APPLICATIONS

BAKING SOLUTIONS

AXIOM® FOODS

Global Plant Proteins & Ingredients

From Innovation to Supply

Plant-Based Ingredients for Baking Applications

Pea protein as an egg-replacer and more

Introducing Our Solutions

From high protein cookies to allergen-free brownies and vegan cakes, plus golden brown gluten-free bread, Axiom Foods has multiple ingredient solutions to help your formulating needs. These include dairy alternative powders OryzOlait™ (from whole grain rice) and Avenolait™ (from whole grain oats), Oryza™ rice syrup solids, Vegostar™ pea starch and multiple plant proteins from Oryzatein® (rice) to Vegotein™ (pea).

FDA GRAS Generally Recognized As Safe

USDA Organic

Non GMO Project Verified nongmoproject.org

Kosher

VEG-O-TEIN™

VEG-O-STAR™

ORYZATEIN®

ORYZA™

ORYZOLAIT™

AVENOLAIT™

Eggs Optional

Good things come in small packages so it's no big surprise that the protein portion of a pea would offer food manufacturers and consumers a functional and affordable egg alternative.

Using pea protein isolates (≥80%*) and concentrates (≥35%), food scientists are solving many egg-less dilemmas. This latest application, thanks to similar emulsification characteristics to eggs, expands the use of highly-functional, high-iron pea protein which has already found its way into healthy, protein-fortified or gluten-free baked goods, snacks, cereals, pastas, energy bars and beverages.

News that pea protein can now mimic the egg in pastas and baked goods will be welcomed by millions worldwide who find the egg neither incredible nor edible because of cholesterol or egg intolerances and allergies. Now they can enjoy the traditional taste and texture of everyday fare from waffles to spaghetti to muffins, cookies, and even chocolate cake, without worry. Food manufacturers also benefit from a clean label, because unlike soy or whey protein, peas are not considered one of the top eight allergens you must disclose.

Well-suited Surrogate

Pea and egg proteins are similar and both have similar emulsion characteristics, enabling the mixing of oil and water. Pea protein has excellent foam stability, comparable to egg albumin. Depending on the product made, independent controlled baking tests found that pea isolates and concentrates can perform better than, equal to, or only slightly less functional than eggs in cookies, cakes, muffins or waffles.

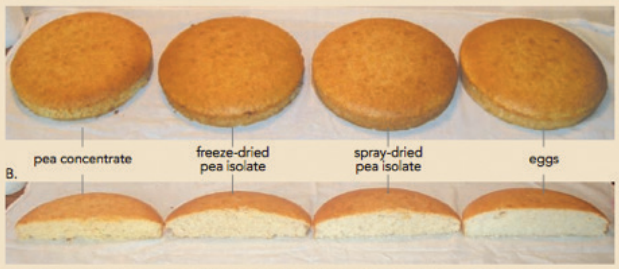
Baking Functionality Test

Putting Pea Protein Through the Paces

Food scientists at North Dakota State University (NDSU) tested the egg replacement functionality of a pea protein isolate containing 80% protein and a pea protein concentrate containing 50% protein in standard commercial cake mixes as well as cookies and pastas.

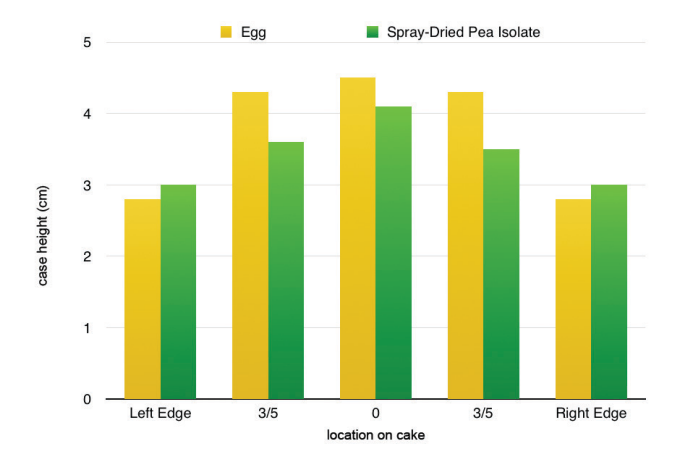
The Cake Test

Scientists used about 12 grams of pea protein isolate (≥80%*) to replace 1 egg in both white and chocolate cakes, since an egg weighs approximately 12 grams. **Pea protein produced denser cakes with greater moistness than cakes made with eggs.** Pea protein isolates (≥80%*) produced cakes **with comparable cake peak heights** (the highest point of the cake; usually the center). Objective measurements found the egg cakes had slightly better cake uniformity and a softer texture, but all the cakes were deemed very tender and soft. Indeed, subjective measures found the pea protein and egg cakes difficult to differentiate in appearance. **The pea protein cakes had similar diameters, shrinkage values and weights compared with cakes made with eggs.**



The white cakes prepared from pea concentrate, pea isolates, and eggs. The top view is represented in A while B represents the cross-section of the corresponding cake.

Cakes made with pea protein scored a 10 for moistness compared with an 8 for cakes made with eggs, with testers concluding that cakes made with eggs had a slighter dry texture compared with cakes made with pea protein. Texture analysis on the chocolate cakes found that those made with pea protein had softer texture (lower peak load values) than the egg cakes after one day of storage, but slightly higher peak loads than egg cakes after two days of storage. Functionally, freeze-dried pea isolate performed similar to spray-dried isolate (part of the Vegotein process).



The heights and contour of white cakes prepared from pea protein isolates and eggs. The 0 represents the center of the cake while the 3/5 indicates a measurement taken at 3/5 the distance from the edge of the cake.

Affect of protein source on white cake parameters

protein source	avg. diameter (cm)*	shrinkage value (cm)*	avg. weight (g)*
egg	19.5	0.8	400
spray-dried isolate	19.6	0.7	391

**The average values were determined from two cakes according to the AACC International method 10-91.01.*

The Cookie Trial

Pea protein proved to be a viable alternative for eggs in both sugar snaps and chocolate chip cookies. Based on these results, food manufacturers can expect cookies made with pea protein to look like cookies made with eggs, with similar cookie spread and height. Pea protein cookies had greater moistness than cookies made with eggs. Objective measurements on cookies made with pea isolates confirmed lower peak hardness and thus softer textures than cookies made with eggs. Indeed, texture analysis indicates that pea protein has a tenderizing effect. Peak hardness values for cookies made with isolates are 1.89 times harder than the cookies made with eggs.

Despite uniform baking times, chocolate chip cookies made with fresh eggs were darker in color than those made with pea protein isolates (≥80%*), suggesting that Maillard browning was an issue. The sugar snap cookies used dehydrated eggs in the control and were similar in color across all comparisons.

Stability—In Triplicate

#1 Emulsion stability: Pea protein holds on to both fat and water, making a creamy, stable emulsion that offers process stability, holds flavor components together and improves shelf life.

#2 Process stability: A powder that blends conveniently into dry ingredients, liquids and batters. Pea protein won't lose its structure or functionality under high temperatures, pH fluctuations or pressure. Such stability enables high-stress processes such as baking, deep frying and extrusion.

#3 Extrusion stability: Pea protein can replace gluten as a stabilizer in snacks and cereals, becoming part of a matrix that allows expansion; thereby maintaining desired structure, texture and shape.

Practical, Affordable, Functional Peas

Because peas are a legume plant that naturally makes and returns nitrogen fertilizer back into the soil, they are as healthy to grow as they are to eat.

Pea protein maintains volume without expansion in bread crumbs and brownies. It stretches gluten supplies in conventional baked goods because pea protein mimics the bulk and structure of wheat flour. And now, reduces market exposure to fluctuating egg costs by using pea protein as an egg replacement in baked goods and pastas.

**Proteins are commonly referred to as isolates when they are ≥90% but the pea protein industry refers to proteins ≥80% as isolates because pea protein has not been manufactured at ≥90% levels in large commercial quantities, due to it not being economically viable at this time.*

Oryzatein® Rises to the Fortified Bread Challenge!

Looking for a way to improve the appearance of your gluten free bread or make a "good source of protein" or "lower carb" claim on a bakery application? Based on recent application testing, **Oryzatein**® 80 brown rice protein is your solution. The following test shows that Axiom's rice protein can be beneficial for Maillard browning of gluten free breads, plus wheat replacement for lower carb and protein fortified breads—and all while not affecting the flavor nor the dough hydration.

Testing showed that the addition of 33 grams protein per loaf is the sweet spot, increasing the protein per serving by 75%—from 2 to 3.5 grams protein per slice and reducing the wheat flour required for dough development and loaf volume. There is additional room for increasing the protein percentage but the addition of the rice protein altered the bread color from white to brown.

The addition of the rice protein did not change the mixing parameters or machinability of the bread dough. There was no adverse flavor noted. The rice protein could be successfully added at 1.5 grams and 3 grams per one ounce slice increase over the control of 2 grams protein for commercial bread (totaling 3.5 grams protein/slice and 5 grams protein/slice).

Avenolait™ Delivers That Bakery-Fresh Experience

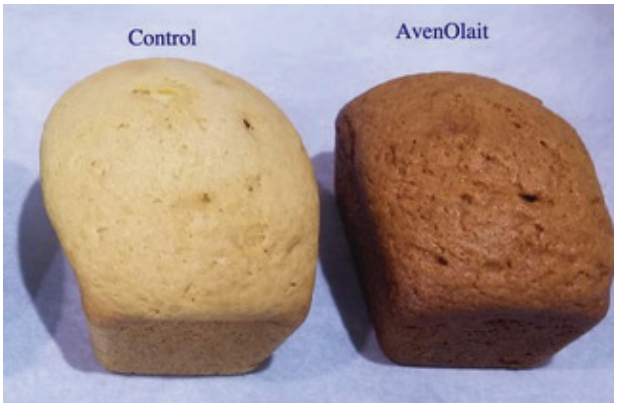
Avenolait™ Oat Dairy Alternative is the perfectly unexpected addition to baked products. It's as simple as substituting a portion of the wheat flour with whole grain oat dairy alternative powder, and the benefits can include:

- Improved sensory experience:
- Increased fresh bakery smell and taste
- Maillard browning effect
- Label to include whole grain oats

Thanks to more starting sugars, the benefits of whole grain Avenolait cannot be replicated by replacing the wheat flour with simple oat flour.

Bakeries will soon discover that the "fresh bakery" experience is as simple as adding Avenolait to existing packaged products and it is a great addition to new formulations. Are you working with gluten-free baked goods? This might be your solution, as Avenolait is one of the only oat milks that comes with a gluten free option.

Quick Bread Formulation Test



100% Wheat Flour | Wheat Flour & Avenolait™ Blend

Effect of ORYZATEIN®80 Rice Protein Addition to Wheat Flour White Bread

Purpose: To evaluate the effect that the addition of rice protein (for protein fortification) will have on the yeast bread loaf quality of white wheat flour bread.

Materials and Methods

1. Formula

   Wheat bread formula [AACC Method10-09] "Basic straight dough bread baking method" modified to include oil. Currently, wheat flour bread provides 2 grams of protein per 1 ounce slice.

   - Bakers™ Wheat flour 100%
   - Salt 2.25
   - Yeast, IDY 1.11
   - Water 66
   - Malt 0.5
   - Oil 3
   - Sugar 7

2. Ingredients
   - Wheat flour with 11.5% protein.
   - IDY yeast
   - Malt from LaSaffre
   - Rice protein [Oryzatein® 80] with protein of 83.4%

3. Equipment
   - Kitchen Aid Mixer K5SS with J-hook
   - Scale
   - 1 pound [9 x 4.5 inch] commercial glazed bread pans from Chicago Metallica
   - Oven
   - Volume by displacement

4. Process
   - Mix until development.
   - Fermentation 2.5 hours @ room temperature.
   - Mould into shape
   - Proof in pan 1 hour @ 80°F.
   - Bake at 400°F for 30 minutes to internal temperature of 203 to 205°F
   - Cool

5. Attributes measured and/or observed
   - Dough mixing
   - Dough quality
   - Dough weight
   - Final interior loaf temperature
   - Record loaf weight, density, volume, grain, and loaf symmetry
   - Photograph

Test Design

1. The control bread loaf had a calculated protein of 34.5 grams [2.156 grams per slice].

2. Add rice protein at increments of 33 grams to bread formula.

3. Reduce wheat flour equal to the addition of the rice protein.

4. The three test formulas of rice protein and quantity of protein per slice:

	CONTROL (grams)	TEST 1 (grams)	TEST 2 (grams)	TEST 3 (grams)
Wheat Flour	300	267	234	201
Rice Protein	0	33	66	99
Total Protein	34.5	30.7+27.5 =58.2	26.9+55.0 =81.9	23.1+82.6 =105.7
Protein Per Slice	2.156	3.64	5.1	6.6

Discussion and Results

1. The three doughs [control, test 1 and test 2] mixed well to development. However, as the rice protein increased the development of a window pane decreased and in test 3 there was no development.

2. The rice protein in test 1 and 2 did not affect the dough hydration. The rice protein did not have a competitive effect for water as some other ingredients [like bran] might.

3. The three doughs [control, test 1 and test 2] fermented well and molded very nicely. While test 3 failed to ferment sufficiently and test stopped.

4. During pan proofing the more rice protein replacing the wheat flour resulted in less dough volume corresponding to a smaller loaf volume.

5. Loaf data for the three rice protein breads:

	CONTROL	TEST 1	TEST 2	TEST 3
Bake yield [%]	89.8	89.9	91.5	failed
Loaf volume [cc]	1848	1500	1213	
Density [g/cc]	0.257	0.318	0.398	
Symmetry	good	good	good	

6. Photograph of the bread loaves (left–control; middle–33 grams rice protein; right–66 grams of rice protein;grid of photoboard is 1⁄2 inch)

7. Photograph of the bread loaf ends and interior slices (left–control; middle–33 g brown rice protein; right–66 grams of rice protein):

Conclusion & Recommendations

1. Rice protein [Oryzatein® 80] is a possible protein fortification ingredient to the limits observed in this study.

2. The greater amounts of rice protein added reduces the wheat flour required for dough development and loaf volume.

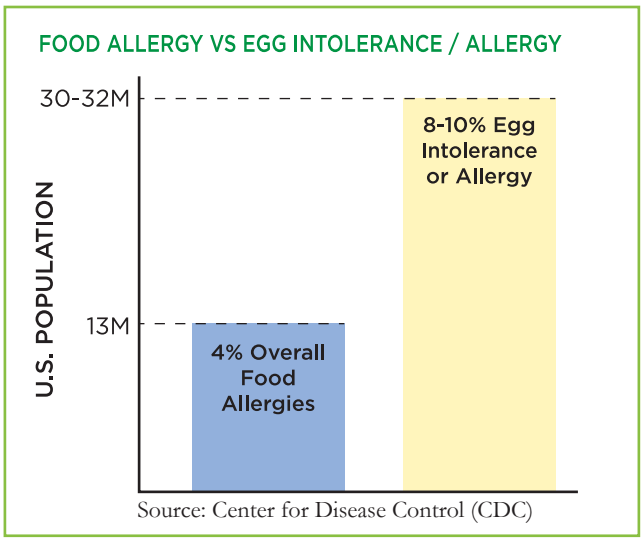
3. The rice protein addition alters the slice color from white to brown.

4. The rice protein up to test 2 did not affect mixing time or dough hydration.

5. The increase in rice protein did reduce the quality of the dough development as measured by window pane.

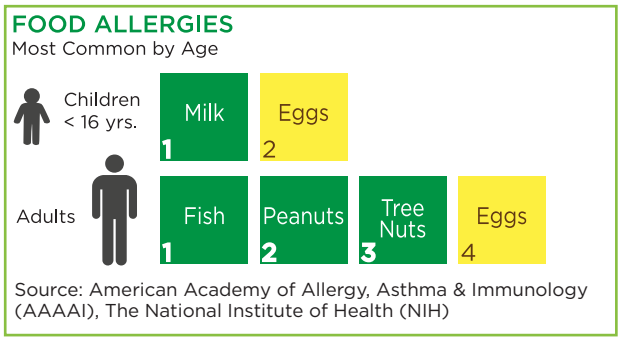
The Isolated Facts

As little as 2% to 5% of a pea protein isolate (≥80%*) added to wheat flour is enough to hike the nutritional value without major formula changes. Highly refined to reduce oligosaccharides, pea protein isolates (≥80%*) offer improved flavor, mouth feel and digestive ease, in addition to providing a higher protein claim with fewer grams. These attributes allow increased protein levels in foods such as high-fiber, high-protein, low-calorie breads without changing their flavor. Don't fret about cardboard chewiness. Pea proteins provide their potent protein boost without that mouth-drying woody taste.



A "Niche" Market of 30 Million?

Egg allergy isn't the temporary problem once assumed. Results from a recent and large John Hopkins study found 32% of those diagnosed as kids continue to suffer reactions to egg after the age of 16, many of them throughout adulthood. Adult allergies are a little less prevalent than kids.



Beyond allergies, sensitivities to egg and egg-containing products explodes the market for a functional egg replacer to more than 30 million people, according to CDC's conservative estimates. Indeed, many people who can't tolerate egg products don't have an actual egg allergy as medically defined, but rather a sensitivity to eggs, including inflammation and diarrhea. In England, some 53% of those recently surveyed had intolerance to egg white and 32% to egg yolk. That's a lot of folks looking for an egg-free eating experience.

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