

RESEARCH NOTE

Comparison of nutrition composition of transgenic maize (chitinase gene) with its non-transgenic counterpart

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Abstract

Y. Ping-mei, R. Yu-kui, Y. Xiao-yan, C. Zheng, W. Qing, D. Jian-zhong, and S. Yi. 2011. Comparison of nutrition composition of transgenic maize (chitinase gene) with its non-transgenic counterpart. *Cien. Inv. Agr.* 38(1): 149-153. In order to compare the nutrition components of transgenic maize seeds (chitinase gene), achieved by the pollen-mediated approach, with its non-transgenic counterpart, Vitamin B1, vitamin B2, fatty acids and essential amino acids of transgenic maize seeds and their counterparts were analyzed by the Chinese national standard methods or AOAC methods. The results showed that the contents of all the six kinds of fatty acids detected in transgenic maize seeds were significantly higher than those in their non-transgenic counterpart, the content of vitamin B2 in transgenic maize was significantly lower than that in non-transgenic maize seeds, the content of total amino acids in transgenic maize seed was higher than that in non-transgenic maize seeds, while vitamin B1 and most of essential amino acid have no significant difference between transgenic maize and non-transgenic maize seeds. According to the above data, transgenic foods should be strictly analyzed to find out whether it can reach the standard of "substantial equivalence" in nutrient composition.

Key words: Transgenic maize, nutrition, fatty acids, essential amino acids, vitamin, chitinase gene.

Introduction

Chitinase hydrolyses chitin and prevents fungi from infecting plants and propagating inside plant tissues. Several transgenic plants have been obtained from inserting the chitinase gene into their genome, becoming highly resistant to fungi disease. (Lorito *et al.*, 1998) Maize is one

of the three biggest yield cereal crops and most of maize diseases are fungal diseases, so inserting the chitinase gene into maize is surely an effective approach to resist fungi diseases and ensure food security.

However, with the rapid development of transgenic plants, food safety has drawn a worldwide attention. Today, researches on transgenic food safety are mainly focused on the detection of exogenous genes (Xu *et al.*, 2009a) and exogenous

proteins (Xu *et al.*, 2009b). The introduction of exogenous genes could break the metabolic balance in the plant, or change some physiological and biochemical courses, which could result in food safety problems, including changes in nutrition such as content of protein, vitamins, essential fatty acids, amino acids, etc.

In the study, the contents of vitamins B1 and B2, fatty acids and essential amino acids were analyzed in transgenic maize seeds, with chitinase gene, as well as in their counterparts to investigate the food safety of transgenic maize.

Materials and methods

Plant materials

The transgenic maize seeds and non-transgenic maize seeds were provided by Agricultural Biotechnology Center of Shanxi, Taiyuan, China. The transgenic maize was achieved by the pollen-mediated approach on maize (*Zea mays L.*) cultivar Hai 921, which is the control. Plasmid DNA of pGL α -RC-1 was mixed with fresh pollen of maize inbred in sucrose solution (Wang *et al.*, 2001).

Fatty acid extraction

Ten grams maize seed were ground in a high speed tissue masher. The maize seed powder was extracted with petroleum ether, filtered through filter paper, and then the petroleum

ether was removed by vacuum. The concrete methods refer to Rui's method (Rui *et al.*, 2007).

Methods of analysis

The detection method of vitamin B1 composition and concentration refers to GB/T 5009.84-2003 (2004), the detection method of vitamin B2 composition and concentration refers to GB/T 5009.85-2003 (2004), the detection method of vitamin C composition and concentration refers to GB/T 5009.86-2003 (2004), the detection methods of amino acids composition and concentration refer to GB/T 5009.124-2003 (2004), and the detection methods of fatty acids composition and concentration refer to AOAC (1995). Statistical analysis: all data were analyzed by Excel and SPSS software.

Results and discussion

Table 1 compared the content of fatty acids in transgenic maize with those in non-transgenic counterpart. Six kinds of fatty acids, C14:0, C16:0, C18:0, C18:1, C18:2 and C18:3 were found in transgenic maize seeds and its counterpart, and no new fatty acids were found. Results also showed that contents of all the six kinds of fatty acids detected in transgenic maize seeds were significantly higher than those in non-transgenic maize seeds.

The content of vitamin B1 in transgenic maize has no significant difference from its non-trans-

Table 1. Comparison of the content of fatty acids in transgenic maize with that in non-transgenic maize (g/100 g) (n=3).

Fatty acid type	Transgenic	Non-transgenic
c14:0	0.017±0.02a	0.010±0.03b
c16:0	0.703±0.056a	0.610±0.061b
c18:0	0.058±0.009a	0.038±0.005b
c18:1	1.107±0.054a	0.586±0.039b
c18:2	2.794±0.073a	2.085±0.091b
c18:3	0.062±0.010a	0.054±0.006a

Different letters after numerical values indicate significant differences ($P \leq 0.05$).

Table 2. Comparison of the contents of vitamin B1 and vitamin B2 in transgenic maize with those in non-transgenic maize (mg/100 g).

Fatty acid type	Transgenic	Non-transgenic
VB1	0.122±0.008a	0.113±0.012a
VB2	0.267±0.017a	0.445±0.023b
VC	Null	Null

Different letters after numerical values indicate significant differences ($P \leq 0.05$).

Table 3. Comparison of the content of amino acids in transgenic maize with the non-transgenic maize (g/100 g).

Amino acid	Transgenic	Non-transgenic
Aspartic acid	0.62±0.05a	0.59±0.03a
Threonine	0.35±0.02a	0.33±0.01a
Serine	0.42±0.00a	0.40±0.02a
Glutamic acid	1.67±0.08a	1.61±0.10a
Proline	0.63±0.05	0.61±0.06
Glycine	0.31±0.03a	0.30±0.01a
Alanine	0.64±0.04a	0.61±0.00a
Cysteine	0.59±0.00a	0.60±0.02a
Valine	0.50±0.03a	0.49±0.00a
Methionine	0.16±0.04a	0.18±0.03a
Isoleucine	0.28±0.00a	0.27±0.04a
Leucine	1.05±0.05a	0.99±0.02a
Tyrosine	0.44±0.02a	0.42±0.00a
Phenylalanine	0.44±0.00a	0.42±0.01a
Lysine	0.31±0.03a	0.29±0.02a
Histidine	0.29±0.00a	0.29±0.00a
Arginine	0.33±0.02a	0.35±0.03a
Total amino acid	9.04±0.63a	8.72±0.70a

Different letters after numerical values indicate significant differences ($P \leq 0.05$).

genic counterpart, but the content of vitamin B2 in transgenic maize was significantly lower than that in its non-transgenic counterpart. Vitamin C is not found in either transgenic or non-transgenic maize seed, because the content of Vitamin C is too low (Table 2).

Amino acids are components of protein and the product of the exogenous gene is protein; therefore, whether the insertion of exogenous gene can result in a change of amino acid contents should be an important aspect for trans-

genic food safety. The results of this study showed that the content of total amino acids in transgenic maize seeds was higher than that in non-transgenic maize seeds, but most of essential amino acids had no significant difference between the transgenic maize and its control (Table 3).

From the above data, the nutrition of the transgenic maize with chitinase gene from inbred lines Tai 9101 and Zong 31, achieved through the pollen-mediated approach, changed although

the cause of the changes should be further researched. So transgenic food should be strictly analyzed not only regarding the exogenous gene and exogenous protein, but also about other components which seem not directly related to the exogenous gene, even though many researches

have proven the nutrition of transgenic food showed no changes (Han *et al.*, 2005; Tang *et al.*, 2006). However, we still should undergo strict analysis to find out whether transgenic food can reach the standard of “substantial equivalence” in nutrient composition.

Resumen

Y. Ping-mei, R. Yu-kui, Y. Xiao-yan, C. Zheng, W. Qing, D. Jian-zhong y S. Yi. 2011. Comparación de la composición nutricional del maíz transgénico (gen quitinasa) con maíz no transgénico. Cien. Inv. Agr. 38(1): 149-153. Con el fin de comparar los componentes nutricionales de las semillas de maíz transgénico (gen quitinasa), obtenidos por el método del polen, con respecto a un maíz no transgénico, se analizó la vitamina B1, vitamina B2, ácidos grasos y aminoácidos esenciales de semillas de maíz transgénico y sus homólogos, a través del método chino estándar nacional o métodos de la AOAC. Los resultados mostraron que el contenido de los seis tipos de ácidos grasos detectados en semillas de maíz transgénico fueron significativamente superiores a los de su contraparte no transgénico, el contenido de vitamina B2 en el maíz transgénico fue significativamente menor que en las semillas de maíz no transgénico. El contenido total de aminoácidos en las semillas de maíz transgénico fue mayor que en las semillas de maíz no transgénico, mientras que la vitamina B1, y la mayor parte de los aminoácidos esenciales, no tuvieron ninguna diferencia significativa entre el maíz y las semillas transgénicas de maíz no transgénico. De acuerdo con la información anterior, los alimentos transgénicos deben ser rigurosamente analizados, para saber si se puede alcanzar el estándar de “equivalencia sustancial” en la composición de nutrientes.

Palabras clave: Ácidos de maíz transgénico, nutrición, ácidos grasos, aminoácidos esenciales, vitamina A, gen quitinasa.

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