# Triticale for Food Products (April 1993)

## Triticale for Food Products

## Executive Summary

Triticale is a cereal grain created by pollinating wheat with rye, then interbreeding and selecting from succeeding generations to produce stable, superior varieties. Most research on food use of triticale has focused on the substitution of triticale for wheat in existing products. Little has been done to analyze modern triticale varieties or to use them creatively in food.

The characteristics of triticale grain differ tremendously among triticale varieties. In general triticale grain is similar to wheat, but differs from wheat in the following respects:

1) Less gluten and weaker gluten than hard red breadwheat,
2) Higher alpha-amylase and other enzymes,
3) Better quality protein in terms of amino acid composition and digestibility,
4) Higher content of soluble dietary fiber and minerals,
5) A pleasing, nutty, mild-rye flavor.

For large-scale commercial breadmaking using methods developed for wheat, triticale produces a weak, sticky dough and unsatisfactory bread. New methods are needed for breadmaking with triticale, or for blending and processing triticale and wheat together, especially in wheat-poor countries having limited resources to grow or import wheat.

In addition to breadmaking, a multitude of other food uses have been proposed for triticale based on research evaluations - pancakes, cookies, breakfast cereal, snack food, malsters' adjuvant, brewers' adjunct, distilling grain, emulsifier, and water-absorbing agent. For some products triticale has advantages over other cereal grains; for other products its use would depend on lower cost.

The use of triticale for food products warrants greater attention for the following reasons:

1) In wheat-poor countries, the economic and nutritional advantages of triticale compared to wheat are increasingly important.
2) In wheat-rich countries, markets for cereal-based products have expanded and become more diverse. Triticale offers novelty and flavor. It appeals to consumer

concerns about nutrition and the environment, and can enhance the quality, labeling, and promotion of food products.

3) Modern varieties of triticale have higher test-weight, plumper kernels, and differ in other potentially important ways from the first varieties.

4) The agronomics and economics of producing triticale grain have improved dramatically.

## Triticale: Origin, Production, and Nutritional Value

Triticale is a cereal grain created by pollinating wheat with rye, then interbreeding and selecting from succeeding generations to produce stable, superior varieties. The goal in breeding triticale is to combine the best features of wheat and rye into one crop, enhanced further by the "hybrid vigor" of the combination (Table 1).

Triticale's potential was highly publicized over twenty years ago, but only now is the crop beginning to fulfill that potential. The agronomic performance of triticale has improved dramatically, with triticale yields now superior to wheat in many production areas. Further increases in triticale yields relative to wheat are expected. In addition to yielding well compared to wheat under good growing conditions, triticale with its rye component can tolerate diseases and environmental stresses that wheat cannot. As pesticide regulations, water shortages, soil acidity, and other environmental factors become more significant, the disease resistance and vigor from rye will become more important.

Although first promoted as a food grain, triticale's current use in wheat-rich countries like the U.S. is primarily for forage and feedgrain. In wheat-poor countries - those with limited capability to produce or import wheat - the focus remains on the use of triticale for food.

The first varieties of triticale produced in the U.S. had significantly higher levels of protein than wheat, largely the result of poorly developed endosperm and shriveled kernels. Modern varieties have plumper kernels, higher test weight, and protein levels much closer to that of wheat. The protein digestibility and amino acid balance of the modern triticale varieties, however, have generally remained better than those of wheat. Recent research in Europe indicates that "some modern high-yielding triticale cultivars have nutritional advantages over wheat in terms of UP (utilizable protein) content in the grain, the production of energy and UP per hectare" (J. Heger and B. O. Eggum, 1991).

Triticale grain has been reported to have higher content of soluble dietary fiber than wheat, and to be slightly superior to wheat in terms of mineral content, with calcium and zinc most often cited as being higher in triticale than in wheat.

**TABLE 1. Generalized Comparison of Wheat, Rye, and Triticale**

| | Wheat | Rye | Triticale |
|---|---|---|---|
| Yield Potential | + | | ++ |
| Gluten | ++ | | + |
| Low Anti-nutrients | + | | + |
| Stress Tolerance | | ++ | + |
| Disease Tolerance | | ++ | + |
| Lysine | | ++ | + |

The flavor of triticale grain - described as "rich, distinctive, honey-nut-like", and "nutty, aromatic, and naturally sweet" - has been rated highly in most evaluations, and superior to wheat in some products.

When the first commercial triticale varieties were being produced in the U.S. during the 1970's and early 1980's, there was a flurry of research on the food-use characteristics of the crop. Triticale and the food industry have changed considerably since that time, but little has been done to analyze modern triticale varieties for their potential for food products.

## Triticale in Bread

Much of the research that has been done on food use of triticale has been on its potential as a substitute for wheat in bread. Although some triticale varieties are substantially better than others, all of the currently available varieties are inferior to high-quality breadwheat for large-scale commercial breadmaking using technology and methods designed for wheat flour. Triticale varieties have less gluten and weaker gluten than high quality breadwheat. Some triticale varieties also have higher alpha-amylase and pentosan content than wheat. Consequently, triticale generally produces a weak, sticky dough, and unsatisfactory bread when mixing and fermentation methods developed for wheat flour are used.

Satisfactory results with triticale flour for breadmaking have been obtained by changing mixing and fermentation procedures, adding dough conditioners, or blending triticale and wheat. Ceglinska and Wolski (1991) have described results from a comparison of four different methods of making bread with 100% triticale flour, including unsatisfactory results with methods used for wheat flour and excellent results from two modified methods (Appendix A). Methods of breadmaking that have been used successfully with 100% triticale flour, however, tend to be long, tedious, and inadequate for large-scale bakeries, so further improvements in those methods are needed.

In wheat-poor countries the use of triticale for breadmaking remains an important objective. In countries such as India, Kenya, and Poland, triticale yields more than wheat, and offers a valuable alternative to domestic wheat production and imports. These countries look to triticale as a lower cost, more nutritious substitute for wheat. National debt, foreign exchange limitations, population growth, water scarcity, and marginal land resources all heighten the interest in triticale.

Currently in wheat-rich countries the principal motivation for including triticale in bread is its novelty. It is included in most multigrain breads in small amounts that contribute to the label but have little affect on the product itself. When asked whether triticale offered anything to bakers beyond its novelty value, two of the principal suppliers of triticale for baking in the U.S. thought it did not.

One exception to the token use of triticale in bread is its use by the Lucky's supermarket chain, one of the country's largest. Lucky's prominently features triticale in one of its *Harvest Day*® breads. The developer of the product reports that the bread has been popular for fifteen years, and that triticale contributes significantly to the flavor and texture of the product as well as to its promotion. In this product, the triticale ingredient is whole grain, slightly rolled, rather than flour.

Researchers have suggested the use of triticale flour or malts for low-sugar dough because of triticale's high diastatic power. A surprising number of recipes for automatic breadmakers for home use include triticale flour, but the flavor rather than the diastatic power of triticale seems to have motivated its inclusion in those recipes.

The triticale now used in baking in the U.S. commonly costs more than wheat. However, new triticale varieties that have higher yields and lower production costs than wheat will soon be available. Companies that have access to those varieties and knowledge of how best to use them in bread flour could achieve significant cost savings.

In wheat-rich and wheat-poor countries, further improvements in varieties, product formulation or processing will be needed if triticale is to become a major bread grain.

## Triticale for Malting, Brewing, and Distilling

Triticale has significant advantages for malting: short seeping period, high diastatic power, rapid malting, and high extract yields. It also has problems: high soluble nitrogen, and viscous worts.

Triticale grain and malts have good potential as malsters' adjuvant and brewers' adjunct. Triticale malts have proved to be more effective than malts from wheat, barley, or rye for increasing loaf volume in low-sugar bread formulations. Triticale malts also are a potentially desirable source of flavor and color for specialty bakery products.

In Canada, domestically produced triticale has been evaluated for distilling as an alternative to imported corn. Reportedly triticale is a suitable replacement for corn for that use, and is preferable to wheat. The favorable price and easy availability of corn has limited this use of triticale for distilling in the past, but interest remains and opportunities may develop in the future. Evaluations of triticale distillers' grain have shown it to be comparable to wheat distillers' grain for food products.

## Triticale for Other Food Uses

In addition to breadmaking and malting, a multitude of food uses have been proposed for triticale based on research evaluations - pancakes, cookies, breakfast cereal, snack food, emulsifier, and water-absorbing agent. The tremendous diversity among triticale varieties, and among potential uses, make it difficult to generalize about the performance of triticale for those uses.

In standard cookie and cake baking tests, triticale has rated equal or superior to soft red wheat in a few cases, but in most cases the triticale varieties that have been tested have not performed as well as the soft wheat varieties. Blends of triticale and wheat, however, have performed consistently well in the cookie and cake tests, better than wheat alone in several cases. Blends also have performed well in evaluations of triticale for crackers and flat breads.

Triticale pancakes have been rated highly in several reports, having advantages over wheat in terms of flavor, tenderness, and spread. Those with experience with the product suggest that triticale pancakes would have excellent potential for the restaurant and fast-food industries.

Work done almost twenty years ago with some of the first triticale varieties suggests that tempered triticale grain can be extruded successfully to produce breakfast cereal and other products. There have been no reports on extrusion processing of modern triticale varieties.

Other early research on triticale indicated that protein concentrates from the crop had good hydration capacity, excellent emulsifying activity, and excellent emulsion stability, suggesting possible use as a fat emulsifier and water-absorbing agent in foods. Residues and pure starch produced in association with protein extraction were found to be suitable for uses of their own.

## Opportunities for Food Use of Triticale

Opportunities for using triticale in food include (1) those based on cost savings from substituting triticale for more expensive ingredients such as wheat, and (2) those based on the advantages of triticale for the quality and consumer appeal of the product.

In wheat-poor countries there are important, immediate opportunities for substituting triticale for wheat in major food products. Such a substitution will require changes in product formulation and production technology.

In the wheat-rich countries of North America and Europe, new varieties of triticale will soon be available that have significantly higher yield and lower production cost than wheat. As government subsidies favoring wheat decrease, and environmental regulations favoring triticale increase, the economic advantages of producing triticale will increase. The inherent cost advantage of the new triticale varieties will create incentives to substitute triticale for wheat in food products even in the wheat-rich countries. Technology that facilitates this substitution will become increasingly valuable.

With or without a cost advantage, the novelty and flavor of triticale create opportunities for its use in food products. The origin of the crop - its "story" - is unique; its flavor and aroma are pleasing. The natural sweetness and diastatic power of triticale could reduce the need for adding sucrose or other sweeteners. Because of its superior tolerance to pests and other stresses, triticale is well suited for "organic" production methods favored by some consumers due to concerns about the environment and pesticide residues.

Past research provides clues to current opportunities and obstacles to food use of triticale. Modern triticale varieties, however, differ significantly from those analyzed in the past, and have yet to be analyzed thoroughly and creatively for food use. The modern varieties make triticale grain more attractive to produce, and increase the potential payoff for those who develop food products and processing technology to take advantage of the increasing supply.

As concluded by the National Research Council in its recent report on triticale, "The plant's future now seems clear of fundamental agronomic obstacles. A mere three decades after the first practical triticales were made, the crop is ready to forge ahead into production. . . (for) foods, feeds, and brewing grains."

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## Appendix A

Loaf profiles from four baking methods for two triticale varieties (CHD 1089 and Lasko) each grown at two locations in Poland (Laski and Choryn).

- Method 1: Biskupski Wheat Method
  Fermentation: 60 minutes at 30° C.
  Baking Time: 20 minutes at 230° C.

- Method 2: Biskupski Rye Method (with lactic acid)
  Fermentation: 150 minutes at 30° C.
  Baking Time: 20 minutes at 230° C.

- Method 3: Bekutova / Podmoskovskovye (with lactic acid and sugar)
  Fermentation: 1st) 60 minutes at 30° C.
  2nd) 30 minutes at 30° C.
  Baking Time: 20 minutes at 260° C.

- Method 4: Three-Phase Method (with 10% rye flour)
  Fermentation: 1st) rye flour only, 24 hours at 28° C.
  2nd) 60% of triticale flour added, 180 minutes at 32° C.
  Baking Time: 30 minutes at 235° C.

In contrast to these methods described by Ceglinska and Wolski (1991), other researchers have successfully compensated for the weak gluten strength of triticale by reducing fermentation time.