: Group of ferulic acid esters of phytosterols and triperpene alcohols. Present mainly in the germ and bran layers at levels ranging from 0.2% to 2.5% (w/w).

- **Cholesterol Regulation**
  - Conversion of cholesterol to bile acids
  - Bile acid excretion
  - Inhibits absorption of cholesterol

- **Allergy Control**
  - γ-Oryzanols binds IgE antibodies
  - Suppresses IgE binding to mast cells
  - Inhibits mast cell degranulation

- **Glucose Regulation/Inflammation**
  - Suppresses activation of NFκB
Gamma-Oryzanols – Mode of Action

Signal

IkB kinase (IKK)

Phosphorylation of IkB

Proteolytic degradation of IkB

IkB binding to promoter sequence of DNA

Transcriptional Activation

Production of Cytokines, chemokines, adhesion molecules and suppresses adiponectin
Vitamin E Induces Adiponectin

- Vitamin E (i.e. α- and β-Tocopherols)
- γ-Oryzanols: Inhibitors of Activation
- NF-κβ
- PPARγ: Agonists

Increased gene expression

Unlocking the Nutritional Value of Rice Bran
Adiponectin Mechanisms of Action

Mol. Nutr. Food Res. 2016, 60, 175-184
Randomized, placebo controlled trial with Type II diabetic subjects (N=28) had 40% higher adiponectin after consuming rice bran (20g/day) for 12 weeks (Cheng 2010)

Preclinical study on mice with hypoadiponectinemia showed increased adiponectin levels when administered gamma-oryzanol (Nagasaka 2011)

Obese rats fed 5% rice bran extract containing gamma-oryzanol for 20 weeks recovered adiponectin levels (Justo, 2013)
Rice Bran Consumption Increases Adiponectin

**Title:** Search for novel circulating cancer chemopreventive biomarkers of dietary rice bran intervention in Apc\textsuperscript{Min} mice model of colorectal carcinogenesis, using proteomic and metabolic profiling strategies

*University of Leicester, Loughborough University & Glenfield Hospital*

*Molecular Nutrition & Food Research 59:1827-1836, 2015*

Mice diet supplemented with a rice bran derivative (RiFiber) supplied by RiceBran Technologies
Unlocking the Nutritional Value of Rice Bran

Process Flow

California Rice
  ↓
  De-husking
  ↓
  Milling
  ↓
  Raw Rice Bran → White Rice

→ Heat/Pressure extrusion
↓
Stabilized rice bran

Stabilized rice bran
↓
Water + alpha-amylase
↓
Centrifuge → Solids → RiFiber
↓
Drying
↓
Liquids
↓
RiSolubles®

Nutritional Profile

Protein 7-12%
Fat 25-32%
Carbohydrates 50-60%
Ash 3-7%
Gamma-Oryzanols 250 mg/100g
Tocopherols 8 mg/100g
Tocotrienols 10 mg/100g
Phytosterols 400 mg/100g

Production capacity: >500 MT/yr (Dillon, MT)

Process & Use Patents: USPTO
6,126,943; 6,303,586; 6,350,473; 6,350,473; 6,558,714; 6,733,799
## RiSolubles® – Possible Claims

<table>
<thead>
<tr>
<th>Claim</th>
<th>Substantiated Statements &amp; Evidence Tables</th>
</tr>
</thead>
</table>
| Reduces hyperglycemia                      | - Two human clinical studies have shown that RI-Solubles® can reduce serum glucose levels in both diabetic and healthy subjects  
- One human study, eight preclinical studies and one in vitro/in vivo study have shown that gamma-oryzanol and rice bran in general can reduce glucose levels |
| Improves insulin levels and insulin sensitivity | - Two human clinical studies have shown that RI-Solubles® can improve insulin levels and insulin sensitivity in diabetic and healthy subjects  
- Six preclinical studies, one in vitro/in vivo study and one review have shown that gamma-oryzanol and rice bran in general can improve insulin levels insulin sensitivity |
| Increases adiponectin levels               | - Four human clinical studies, one in vitro/in vivo study, and two reviews have revealed that plasma adiponectin is positively correlated with insulin sensitivity and lower risk of impaired glucose metabolism  
- Two human studies, three preclinical studies and two in vitro studies have shown that gamma-oryzanol and rice bran in general can increase adiponectin levels through NF-kappaB inhibition |
Study: Effects of stabilized rice bran, its soluble and fiber fractions on blood glucose levels and serum lipid parameters in humans with diabetes Types I and II


Treatment: 20 g/day RiSolubles® for 8 weeks

Results:

- Significant reduction in fasting serum glucose Type I and Type II diabetes subjects
- Significant increase in insulin levels by 4% in both Types I & II diabetes subjects
RiSolubles® - Trial on Healthy Subjects

**Study:** Glycemic and Insulinemic Response and Glycemic Index Determination of RiSolubles

**Publication:** Final Report by Glycemic Index Laboratories, 2007

**Subjects:** Healthy subjects (N=10)

**Treatment:** 45 g RiSolubles®

**Results:**
- Significantly lower postprandial glucose at 15, 30, 45 and 60 min post consumption
- Glycemic Index = 54.9
Evidence-Based Functionality: Glucose and lipid metabolism

Clean Label: Minimally processed, free of all major allergens, non-GMO, natural

Country of Origin: 100% Made in the USA

IP Protection: Process and use patents 100% owned by RBT

Production: >500 MT per year and can easily be expanded

Applications: Ideal for health and wellness beverages and foods

Taste/Flavor: Very nice flavor profile