Health Canada Santé Canada

FD/OFB-096-228-B
October 1999

NOVEL FOOD INFORMATION - FOOD BIOTECHNOLOGY

INSECT RESISTANT AND HERBICIDE TOLERANT CORN, BT11

Health Canada has notified Northrup King Seeds Ltd. (now Novartis Seeds, Canada) that it has no objection to the food use of the transgenic corn line BT11, which has been developed to be resistant to insects, particularly the European Corn Borer (ECB), and tolerant to phosphinothricin containing herbicides, specifically glufosinate ammonium. The Department conducted a comprehensive assessment of BT11 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 Northrup King Seeds Ltd. notification to Health Canada and contains no confidential business information.

1. Introduction

The BT11 line of corn (*Zea mays*) was developed through a specific genetic modification to be ECB (*Ostrinia nubilalis*) resistant and tolerant to glufosinate ammonium herbicide. The novel variety produces a truncated version of the insecticidal protein, CryIA(b) derived from *Bacillus thuriengensis*, and an enzyme, phosphinothricin N-acetyl transferase (PAT), from *Streptomyces viridochromogenes*. Delta-endotoxins, such as the CryIA(b) protein expressed in BT11 corn, act by selectively binding to specific sites localized on the brush border midgut epithelium of susceptible insect species. Following binding, cation-specific pores are formed that disrupt midgut ion flow and thereby cause paralysis and death. CryIA(b) and related endotoxins are insecticidal only to lepidopteran insects and their specificity of action is directly attributable to the presence of specific binding sites in the target insects. There are no binding sites for delta-endotoxins of *B. thuringiensis* on the surface of mammalian intestinal cells, therefore, livestock animals and humans are not susceptible to these proteins. Phosphinothricin containing herbicides, such as glufosinate ammonium, act by inhibiting glutamine synthetase resulting in the accumulation of toxic levels of ammonia. The PAT enzyme detoxifies phosphinothricin by acetylation into an inactive compound. The modified corn line is protected from ECB damage and permits farmers to use phosphinothricin-containing herbicides for weed control in the cultivation of corn.

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*.

(Également disponible en français)

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2. Development of the Modified Plant

The BT11 corn line was created through direct DNA transformation of plant protoplasts and regeneration of plants by tissue culture on selective medium. The plasmid used for transformation, pZ01502, contained a truncated version of the *cryIA(b)* gene from *B. thuriengensis* subsp. *kurstaki* and the gene encoding the PAT enzyme from *S. viridochromogenes*. The open reading frames of both of these genes were modified for optimal expression in plant cells. The expression of these genes was controlled by inclusion of sequences from the 35S promoter of cauliflower mosaic virus and the 3'-polyadenylation signal of the nopaline synthase gene from *Agrobacterium tumefaciens*. Apart from the sequences encoding Cry1A(b) and PAT, no other translatable DNA sequences were introduced into the plant genome. The gene products were expressed throughout the plant and data from several generations of backcrossing demonstrated that the *cryIA(b)* and *pat* genes were tightly linked and stably inherited as a single locus.

3. Product Information

The expression levels of both the CryIA(b) protein and the PAT enzyme were determined in the leaves and kernels of transgenic corn. Accounting for extraction efficiencies, the amount of expressed CryIA(b) protein was found to be 15.2 and 28.9 µg/g fresh weight for mature and young leaves, respectively, and 3.7 and 4.76 µg/g fresh tissue for heterozygous or homozygous kernels respectively. The PAT enzyme was detected at levels of 38.6 – 49.4 ng/g fresh weight of leaf tissue, but not in roots, pollen or kernels. However, enzyme activity analysis indicated that PAT was expressed in all tissues throughout the plant. No significant differences were observed between hybrids derived using original elite lines and the selected BT11 line for the agronomic traits of yield, moisture at harvest, root lodging rating, ear height, plant height, heat units to silking or pollen shed. Other than resistance to ECB and tolerance to glufosinate ammonium herbicide, the disease, pest and other agronomic characteristics of BT11 corn were comparable to non-transgenic lines of corn.

4. Dietary Exposure

The genetic modification of BT11 corn will not result in any change in the consumption pattern for this product. Consequently, the dietary exposure of Canadians to this product is anticipated to be the same as for other lines of commercially available corn.

5. Nutrition

The analysis of nutrients from transgenic BT11 corn and non-transgenic corn did not reveal any significant differences in the levels protein, fat, fibre and starch. Similarly, the levels of micronutrients including calcium, phosphorus, potassium and magnesium were within the established ranges for corn. The consumption of products from BT11 corn will have no significant impact on the nutritional quality of the Canadian food supply.

6. Safety

a) Potential Toxicity:

Mammalian toxicity studies conducted using CryIA(b) and PAT test material did not reveal any deleterious effects. The amino acid sequence of the truncated CryIA(b) protein expressed in BT11 corn is closely related to the sequence of the same proteins that are present in strains of *B. thuringiensis* that have been used for over 30 years as commercial organic microbial insecticides. An analysis of the amino acid sequences of the inserted CryIA(b) protein and the PAT enzyme did not show homologies with known mammalian protein toxins and they are not judged to have any potential for human toxicity.

b) Potential Allergenicity:

The truncated CryIA(b) protein and the PAT enzyme expressed in BT11 corn do not possess characteristics typical of known protein allergens. There were no regions of homology when the sequences of these introduced proteins were compared to the amino acid sequences of known protein allergens. Unlike known protein allergens, both of these proteins are rapidly degraded by acid and/or enzymatic hydrolysis when exposed to simulated gastric fluids. The Cry1A(b) and PAT proteins are extremely unlikely to be allergenic.

CONCLUSION:

Health Canada's review of the information presented in support of the food use of insect resistant and herbicide tolerant BT11 corn concluded that this corn does not raise concerns related to human food safety. Health Canada is of the opinion that products from BT11 corn are as safe and nutritious as those available from current commercial corn varieties.

Health Canada's opinion pertains only to the food use of this insect resistant and herbicide tolerant corn. Issues related to growing insect resistant and herbicide tolerant corn in Canada and its use as animal feed are addressed separately through existing regulatory processes in the Canadian Food Inspection Agency.