

Insight



Roundup Ready® Soybeans: Food & Feed Safety

Roundup Ready® soybeans set a precedent in 1996, as they were the first Roundup Ready seed product to come to market in the United States. Since then, other Roundup Ready crops such as corn, cotton and canola have been introduced. All are tolerant to over-the-top applications of Roundup® herbicide - providing post-emergent weed control. The benefits of this technology are many, including:

- Superior broad-spectrum weed control combined with excellent crop safety
- Outstanding yield potential
- Cost savings and convenience
- Reduced foreign matter (e.g., weed seeds) in harvested grain

Food and feed safety overview

The safety of biotech products such as Roundup Ready soybeans is established through comprehensive studies validated by national and international regulatory systems. These studies demonstrate that the newly introduced protein in Roundup Ready soybeans is safe, and the genetic modification has not changed the grain's food, feed or environmental safety.

Roundup Ready soybeans have cleared the reviews for food, feed and environmental safety by the U.S. Department of Agriculture and the U.S. Food and Drug Administration. In addition, they received label approval for Roundup herbicide usage from the Environmental Protection Agency.

Roundup Ready soybeans also have cleared food/feed regulatory agencies' reviews in Canada, Japan, the European Union, Argentina and other countries. They all concluded that Roundup Ready soybeans are the same ("substantially equivalent") as other soybeans in nutrition, composition, safety, and how they function in food and feed products.

"Substantially equivalent" to other soybeans

A basic principle in the regulation of foods and feeds produced from plant biotechnology is a concept called "substantial equivalence." It was established in the early 1990s by the Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO) and the Organization for Economic Cooperation and Development (OECD).

To establish "substantial equivalence," the composition of Roundup Ready soybeans was compared to conventional varieties. The assessments included proximate analysis (protein, fat, ash, fiber, carbohydrates and moisture), which showed the Roundup Ready soybeans to be comparable in composition to conventional soybeans. In addition, amino acids, fatty acid composition and anti-nutrients were found to be comparable to conventional soybeans.

In total, more than 1,800 independent analyses were conducted and conclusively demonstrated that the composition of Roundup Ready soybeans is equivalent to other soybeans on the market.

Nutritionally equivalent to conventional soybeans

In addition to extensive compositional studies showing that Roundup Ready soybeans are comparable to conventional soybeans, feeding studies demonstrate the nutritional equivalence of Roundup Ready soybeans. Feeding studies were performed across the zoological spectrum, including broiler chickens, dairy cattle, catfish and rats.

Roundup Ready soybeans – just like all biotech foods reviewed to date – were found to be comparable, or substantially equivalent, to their traditional counterparts aside from the defined differences conferred by the novel trait.



Roundup Ready soybeans are compositionally equivalent to conventional soybeans

Protein	✓
Fat	✓
Ash	✓
Fiber	✓
Carbohydrates	✓
Amino acids	✓
Fatty acid composition	✓
Anti-nutrients	✓

"When substantial equivalence is established for an organism or food product, the food is regarded to be as safe as its conventional counterpart and no further safety consideration is needed."

Report of a Joint FAO/WHO Consultation on Biotechnology and Food Safety held Sept. 30 - Oct. 4, 1996, in Rome

“The growth and gain-to-feed performance of animals fed GTS (Roundup Ready soybean) meal sources was comparable to those of animals fed parental-line (conventional) soybeans.”

Hammond, et al.,
Journal of Nutrition, 1996

Safety assessment summary for Roundup Ready soybeans

Nutritional composition	✓
Animal feed performance (chickens, cows, fish, rodents)	✓
Processing	✓
Wildlife safety	✓
Disease susceptibility	✓
Allergenic potential	✓
Tolerance to Roundup herbicide	•
One additional protein/gene	•
KEY Changed ■ Unchanged <input checked="" type="checkbox"/>	

Summary of the safety assessment

In summary, Roundup Ready soybeans:

- Are compositionally equivalent to conventional soybean varieties.
- Are nutritionally equivalent and perform comparably to conventional varieties in food production and for livestock feed.
- Contain the CP4 EPSPS protein that is proven safe for consumption.
- Offer a number of environmental benefits.



#00499183

Data from these studies was published in the peer-reviewed *Journal of Nutrition*, thus confirming the quality and integrity of the studies.

- A chicken feeding study showed no differences among groups in body weight, live weight gain, feed intake, gain-to-feed ratio or livability. In addition, there were no differences among groups in breast muscle and fat pad weights between chickens fed Roundup Ready soybeans and its parental line.
- Milk production and composition, rumen fermentation, feed digestibility and nitrogen utilization were comparable in dairy cows fed both the Roundup Ready and parental soybean lines.
- A catfish study showed that gain-to-feed ratios, proportionate weight gains and body composition were not different among fish fed conventional soybean lines vs. Roundup Ready soybean lines. Overall health and survival also were comparable among groups.
- Studies with rats showed no meaningful differences in body weight, weight gain or food consumption between rats fed processed soybean meal or unprocessed ground meal relative to the Roundup Ready and conventional soybean lines.

The conclusion: The feed performance of Roundup Ready soybeans is equivalent to conventional soybeans.

Safety history of the CP4 EPSPS protein

Roundup Ready soybeans are tolerant to Roundup herbicide due to a single added protein: the enzyme CP4 EPSPS. Whereas the wild-type, native EPSPS enzyme present in soybeans is sensitive to glyphosate, the active ingredient in Roundup herbicide, the CP4 EPSPS protein is naturally tolerant to glyphosate.

The CP4 EPSPS protein is derived from *Agrobacterium* sp. strain CP4, a common soil microorganism. The protein is functionally similar to the wild-type soybean EPSPS except for its tolerance to glyphosate. It also is similar to other EPSPS proteins found in plants, bacteria, fungi and microorganisms such as baker's yeast, establishing a history of safe consumption.

The safety of the CP4 EPSPS protein in Roundup Ready soybeans has been thoroughly evaluated. Tests confirm that the protein:

- Is present at very low levels (0.1 percent of total protein) in grain.
- Is rapidly digested.
- Poses no allergenic concerns.
- Shows no harmful effects to animals when fed at very high levels.

Environmental impact evaluation

The overall safety assessment of Roundup Ready soybeans also included an environmental component. The assessments found that Roundup Ready soybeans' built-in herbicide tolerance offers a number of benefits that conventional soybeans do not. For example, Roundup herbicide can be applied on an "only-as-needed" basis after weeds appear, reducing herbicide costs and the need for pre-emergent soil-applied residual herbicides.

Sustainability also is a key component of the Roundup Ready soybean system. In 1997, Monsanto commissioned an independent study on sustainability and the Roundup Ready system. The key findings follow:

- Regardless of tillage system, the Roundup Ready soybean system provides better weed control than other soybean-herbicide systems.
- Use of Roundup herbicide over Roundup Ready soybeans reduces crop damage common with other soybean herbicides.
- The Roundup Ready system improves farm efficiency by:
 - Optimizing yield
 - Using arable land more efficiently
 - Saving time for the farmer
 - Reducing the number of herbicide applications
 - Reducing foreign matter in grain
 - Eliminating crop rotation restrictions
- Herbicide-tolerant soybeans fit well with and encourage farmers to adopt conservation tillage practices, especially no-till. Conservation tillage sustains the environment by:
 - Reducing soil erosion
 - Improving water quality
 - Increasing carbon retention in the soil
 - Reducing fuel use and CO₂ emissions
 - Improving wildlife habitat



Additional print sources

Hammond, B. G., Vicini, J. L., Hartnell, G. F., Naylor, M. W., Knight, C. D., Robinson, E. H., Fuchs, R. L. and Padgett, S. R. (1996) The feeding value of soybeans fed to rats, chickens, catfish and dairy cattle is not altered by genetic incorporation of glyphosate tolerance. *Journal of Nutrition*. 126: 717-727.

Harrison, L.A., Bailey, M. R., Naylor, M. W., Ream, J. E., Hammond, B. G., Nida, D. L., Burnette, B. L., Nickson, T. E., Mitsky, T.A., Taylor, M. L., Fuchs, R. L. and Padgett, S. R. (1996) The expressed protein in glyphosate-tolerant soybean, 5-enolpyruvylshikimate-3-phosphate synthase from *Agrobacterium* sp. strain CP4, is rapidly digested in vitro and is not toxic to acutely gavaged mice. *Journal of Nutrition*. 126: 728-740.

Monsanto. (1998, April) The Roundup Ready® system: Sustainability and herbicide use. 96EU4.

Padgett, S. R., Taylor, N. B., Nida, D. L., Bailey, M. R., MacDonald, J., Holden, L. R. and Fuchs, R. L. (1996) The composition of glyphosate-tolerant soybeans is equivalent to that of conventional soybeans. *Journal of Nutrition*. 126: 702-716.



www.FARMSOURCE.com

Roundup® and Roundup Ready® are registered trademarks of Monsanto Company.