



NOVEL FOOD INFORMATION - FOOD BIOTECHNOLOGY

GLUFOSINATE AMMONIUM TOLERANT CORN (T14 AND T25)

Health Canada has notified AgrEvo Canada Inc. that it has no objection to the food use of corn varieties derived from the genetically modified corn transformants designated T14 and T25, which are resistant to glufosinate ammonium. The Department conducted a comprehensive assessment of T14 and T25 derived corn varieties according to its *Guidelines for the Safety Assessment of Novel Foods* (September, 1994). These guidelines are based upon internationally accepted principles for establishing the safety of foods derived from genetically modified organisms.

BACKGROUND:

The following provides a summary regarding the AgrEvo Canada Inc. notification to Health Canada and contains no confidential business information.

1. Introduction

Corn transformants T14 and T25 were developed through genetic modification to be tolerant to glufosinate ammonium, which is the active ingredient of the herbicide Liberty®. The modification permits farmers to use the broad-spectrum herbicide for weed control in the cultivation of corn without damaging the crop.

2. Development of the Modified Plant

The T14 and T25 transformants were produced by direct gene uptake by protoplast cultures with additional genetic material (DNA). The introduced DNA is based on the *pat* gene which was originally isolated from a common soil bacterium, *Streptomyces viridochromogenes*, and encodes the enzyme, phosphinothricin acetyltransferase (PAT). The gene introduced in transformants T14 and T25 was modified to optimize its expression in plants without altering the amino acid sequence it encodes. Also included on the introduced DNA is the *amp^r* gene which encodes resistance to the antibiotic ampicillin.

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This Novel Food Information document has been prepared to summarize the opinion regarding the subject product provided by the Food Directorate, Health Protection Branch, Health Canada. This opinion is based upon the comprehensive review of information submitted by the petitioner according to the *Guidelines for the Safety Assessment of Novel Foods*.

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This gene was included as a selectable marker for the development of the introduced DNA in bacteria, but is not functional in plants. Molecular analyses show T14 to contain 3 copies of the *pat* gene, but no intact copies of the *amp^r* gene. Molecular analyses also indicated that T25 contained a single copy of the *pat* gene and did not contain an intact copy of the *amp^r* gene. The integration of the transferred DNA was demonstrated to be stable by segregation analysis.

3. Product Information

Expression of the *pat* gene in T14 and T25 derived plants results in the production of the PAT protein in corn tissues at low levels (< 0.003% of total crude protein). The expressed PAT protein mediates the rapid metabolism of glufosinate ammonium herbicide.

Corn lines derived from T14 and T25 do not produce mRNA from the disrupted *amp^r* genes, nor do they produce β -lactamase, the enzyme encoded by the *amp^r* gene. This demonstrates that the introduced *amp^r* genes are indeed non-functional in T14 and T25 derived corn plants.

The only newly expressed material in T14- and T25-derived plants is the PAT protein. The PAT protein is an enzyme which is highly specific for glufosinate ammonium, and does not possess proteolytic or heat stability. PAT has been compared with known toxins and allergens in the GENBANK database which demonstrated that the amino acid sequence of the PAT protein did not share similarity with sequences of known toxins or allergens.

4. Dietary Exposure

Human consumption of corn products includes starch, oil, bran, grits, meal and flour. No PAT protein was detected in starch or oil. Neither was PAT protein detected in wet milled corn grain fractions with the exception of the bran. Wet milled bran and all of the dry milled corn fractions contained very low levels of the PAT protein (< 0.00035% of crude protein).

5. Nutrition

Compositional analyses of corn grain from T14 and T25-derived lines and current commercial corn varieties were compared for compositional and nutritional parameters including moisture, crude fat, crude protein, crude fiber, ash, carbohydrates, mineral content (calcium and phosphorous), amino acid profile, phytates and oil composition. Some variation in the parameters compared were noted. However, none of these difference were determined to be of nutritional significance and all nutrient values were well within the range of nutrient values reported for corn grain. The use of corn grain from T14- and T25-derived corn lines would therefore have no significant impact on the nutritional quality of the Canadian food supply.

6. Safety

a) Potential Toxicity:

The nucleotide sequence of the *pat* gene and the amino acid sequence of the PAT protein were compared with sequences available for known toxins in the GenBank database.



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This demonstrated that PAT has no significant homology to known toxins. The PAT enzyme was demonstrated to be highly substrate specific. In addition, acetyltransferases are ubiquitous in nature and do not possess proteolytic or heat stability. An acute oral toxicity study demonstrated no evidence of toxicity for PAT protein when administered to rats at dietary concentrations up to 50,000 ppm for 14 days which represents a concentration of 6 orders of magnitude greater than that in grain from T14- and T25-derived corn lines.

b) Potential Allergenicity:

The nucleotide sequence of the *pat* gene and the amino acid sequence of the PAT protein were compared with sequences available for known allergens in the GenBank database. This demonstrated that PAT has no significant homology to known allergens. In addition, the potential for allergenicity was assessed based upon the characteristics of known food allergens (stability to digestion, stability to processing). The PAT protein does not possess characteristics typical of known protein allergens.

PAT is not likely to be toxic or allergenic and will be readily digested in the gut. No adverse effects have been reported to be associated with this enzyme.

CONCLUSION:

Health Canada's review of the information presented in support of the food use of corn grain from glufosinate ammonium tolerant corn lines derived from the genetically modified corn transformants designated T14 and T25 concluded that such corn grain does not raise concerns related to human food safety. Health Canada is of the opinion that corn grain from T14 and T25-derived corn lines is as safe and nutritious as corn grain from current commercial corn varieties. Health Canada's opinion deals only with the food use of corn grain from the genetically modified corn transformants designated T14 and T25. Issues related to growing T14- and T25-derived corn in Canada and its use as animal feed have been addressed separately through existing regulatory processes in Agriculture & Agri-Food Canada.