

PROSPECTIVA TECNOLÓGICA

AAPRESID

**Los Organismos Vegetales Genéticamente
Modificados (OVGMs) y los alimentos**

(Número Especial)

Octubre de 2008

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Temario

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El presente trabajo corresponde a una búsqueda bibliográfica de diferentes revistas científicas especializadas en áreas temáticas de interés agropecuario y biológico. Cada título está vinculado al artículo original, se incluyó el resumen y se hizo una pequeña descripción del mismo.

En la entrega de este mes se preparó un número especial que refiere a “**Los Organismos Vegetales Genéticamente Modificados (OVGMs) y los alimentos**”. El informe se divide en seis partes. La primera presenta, con una serie de revisiones generales, un análisis de los OVGMs y los ALIMENTOS. La segunda se concentra en la SEGURIDAD ALIMENTARIA DE LOS OVGMs, sus aspectos generales, la alergenicidad, su relación con la nutrición y con la salud de los consumidores. En ésta se desarrolla especialmente el tema de la biofortificación (granos -arroz- enriquecidos en provitamina A, minerales, ácido fólico y ficocianinas) y la remoción de la alergenicidad natural de los alimentos. La tercera enfoca los ASPECTOS REGULATORIOS y también ofrece ANÁLISIS DE LA OPINION PUBLICA relacionada con la adopción y uso de productos derivados de estas tecnologías. La cuarta analiza la PRESENCIA, RESIDUALIDAD Y DEGRADACIÓN LOS OVGMs EN LOS ALIMENTOS. La quinta y última parte presenta algunas CONSIDERACIONES FINALES del tema.

I. LOS OVGMS y LOS ALIMENTOS (Revisiones Generales).

Genetically Modified Crops and Foods

Council on Scientific Affairs. 10, 1-28. 2000

Genetically modified foods "raise many issues--scientific, technological, environmental, social, ethical, economic, and political."¹³² Controversy over GM food exposes larger issues about public trust in science and the role of science in policymaking. In an increasingly complex world, trust functions as a substitute for knowledge. Interference with our systems of food production has always aroused public concern, occasionally with justification. Attempts to introduce GM foods have stimulated not a reasoned debate, but a potent negative campaign by people with other agendas. Opponents ignore common farming practices and well investigated facts about plants, or inaccurately present general problems as being unique to GM plants.

Keywords: OGMs, alimentos, bioseguridad, opinion pública

Se trata de un informe que toma el tema de los cultivos transgénicos desde varios puntos de vista. En lo concerniente a alimentos, enfoca los aspectos que incluye la evaluación de los alimentos derivados de cultivos transgénicos desde la eventual toxicidad, la alergenicidad y la resistencia a antibióticos como consecuencia del uso de marcadores de selección durante el desarrollo de estos cultivos. También discute temas de la elección de los consumidores de alimentos sobre estos productos y de la calidad de los alimentos. El impacto ambiental también es ampliamente discutido.

Overall conclusion on Genetically modified foods

Trends in Food Science & Technology 14: 333–334 (2003)

Taking the reviews of current knowledge as a scientific basis for expert opinions and projections about the development, use and risk assessment of genetically modified foods (GMFs) for human health and nutrition, workshop participants reached a number of overall conclusions, as summarised below.

The process of the development of transgenic organisms presents no new categories of risk compared with conventional methods for the improvement of plants, animals or microorganisms. However, specific traits introduced by either approach might pose unique risks, which need to be identified.

Keywords: OGMs, alimentos, ingeniería genética

El presente artículo es un resumen de un número especial de la revista donde se discuten los alimentos derivados de OGMs. Los distintos capítulos de este número se incluyen en este informe de manera más específica con los temas que se analizan.

Is the battle over genetically modified foods finally over?

Editorial

Biotechnology Advances 23 (2005) 93–96

The Earth is finite, and as such has a limited capacity to produce the food and fresh water necessary to sustain human populations. With the size of the world's population, currently topping 6 billion people, including over 1 billion each in China and India alone, not only has the availability of natural resources

become limiting, but also it has become increasingly difficult to feed this enormous population. Moreover, the world's population is expected to double in the next 50 years. Birth control awareness programs and government restrictions on the number of children a family can have has had a positive effect in decreasing the rate of population growth, especially in China. However, in many countries of the world, cultural and religious views on birth control are a major impediment to effective population control. As a result, many countries are faced with a population that is well beyond their carrying capacities. Many of the regions beset with uncontrolled population growth and/or the inability to feed a burgeoning population include developing countries in Africa, Asia, and Latin America.

Keywords: OGMs, alimentos

La presente nota editorial enfoca la introducción de cultivos transgénicos para atender las demandas alimenticias de las regiones más pobres y pobladas del planeta.

Are GM and conventionally bred cereals really different?

Peter R. Shewry, Marcela Baudo, Alison Lovegrove, Stephen Powers, Johnathan A. Napier, Jane L. Ward, John M. Baker and Michael H. Beale

Trends in Food Science & Technology 18 (2007) 201-209

Concerns over the safety of GM crops have led to detailed comparisons of their composition and performance with those of conventionally bred crops, under both field and glasshouse conditions. Such studies of wheat have shown that it is possible to develop GM lines which are substantially equivalent to conventional varieties. This information is important to inform the debate on the future development of GM food crops.

Keywords: OGMs, alimentos, pan, cereales

El presente artículo analiza la equivalencia sustancial (concepto que se discutirá más adelante) en trigo transgénico y convencional, cuando el primero es modificado para mejorar la calidad panadera.

Genetically Engineered Plants and Foods: A Scientist's Analysis of the Issues (Part I)

Peggy G. Lemaux

Annual Review in Plant Biology 59, 771-812 (2008)

Through the use of the new tools of genetic engineering, genes can be introduced into the same plant or animal species or into plants or animals that are not sexually compatible—the latter is a distinction with classical breeding. This technology has led to the commercial production of genetically engineered (GE) crops on approximately 250 million acres worldwide. These crops generally are herbicide and pest tolerant, but other GE crops in the pipeline focus on other traits. For some farmers and consumers, planting and eating foods from these crops are acceptable; for others they raise issues related to safety of the foods and the environment. In Part I of this review some general and food issues raised regarding GE crops and foods will be addressed. Responses to these issues, where possible, cite peerreviewed scientific literature. In Part II to appear in 2009, issues related to environmental and socioeconomic aspects of GE crops and foods will be covered.

Keywords: biotecnología, cultivos transgénicos, seguridad alimentaria, ingeniería genética, alimentos

El presente y extenso artículo de revisión enfoca los alimentos derivados de OGMs atendiendo preguntas y ensayando respuestas que preocupan a la sociedad que los consume (toxicidad, alergenidad, flujo de genes, etc.).

LECTURA RECOMENDADA.

Calidad y seguridad de los alimentos derivados de cultivos genéticamente modificados: el caso del maíz Bt

Ezequiel Margarit y Hugo Permingeat

Revista de Investigaciones de la Facultad de Ciencias Agrarias UNR, 5 (8) 51-60 (2005)

El consumo de alimentos derivados de organismos genéticamente modificados es resistido desde algunos sectores de la sociedad debido, entre otros factores, a temores que éstos generen riesgos en la salud de la población. Diferentes enfoques para enriquecer el análisis, tales como la presencia, consumo y seguridad del ADN transgénico de los alimentos, la estabilidad, seguridad y consumo de las proteínas codificadas por los transgenes, y el origen de las demandas de detección de OVGMs en los alimentos son profundamente discutidos en el presente artículo de revisión.

Keywords: Organismos Vegetales Genéticamente Modificados (OVGMs), maíz Bt, alimentos, riesgos de salud.

El presente artículo de revisión analiza la seguridad para el consumidor de los alimentos derivados de OGMs, particularmente de maíces modificados con el gen Bt de resistencia a insectos lepidópteros.

II. SEGURIDAD ALIMENTARIA DE LOS OVGMS. Aspectos Generales, Alergenicidad, Nutrición y Salud.

Substantial Equivalence in Food Safety Assessment COUNCIL FOR BIOTECHNOLOGY INFORMATION (2001)

Substantial equivalence,” or SE, is an internationally recognized standard that measures whether a biotech food or crop shares similar health and nutritional characteristics with its conventional counterpart. Biotech foods that are substantially equivalent have been determined to be as safe as their conventional counterparts. Products that are not substantially equivalent may still be safe, but must undergo a broader range of tests before they can be marketed.

Keywords: OGMs, alimentos, equivalencia sustancial

El concepto de “equivalencia sustancial” refiere a las características comparativas nutricionales existentes en alimentos derivados de OGMs y organismos convencionales. Se constituye en un parámetro de evaluación de seguridad alimentaria para alimentos derivados de biotecnología.

DNA stability in plant tissues: implications for the possible transfer of genes from genetically modified food

Amar Chiter, J. Michael Forbes, G. Eric Blair

FEBS Letters 481, 164-168. 2000

The potential for transfer of antibiotic resistance genes from genetically modified (GM) plant material to microbes through genetic recombination in the human or animal gut is a consideration that has engendered caution in the use of GM foods. This study was aimed at defining the optimal physical and chemical conditions necessary to ensure sufficient fragmentation of DNA in plant tissues to a size where

it would be unlikely to be stably transferred to bacterial gut microflora. The ribulose 1,5- bisphosphate carboxylase/oxygenase small subunit (Rubisco SS) genes are of similar size (approximately 1.4 kb) to transgenes present in GM plants. DNA analysis and PCR amplification of Rubisco SS genes showed that fresh maize and maize silage contained high molecular weight DNA and intact Rubisco SS genes. Relatively high temperatures and pressurised steam were necessary to degrade fully genomic DNA and Rubisco SS genes in maize and wheat grains, the source of most animal feedstuffs. Furthermore, chemical expulsion and extrusion of oilseeds resulted in residues with completely degraded genomic DNA. These results imply that stringent conditions are needed in the processing of GM plant tissues for feedstuffs to eliminate the possibility of transmission of transgenes.

Keywords: Rubisco; OGMs; alimentos, flujo génico, bioseguridad alimentaria

Uno de los aspectos que preocupan a la sociedad es el flujo de ADN transgénico de alimentos derivados de biotecnología a las bacterias habitantes del tracto digestivo de ser humano. El presente artículo describe un estudio en el que se evaluó la persistencia y estabilidad del ADN de tejidos vegetales para evaluar el riesgo de la transferencia génica mencionada.

Safety Considerations of DNA in Food

D.A. Jonas, I. Elmadfa, K.H. Engel, K.J. Heller, G. Kozianowski, A. König, D. Müller, J.F. Narbonne, W. Wackernagel, J. Kleiner
Ann Nutr Metab 2001; 45:235–254

Recombinant DNA techniques are capable of introducing genetic changes into food organisms that are more predictable than those introduced through conventional breeding techniques. This review discusses whether the consumption of DNA in approved novel foods and novel food ingredients derived from genetically modified organisms (GMOs) can be regarded as being as safe as the consumption of DNA in existing foods. It concludes that DNA from GMOs is equivalent to DNA from existing food organisms that has always been consumed with human diets. Any risks associated with the consumption of DNA will remain, irrespective of its origin, because the body handles all DNA in the same way. The breakdown of DNA during food processing and passage through the gastrointestinal tract reduces the likelihood that intact genes capable of encoding foreign proteins will be transferred to gut microflora. The review does not specifically address food safety issues arising from the consumption of viable genetically modified microorganisms but it shows that the likelihood of transfer and functional integration of DNA from ingested food by gut microflora and/or human cells is minimal. Information reviewed does not indicate any safety concerns associated with the ingestion of DNA per se from GMOs resulting from the use of currently available recombinant DNA techniques in the food chain.

Keywords: seguridad alimentaria, OGMs, alimentos, DNA

El presente artículo enfoca las características relevantes de los ácidos nucleicos (entre ellos el DNA y los transgenes) en relación a la estabilidad y riesgos que ofrece para la transferencia génica horizontal entre diferentes organismos. También se discuten temas de seguridad alimentaria.

Assessing the transfer of genetically modified DNA from feed to animal tissues

Raffaele Mazza, Mirko Soave, Mauro Morlacchini, Gianfranco Piva & Adriano Marocco
Transgenic Research (2005) 14:775–784

In Europe, public and scientific concerns about the environmental and food safety of GM (Genetically Modified) crops overshadow the potential benefits offered by crop biotechnology to improve food quality. One of the concerns regarding the use of GM food in human and animal nutrition is the effect that newly introduced sequences may have on the organism. In this paper, we assess the potential transfer of

diet derived DNA to animal tissues after consumption of GM plants. Blood, spleen, liver, kidney and muscle tissues from piglets fed for 35 days with diets containing either GM (MON810) or a conventional maize were investigated for the presence of plant DNA. Only fragments of specific maize genes (Zea, Sh-2) could be detected with different frequencies in all the examined tissues except muscle. A small fragment of the Cry1A(b) transgene was detected in blood, liver, spleen and kidney of the animals raised with the transgenic feed. The intact Cry1A(b) gene or its minimal functional unit were never detected. Statistical analysis of the results showed no difference in recovery of positives for the presence of plant DNA between animals raised with the transgenic feed and animals raised with the conventional feed, indicating that DNA transfer may occur independently from the source and the type of the gene. From the data obtained, we consider it unlikely that the occurrence of genetic transfer associated with GM plants is higher than that from conventional plants.

Keywords: maíz Bt, transferencia horizontal de genes, alimentos

En el presente estudio se analizó la transferencia de genes desde los alimentos a diferentes tejidos de cerdos alimentados con maíz Bt y convencional. Los resultados indican que no se detectaron diferencias entre ambos grupos de animales evaluados; es decir, no existió transferencia génica del alimento a los tejidos animales estudiados.

The fate of transgenes in the human gut

John Heritage

Nature Biotechnology 22 (2): 170-172 (2004)

Gut microbes that cannot be recovered in artificial culture may acquire and harbor genes from genetically modified plants

Keywords: alimentos, OGMs, riesgo

En el presente comentario se cita un trabajo en el que DNA de soja transgénica (específicamente el transgen) fue encontrado en el fluido intestinal de voluntarios que ingirieron alimentos a base de soja RR. El ensayo fue realizado por una amplificación por PCR del transgen.

Food derived from insect-protected corn line Mon810 - A Safety Assessment

TECHNICAL REPORT SERIES NO. 5

***Australia New Zealand Food Authority - ISBN 0 642 34519 8 –
ISSN 1446-4977, 22 pp (2001).***

Food derived from the insect-protected corn line MON 810 has been evaluated to determine its suitability for human consumption. The evaluation criteria included characterisation of the transferred genes, analysis of changes at the DNA, protein and whole food levels, stability of the introduced genes, evaluation of intended and unintended changes and assessment of the potential allergenicity or toxicity of any newly expressed proteins.

Keywords: OGMs, alimentos, maíz Bt, bioseguridad alimentaria

El presente informe técnico, elaborado por un ente oficial, la Autoridad de Alimentos de Australia y Nueva Zelanda, detalla un análisis de evaluación de seguridad alimentaria de alimentos elaborados con maíz transgénico conteniendo el evento MON810. Se concluye que estos alimentos no constituyen un riesgo a la salud de los consumidores.

Exploitation of molecular profiling techniques for GM food safety assessment

Harry A Kuiper, Esther J Kok and Karl-Heinz Engel
Current Opinion in Biotechnology 2003, 14:238–243

Several strategies have been developed to identify unintended alterations in the composition of genetically modified (GM) food crops that may occur as a result of the genetic modification process. These include comparative chemical analysis of single compounds in GM food crops and their conventional non-GM counterparts, and profiling methods such as DNA/RNA microarray technologies, proteomics and metabolite profiling. The potential of profiling methods is obvious, but further exploration of specificity, sensitivity and validation is needed. Moreover, the successful application of profiling techniques to the safety evaluation of GM foods will require linked databases to be built that contain information on variations in profiles associated with differences in developmental stages and environmental conditions

Keywords: OGMs, alimentos, evaluación de riesgos

En el presente artículo de revisión se discuten las técnicas utilizadas para la evaluación de riesgos de los alimentos derivados de OGMs, especialmente para identificar efectos no intencionales que preocupan a la sociedad consumidora. Estas técnicas incluyen estudios de los transgenes, de su expresión, de sus metabolitos, etc. Se destaca la importancia de existencia de bases de datos con la información de los eventos transgénicos que se van liberando al medio.

The scientific basis for risk assessment and regulation of genetically modified foods

Harry A. Kuiper and Gijs A. Kleter
Trends in Food Science & Technology 14 (2003) 277–293

The safety assessment of genetically modified (GM) food (GMF) crops has attracted the attention of plant breeders, food scientists, risk assessors and regulators, and consumer and environmental organizations. A major concern is whether GM crops are so special in nature that new safety assessment strategies are needed, or whether safety evaluations can be carried out in the manner usually used for crops cultivated by traditional breeding techniques. This chapter examines the characteristics of GMF crops and the need for specific risk assessment models. The difficulties in safety testing of whole foods are also highlighted, and new approaches for the safety assessment of whole foods, taking advantage of modern molecular-biological, toxicological and analytical methods, are discussed. This is of particular interest for the safety and nutritional assessment of future GM crops with improved nutritional properties or properties beneficial to health.

Keywords: evaluación de riesgos, OGMs, alimentos, salud

El presente artículo discute los aspectos científicos que justifican la evaluación de bioseguridad de los alimentos, con énfasis en la comparación entre alimentos convencionales de los que derivan de OGMs. Las eventuales toxicidad, alergenicidad, efectos no deseados de las nuevas proteínas y la transferencia horizontal de genes son los aspectos más desatcados.

NUTRICION Y SALUD

Genetically modified foods for human health and nutrition: the scientific basis for benefit/risk assessment

Trends in Food Science & Technology 14 (2003) 173–181

The purpose of this monograph is to provide an independent analysis of the scientific basis for assessing the benefits and risks of genetically modified (GM) crops and food, specifically in relation to their current and future impacts on human health and nutrition worldwide.

Keywords: OGMs, alimentos, salud, nutrición, evaluación de riesgos

El presente artículo revisa beneficios y riesgos derivados del uso de cultivos transgénicos como materias primas de alimentos, tanto en aspectos de salud como de nutrición de los consumidores. En el análisis se destaca que los beneficios que ofrecen estas tecnologías conducen a un balance muy positivo en beneficios y escasos riesgos que deben ser evaluados.

Genetically modified food crops and their contribution to human nutrition and food quality

Howarth E. Bouis, Bruce M. Chassy and James O. Ochando
Trends in Food Science & Technology 14 (2003) 191–209

This chapter discusses the potential of biotechnology to improve the health and nutrition of consumers in developing countries. In the relatively wealthy countries of Europe, North America and elsewhere, consumers spend perhaps 10% of their income on food. For the most part consumers in developed countries are free of classical nutrient deficiencies, although over-consumption is a problem for some. Also in relatively wealthy countries there is, in general, good access to affordable medical care to meet health needs and most consumers in rich countries have access to a relatively inexpensive supply of safe and healthy food. In these settings, the possibility that biotechnology might reduce the price of food or make food more beneficial to health is a relatively minor concern. Rather, public debate about genetically modified foods (GMFs) appears to have focused on the potential for harm to either the environment or health without a clear definition of benefit to the consumer.

Keywords: alimentos, OGMs, nutrición, salud, costo de los alimentos

El presente y extenso artículo de revisión enfoca las posibilidades que ofrece la ingeniería genética de cultivos para conseguir alimentos de mayor nivel nutritivo y a un costo más accesible para los países emergentes. Entre esas ventajas se menciona la posibilidad de diseñar estrategias para eliminar componentes alergénicos de los alimentos convencionales, en contraposición a uno de los riesgos que se mencionan como intrínsecos de los alimentos derivados de biotecnología.

LECTURA RECOMENDADA.

Genetically modified food crops for improving agricultural practice and their effects on human health

Jennifer Thomson

Trends in Food Science & Technology 14 (2003) 210–228

Keywords: alimentos, OGMs, salud, nutrición

Se trata de un artículo de revisión que analiza los beneficios de los cultivos transgénicos utilizados como materias primas de alimentos. Entre esos beneficios se destacan las mejoras en las prácticas agrícolas (resistencias a estrés biótico y abiótico) y las mejoras en la calidad nutricional de las cosechas. También se discuten aspectos de los sistemas regulatorios.

Genetically modified crops for industrial products and processes and their effects on human health

Thomas A. McKeon

Trends in Food Science & Technology 14 (2003) 229–241

Industrial crops are grown as sources of chemicals or components that serve non-food uses. Products derived from plants for industrial applications include oils, fibres, fuels and pharmaceuticals. Some of these products are extracted from the plant and used directly by industry, while others require mechanical or chemical conversion to be suitable for application. The plant itself may be the conveyor of the product, for example vaccines produced in fruits and vegetables.

Keywords: OGMs, salud, productos industriales.

El presente artículo enfoca los OGMs y sus efectos sobre la salud como consecuencia del uso en la producción y proceso de compuestos industriales. Los aceites, los polisacáridos y otros polímeros, los combustibles, principios activos de fármacos, etc son considerados en este análisis. La evaluación de riesgos específicos para estos usos y los beneficios que ellos detentan son analizados en esta revisión.

Genetically modified livestock and poultry and their potential effects on human health and nutrition

Helen Sang

Trends in Food Science & Technology 14 (2003) 253–263

The first methods for genetic modification of animals were developed in the 1980s and many of the ideas for applications of the technology to livestock and poultry were suggested at that time. Genetic modification of animals from the main livestock and poultry species is now possible. Several different technologies have been developed, with different uses depending on the specific modifications required, but there are still significant advances required to enable efficient and sophisticated modifications to be generated. Many possible applications of transgenic technologies to livestock and poultry have been identified. The two main areas of application are in agriculture and in human healthcare. The applications discussed focus on developing alternatives to methods currently in use, for example traditional animal breeding, with the potential added value of the ability to introduce genetic changes that cannot be achieved by other methods. Transgenic technology could offer alternative production systems to fulfil unmet needs that differ across geographical and socioeconomic regions of the world. Applications relevant to human healthcare include modifications to animal food products but are primarily targeted at healthcare products. There are many similar applications in development or proposed for genetically

modified (GM) animals and poultry and also some applications specific to different species. The majority of research and development has concentrated on genetic modification of mammals, often using the mouse as a valuable model system. In contrast to the major developments in use and potential uses of GM plants in agriculture and specifically for food, the main focus of applications of GM technology in livestock and poultry is in applications relevant to human healthcare. There are currently no transgenic livestock or poultry food products on the market and there are unlikely to be for some years to come. However, several companies have started to produce GM animals with the aim of bringing their products to market.

Keywords: animales transgénicos, salud, OGMs

En el presente artículo de revisión se analizan los efectos de la producción de animales transgénicos (particularmente mamíferos y aves) sobre la salud humana y la nutrición. Así se discute la contribución que puede hacer esta tecnología que está recientemente introducida en aplicaciones específicas, tanto para ofrecer alimentos más nutritivos como para la producción de fármacos y otros compuestos de interés. Un ejemplo más reciente de estas aplicaciones lo constituye el tambo farmacéutico desarrollado en Argentina para la producción de hormonas recombinantes.

In vivo studies on possible health consequences of genetically modified food and feed-with particular regard to ingredients consisting of genetically modified plant materials

*IAN F. PRYME AND ROLF LEMBCKE
Nutrition and Health, 2003, Vol. 17, pp. 1–8*

This synopsis reviews published in vivo studies on possible health consequences of genetically modified food and feed where the ingredients in question have consisted of genetically modified plant materials. The following, however, have not been taken into consideration:

- ingredients consisting of genetically modified microorganisms or parts of animals/fish
- ingredients produced by/from genetically modified organisms but without any DNA present
- studies on consequences for the environment or biodiversity
- in vitro studies or computer simulations

According to a Norwegian report “Gen-mat” (NOU 2000:29), and a more recent search in Medline and Citations Index, to our knowledge a total of ten studies have been published on the health effects of GM-foods and feeds. In this minireview the data made available in these published studies is discussed.

Keywords: alimentos, OGMs, salud, riesgos

En el presente artículo se presentan diferentes estudios donde se evalúan las consecuencias del uso de materiales transgénicos en ratas o pollos, con énfasis en la detección de efectos no deseados de los OGMs en la salud de los animales. Se destaca que los estudios que ofrecen “dudas” sobre la inocuidad de los OGMs en la salud de los animales utilizados para el estudio no poseen la evaluación de científicos pares que garanticen tanto las metodologías como los resultados de los mismos.

Review: genetically modified plants for the promotion of human health

Keiko Yonekura-Sakakibara - Kazuki Saito
Biotechnol Lett (2006) 28:1983–1991

Plants are attractive biological resources because of their ability to produce a huge variety of chemical compounds, and the familiarity of production in even the most rural settings. Genetic engineering gives plants additional characteristics and value for cultivation and post-harvest. Genetically modified (GM) plants of the “first generation” were conferred with traits beneficial to producers, whereas GM plants in subsequent “generations” are intended to provide beneficial traits for consumers. Golden Rice is a promising example of a GM plant in the second generation, and has overcome a number of obstacles for practical use. Furthermore, consumer- acceptable plants with health-promoting properties that are genetically modified using native genes are being developed. The emerging technology of metabolomics will also support the commercial realization of GM plants by providing comprehensive analyzes of plant biochemical components.

Keywords: carotenoides, flavonoides, OGMs, arroz dorado, vitamina A, alimentos

El presente artículo de revisión destaca las ventajas de los OGMs para la producción de alimentos de calidad y de mayor valor nutritivo (vitaminas, minerales, etc.) y sin compuestos alergénicos.

Soja y nutrición. Informe sobre el uso y la seguridad de la soja

Clara Rubinstein y col. 2004
ILSI Argentina 2004, 68 pp

Keywords: soja, alimentos, OGMs

El presente es un informe sobre el uso y seguridad alimentaria de la soja, considerando las propiedades nutritivas de la especie. El informe, elaborado por el Instituto Internacional de las Ciencias de la Vida (ILSI), detalla la composición química de los granos de la soja (aceites, proteínas, aminoácidos, etc.), describe las aplicaciones tecnológicas en que el grano se utiliza como materia prima alimentaria, y enfoca el caso de la soja GM en Argentina. Discute el uso de la soja en la alimentación y su relación con componentes antinutritivos y causales de enfermedades.

Alimentos y tecnología de modificación genética

Clare Robinson
ILSI Bélgica 2003, 51 pp

Keywords: alimentos, OGMs, riesgos

El presente informe, también elaborado por el Instituto Internacional de Ciencias de la Vida (ILSI), ofrece información sobre los riesgos y beneficios de los alimentos derivados de OGMs, la evaluación de esos riesgos y el futuro del desarrollo de nuevos alimentos mediante el uso de estas tecnologías.

BIOFORTIFICACIÓN

Improving the nutritional value of Golden Rice through increased pro-vitamin A content

Paine JA; Shipton CA; Chaggar S; Howells RM; Kennedy MJ; Vernon G; Wright SY; Hinchliffe E; Adams JL; Silverston SL; Drake R

Nature Biotechnology 23 (4): 482-487(2005)

Golden rice is a variety of rice engineered to produce beta-carotene (provitamin A) to help to combat vitamin A deficiency, and it has been predicted that its contribution to alleviating vitamin A deficiency would be substantially improved through ever higher beta-carotene content. We hypothesized that the daffodil gene encoding phytoene synthase (psy), one of the two genes used to develop Golden Rice, was the limiting step in beta-carotene accumulation. Through systematic testing of other plant psys, we identified a psy from maize that substantially increased carotenoid accumulation in a model plant system. We went on to develop "Golden Rice 2" introducing this psy in combination with the *Erwinia uredovora* carotene desaturase (crtl) used to generate the original Golden Rice. We observed an increase in total carotenoids of up to 23-fold (37 ug/g) compared to the original Golden Rice and a preferential accumulation of beta-carotene.

Keywords: OGMs, calidad nutricional, vitamina A, arroz transgénico.

En el presente artículo se presenta un nuevo evento de arroz transgénico "Golden Rice 2", el que contiene mayor cantidad de provitamina A en el endosperma en comparación a eventos desarrollados previamente. El arroz dorado fue el primer caso donde se demostró la capacidad de la biotecnología de plantas de mejorar la calidad nutricional de las cosechas mediante una estrategia denominada biofortificación.

Golden Rice - five years on the road - five years to go?

Salim Al-Babili and Peter Beber

TRENDS in Plant Science Vol.10 No.12: 565-573 (2005)

Provitamin A accumulates in the grain of Golden Rice as a result of genetic transformation. In developing countries, where vitamin A deficiency prevails, grain from Golden Rice is expected to provide this important micronutrient sustainably through agriculture. Since its original production, the prototype Golden Rice has undergone intense research to increase the provitamin A content, to establish the scientific basis for its carotenoid complement, and to better comply with regulatory requirements. Today, the current focus is on how to get Golden Rice effectively into the hands of farmers, which is a novel avenue for public sector research, carried out with the aid of international research consortia. Additional new research is underway to further increase the nutritional value of Golden Rice.

Keywords: OGMs, calidad nutricional, vitamina A, arroz transgénico.

En el presente artículo se revisa nuevamente la obtención del arroz dorado y las vías metabólicas requeridas en plantas para la producción de provitamina A en los tejidos que debe generarse. Igualmente, se discute la combinación de esta característica con otras nuevas a incorporar para aumentar la calidad nutricional del cereal.

Golden rice: introgression, breeding, and field evaluation

Swapan K. Datta - Karabi Datta - Vilas Parkhi - Mayank Rai - Niranjana Baisakh - Gayatri Sahoo - Sayeda Rehana - Anindya Bandyopadhyay - Md. Alamgir - Md. S. Ali - Editha Abrigo - Norman Oliva - Lina Torrizo

Euphytica (2007) 154:271–278

Considerable progress has been made on the genetic engineering of rice for improved nutritional content involving micronutrients and carotenoid content. Golden Rice, developed by genetic engineering (*Agrobacterium* and biolistic transformation) was used in rice breeding for the transfer of high-nutritional value to the local rice cultivars. Simultaneously, commercial Asian indica rice cultivars were also developed with expression of high-carotenoid levels. The lines were developed based on POSITECH (PMI) selection system or made marker free by segregating out the marker gene from the gene of interest. Anther culture was used to develop the homozygous stable lines, which could be of much use in further introgress-breeding and in farmer's field. Enhanced carotenoids levels (up to T3 generation) were observed in a number of lines compared to the T0-T1 seeds which could be due to transgeneration effect of growing under greenhouse versus field conditions. However, a few introgressed lines showed less carotenoid levels than the original lines used in the breeding process. Agronomic performance of introgressed lines, non-transgenic controls, and transgenic golden rice (IR64 and BR29) developed at IRRI showed acceptable and comparable data under identical limited field conditions (screenhouse data). Syngenta generated a new Golden Rice (US cultivar) containing high level of carotenoids grown in the field at Louisiana, USA is expected to be available to the public domain. Incorporation of genes for carotenogenesis in seeds by transgenesis or by introgression did not change any significant agronomic characteristics in rice plants. The ongoing and future study of bioavailability, quality, larger field testing and freedom to operate will ensure the benefit of Golden Rice to the people who need them most.

Keywords: Oryza sativa, Golden Rice, introgresión, carotenoides, arroz transgénico, calidad nutricional.

En el presente artículo se describe la introgresión de los genes responsables de la síntesis de beta-caroteno del arroz dorado a otros cultivares no transgénicos por mejoramiento convencional. Particularmente se atiende al contenido y estabilidad de carotenoides luego de la cocción del arroz y a la performance de las plantas en condiciones de campo y de invernadero luego de la introgresión.

Though lessons from golden rice

MARTIN ENSERINK

SCIENCE VOL 320: 468-471 (2008)

It was supposed to prevent blindness and death from vitamin A deficiency in million of children. But almost a decade after its invention, golden rice is still stuck in the lab.

Keywords: OGMs, calidad nutricional, vitamina A, arroz transgénico.

A pesar de la importancia del desarrollo logrado en el "Golden Rice", del tiempo que está bajo estricta evaluación, no ha sido aún aprobada su liberación al ambiente. Se trata del primer desarrollo con este tipo de característica y en base a esto, el artículo enfatiza las lecciones a aprender para los sucesivos desarrollos.

Carotenoid biotechnology in plants for nutritionally improved foods

Patricia Botella-Pavía and Manuel Rodríguez-Concepción
Physiologia Plantarum 126: 369–381. 2006

Carotenoids participate in light harvesting and are essential for photoprotection in photosynthetic plant tissues. They also furnish non-photosynthetic flowers and fruits with yellow to red colors to attract animals for pollination and dispersal of seeds. Although animals can not synthesize carotenoids *de novo*, carotenoid-derived products such as retinoids (including vitamin A) are required as visual pigments and signaling molecules. Dietary carotenoids also provide health benefits based on their antioxidant properties. The main pathway for carotenoid biosynthesis in plants and microorganisms has been virtually elucidated in recent years, and some of the identified biosynthetic genes have been successfully used in metabolic engineering approaches to overproduce carotenoids of interest in plants. Alternative approaches that enhance the metabolic flux to carotenoids by upregulating the production of their isoprenoid precursors or interfere with light-mediated regulation of carotenogenesis have been recently shown to result in increased carotenoid levels. Despite spectacular achievements in the metabolic engineering of plant carotenogenesis, much work is still ahead to better understand the regulation of carotenoid biosynthesis and accumulation in plant cells. New genetic and genomic approaches are now in progress to identify regulatory factors that might significantly contribute to improve the nutritional value of plant-derived foods by increasing their carotenoid levels.

Keywords: carotenoides, vitamina A, OGMs, calidad nutricional, arroz transgénico.

El artículo de revisión enfoca la síntesis de carotenoides en diferentes organismos, entre ellas plantas como tomate, papa, arroz, etc.. Destaca la importancia de la ingeniería genética como herramienta para lograr aumentar los contenidos de provitamina A y mejorar la calidad nutricional de los alimentos.

Biofortifying crops with essential mineral elements

Philip J. White and Martin R. Broadley
TRENDS in Plant Science Vol.10 No.12: 586-593 (2005)

Humans require more than 22 mineral elements, which can all be supplied by an appropriate diet. However, the diets of populations subsisting on cereals, or inhabiting regions where soil mineral imbalances occur, often lack Fe, Zn, Ca, Mg, Cu, I or Se. Traditional strategies to deliver these minerals to susceptible populations have relied on supplementation or food fortification programs. Unfortunately, these interventions have not always been successful. An alternative solution is to increase mineral concentrations in edible crops. This is termed 'biofortification'. It can be achieved by mineral fertilization or plant breeding. There is considerable genetic variation in crop species that can be harnessed for sustainable biofortification strategies. Varieties with increased mineral concentrations in their edible portions are already available, and new genotypes with higher mineral densities are being developed.

Keywords: minerales, OGMs, calidad nutricional, plantas transgénicas, biofortificación.

En el presente artículo de revisión se discuten las estrategias de provisión de minerales en las dietas a través de la ingeniería genética, mediante la biofortificación. Estos desarrollos aportarán soluciones a problemas de malnutrición por deficiencias específicas en la alimentación de determinadas comunidades. Se comentan desarrollos logrados y en evaluación con estas características.

Harnessing sorghum and millet biotechnology for food and health

M.M. O'Kennedy, A. Grootboom, P.R. Shewry
Journal of Cereal Science 44 (2006) 224–235

This review highlights recombinant DNA technology as a powerful tool to enhance the gene pools of sorghum and pearl millet crops regarded as jewels of Africa. Although important advances in the improvement of these species have been made by classical breeding and modern marker assisted selection, genetic manipulation and *in vitro* culture allows the gene pool to be broadened beyond that normally available for improvement by allowing the transfer of genes which control well-defined traits between species. The current state of sorghum and millet transformation technology is summarised and applications in the improvement of nutritional quality and the resistance to pathogens and pests for crops grown in Africa and Asia is discussed. Regulatory aspects including gene flow and future prospects are also discussed.

Keywords: ingeniería genética, sorgo, plantas transgénicas, alimentos, calidad nutricional.

El presente artículo de revisión enfoca estrategias de ingeniería genética para fortalecer la calidad nutricional del sorgo (básicamente calidad de proteínas y deficiencias vitamínicas y de minerales), además de conferirle características agronómicas de defensa contra estrés biótico y abiótico.

Folate biofortification in food plants

Samir Bekaert, Sergei Storozhenko, Payam Mehrshahi, Malcolm J. Bennett, Willy Lambert, Jesse F. Gregory III, Karel Schubert, Jeroen Hugenholtz, Dominique Van Der Straeten and Andrew D. Hanson

TRENDS in Plant Science Vol.13 No.1: 28-35 (2007)

Folate deficiency is a global health problem affecting many people in the developing and developed world. Current interventions (industrial food fortification and supplementation by folic acid pills) are effective if they can be used but might not be possible in less developed countries. Recent advances demonstrate that folate biofortification of food crops is now a feasible complementary strategy to fight folate deficiency worldwide. The genes and enzymes of folate synthesis are sufficiently understood to enable metabolic engineering of the pathway, and results from pilot engineering studies in plants (and bacteria) are encouraging. Here, we review the current status of investigations in the field of folate enhancement on the eve of a new era in food fortification

Keywords: OGMs, calidad nutricional, folatos, biofortificación, plantas transgénicas

Es un artículo de revisión donde se discute el estado actual de las investigaciones en el campo de la biofortificación de folatos en los alimentos vía ingeniería genética. Nuevamente, la biotecnología ofrece herramientas para atender deficiencias nutritivas de los alimentos. Se comentan desarrollos logrados en arroz, tomate y Arabidopsis.

Production of phycocyanin—a pigment with applications in biology, biotechnology, foods and medicine

Niels T. Eriksen
Appl Microbiol Biotechnol (2008) 80:1–14

C-phycocyanin (C-PC) is a blue pigment in cyanobacteria, rhodophytes and cryptophytes with fluorescent and antioxidative properties. C-PC is presently extracted from open pond cultures of the cyanobacterium *Arthrospira platensis* although these cultures are not very productive and open for contaminating

organisms. C-PC is considered a healthy ingredient in cyanobacterial-based foods and health foods while its colouring, fluorescent or antioxidant properties are utilised only to a minor extent. However, recent research and developments in C-PC synthesis and functionality have expanded the potential applications of C-PC in biotechnology, diagnostics, foods and medicine: The productivity of C-PC has been increased in heterotrophic, high cell density cultures of the rhodophyte *Galdieria sulphuraria* that are grown under well controlled and axenic conditions. C-PC purification protocols based on various chromatographic principles or novel twophase aqueous extraction methods have expanded in numbers and improved in performance. The functionality of C-PC as a fluorescent dye has been improved by chemical stabilisation of C-PC complexes, while protein engineering has also introduced increased stability and novel biospecific binding sites into C-PC fusion proteins. Finally, our understanding of the physiological functions of C-PC in humans has been improved by a mechanistic hypothesis that links the chemical properties of the phycocyanobilin chromophores of C-PC to the natural antioxidant, bilirubin, and may explain the observed health benefits of C-PC intake. This review outlines how C-PC is produced and utilised and discusses the novel C-PC synthesis procedures and applications.

Keywords: Arthrospira platensis, Galdieria sulphuraria, nutracéuticos, OGMs, calidad nutricional.

El objetivo de la presente revisión fue analizar cómo la ficocianina se produce, purifica y utiliza, y discutir potenciales de nuevos procedimientos de producción y aplicaciones. Entre ellas, las ficocianinas tienen propiedades nutricionales y antioxidantes que la hacen muy atractivas para su producción como nutracéuticos en OGMs. No se citan desarrollos en plantas, pero se discuten aspectos prospectivos de su producción.

Nutritional improvements in plants: time to bite on biofortified foods

Kendal Hirschi

TRENDS in PLANT SCIENCE 13 (9): 459-463 (2008)

Modern breeding, molecular genetic and biotechnology studies frequently describe changes in plant metabolism to improve nutritional content; however, this is often where the process of assessing biofortification ends. Ideally, these modified plants need to be used in controlled animal and human feeding studies to assess nutritional impact. Such bioavailability studies are crucial if any claims are to be made regarding health benefits and might be an important component in public acceptance of biofortified foods.

Keywords: biofortificación, OGMs, alimentos, calidad nutricional.

En el presente artículo de opinión se analizan las mejoras nutricionales que la ciencia se propone lograr en plantas mediante estrategias de biofortificación por ingeniería genética. Entre los temas se discuten las herramientas para medir los parámetros nutricionales.

Zinc biofortification of cereals: problems and solutions

Michael G. Palmgren, Stephan Clemens, Lorraine E. Williams, Ute Krämer, Søren Borg, Jan K. Schjørring and Dale Sanders

TRENDS IN PLANT SCIENCE 13 (9): 464-473 (2008)

The goal of biofortification is to develop plants that have an increased content of bioavailable nutrients in their edible parts. Cereals serve as the main staple food for a large proportion of the world population but have the shortcoming, from a nutrition perspective, of being low in zinc and other essential nutrients. Major bottlenecks in plant biofortification appear to be the root–shoot barrier and – in cereals – the process of grain filling. New findings demonstrate that the root–shoot distribution of zinc is controlled mainly by heavy metal transporting PIB-ATPases and the metal tolerance protein (MTP) family. A

greater understanding of zinc transport is important to improve crop quality and also to help alleviate accumulation of any toxic metals.

Keywords: biofortificación, OGMs, alimentos, calidad nutricional.

El artículo de revisión enfoca las deficiencias en minerales de los cereales (como fuentes de alimentos), la distribución y acumulación de metales en los órganos vegetales (raíz, tallo, etc.) y el transporte al grano durante el proceso de llenado. Se discuten estrategias biotecnológicas como herramientas para biofortificar el contenido y disponibilidad de minerales en cereales transgénicos.

ALERGENICIDAD

Evaluation of Allergenicity of Genetically Modified Foods FAO/WHO 2001

Keywords: OGMs, alergenicidad, alimentos, riesgo, evaluación de riesgo

El presente es un informe de la FAO y de la OMS sobre la evaluación de riesgo de alergenicidad de los alimentos derivados de ingeniería genética. En el mismo se analizan las alergias producidas por alimentos, el árbol de decisiones para la evaluación de alergenicidad de los alimentos y la estandarización de metodologías de análisis.

Improved evaluation of potential allergens in GM food *Bernhard Jank and Alexander G. Haslberger* **TRENDS in Biotechnology Vol.21 No.6: 249-250 (2003)**

One of the main issues in the safety assessment of a genetically modified (GM) crop is its potential allergenicity. Genetic modification can affect the allergenicity in two ways: by introducing allergens, or by changing the level or nature of intrinsic allergens. Potentially, allergens can be introduced by the expression of transgenic proteins because proteins are the causative agents of food allergies, contact allergies and inhalant allergies (pollen, fungal spores). A recent study reviews the current practice of allergological safety assessment for GM crops in the European Union. This investigation covers 11 notifications for placing on the market and sets recommendations for the standardization of the assessment.

Keywords: OGMs, alergenicidad, alimentos, riesgo, evaluación de riesgo

La presente nota se refiere a los análisis de evaluación de alergenicidad de los alimentos derivados de ingeniería genética.

Genetic Modification Removes an Immunodominant Allergen from Soybean

Eliot M. Herman, Ricki M. Helm, Rudolf Jung, and Anthony J. Kinney
Plant Physiology, 2003, Vol. 132, pp. 36–43

The increasing use of soybean (*Glycine max*) products in processed foods poses a potential threat to soybean-sensitive food-allergic individuals. *In vitro* assays on soybean seed proteins with sera from soybean-sensitive individuals have immunoglobulin E reactivity to abundant storage proteins and a few

less-abundant seed proteins. One of these low abundance proteins, Gly m Bd 30 K, also referred to as P34, is in fact a major (i.e. immunodominant) soybean allergen. Although a member of the papain protease superfamily, Gly m Bd 30 K has a glycine in the conserved catalytic cysteine position found in all other cysteine proteases. Transgene-induced gene silencing was used to prevent the accumulation of Gly m Bd 30 K protein in soybean seeds. The Gly m Bd 30 K-silenced plants and their seeds lacked any compositional, developmental, structural, or ultrastructural phenotypic differences when compared with control plants. Proteomic analysis of extracts from transgenic seed detected the suppression of Gly m Bd 30 K-related peptides but no other significant changes in polypeptide pattern. The lack of a collateral alteration of any other seed protein in the Gly m Bd 30 K-silenced seeds supports the presumption that the protein does not have a role in seed protein processing and maturation. These data provide evidence for substantial equivalence of composition of transgenic and non-transgenic seed eliminating one of the dominant allergens of soybean seeds

Keywords: OGMs, alergenicidad, alimentos, riesgo, evaluación de riesgo, soja transgénica, silenciamiento génico.

En el presente artículo se describe la obtención de una soja transgénica en la que se indujo el silenciamiento del gen codificante de la proteína Gly m Bd 30 K, responsable de la alergenicidad de la leguminosa en alimentos. De esta manera, se confirma la capacidad de la tecnología de solucionar un problema como la alergenicidad, más que como un riesgo de generarlo.

Genetically modified soybeans and food allergies

Eliot M. Herman

Journal of Experimental Botany, Vol. 54, No. 386, pp. 1317-1319 (2003)

Allergenic reactions to proteins expressed in GM crops has been one of the prominent concerns among biotechnology critics and a concern of regulatory agencies. Soybeans like many plants have intrinsic allergens that present problems for sensitive people. Current GM crops, including soybean, have not been shown to add any additional allergenic risk beyond the intrinsic risks already present. Biotechnology can be used to characterize and eliminate allergens naturally present in crops. Biotechnology has been used to remove a major allergen in soybean demonstrating that genetic modification can be used to reduce allergenicity of food and feed. This provides a model for further use of GM approaches to eliminate allergens.

Keywords: OGMs, alergenicidad, alimentos, riesgo, evaluación de riesgo, soja transgénica, silenciamiento génico.

En el presente artículo se plantea el tema de la alergenicidad de los alimentos y se enfatiza la capacidad de la biotecnología de plantas para reducir el contenido de alérgenos en los alimentos, ejemplificando la reducción de la proteína de soja comentada en el artículo anterior.

Plant food allergens—structural and functional aspects of allergenicity

Heimo Breiteneder, E.N. Clare Mills

Biotechnology Advances 23 (2005) 395–399

The three dominating plant food allergen groups belong to the prolamin and cupin superfamilies and to the family 10 of pathogenesis-related proteins. The prolamin superfamily comprises allergenic 2S albumins, nonspecific lipid transfer proteins and cereal alpha-amylase/trypsin inhibitors. These allergens have related structures and are stable to thermal processing and proteolysis. The cupin superfamily comprises the allergenic 7S and 11S globulin storage proteins from peanuts, soybean and tree nuts which are heat stable and can form immunogenicity enhancing aggregates. The Bet v 1 family of allergens includes tree pollinosis-associated food allergens with low stability which induce the symptoms of the oral allergy syndrome.

Keywords: alergenicidad, alimentos, riesgo, evaluación de riesgo.

En el presente artículo de revisión se analizan las familias proteicas responsables de la alergenicidad de los alimentos de origen vegetal, entre las que se destacan las prolaminas, las cupinas y las Bet v 1.

Biotechnologies in new high-throughput food allergy tests: why we need them

Neil K. Renault - Luciana Mirotti - Marcos J. C. Alcocer
Biotechnol Lett (2007) 29:333–339

The increase in prevalence of food allergies generates a need for more accurate and reliable quantitative allergy testing in order to help diagnosis. In this short review, we briefly outline the history of food allergy testing and extend our comments to current multiplex techniques. Particular emphasis is given to new developments in the protein microarray area, where the use of recent advances in biotechnology has the potential to produce high-throughput devices with improved clinical significance.

Keywords: alergenicidad, alimentos, riesgo, evaluación de riesgo, microarrays.

El artículo de revisión enfoca la historia de la evaluación de alérgenos en los alimentos y discute las técnicas de su estudio. Particularmente se centra en nuevos desarrollos para evaluar la alergenicidad, algunos de ellos basados en técnicas biotecnológicas.

Genetic engineering for removing food allergens from plants

Mohan B. Singh and Prem L. Bhalla
Trends in Plant Science Vol.13 No.6: 257-260 (2008)

Genetic engineering has great potential for improving the safety of plant-based foods by eliminating allergenic components. A recent publication by Dodo *et al.* demonstrates that RNA interference can mediate the silencing of a major allergen protein from peanuts. Three additional papers (two by Le *et al.* and one by Lorenz *et al.*) report the removal of allergenic proteins from tomato fruits. This research highlights the potential for using genetically engineered hypoallergenic plants in a new approach to alleviating food allergy symptoms.

Keywords: OGMs, alergenicidad, alimentos, riesgo, evaluación de riesgo, plantas transgénicas, silenciamiento génico.

El artículo destaca la capacidad de la biotecnología de plantas para desarrollar alimentos seguros y libres de compuestos alérgicos, mediante estrategias de silenciamiento génico basado en el RNA de interferencia. Se ejemplifica la producción de maní y tomate transgénicos sin alérgenos, además de soja, manzanas y arroz.

III. ASPECTOS REGULATORIOS Y OPINION PUBLICA.

Genetically modified organisms and the EU

Bernhard Jank, Johannes Rath and Armin Spök

TRENDS in Biotechnology Vol.23 No.5: 222-224 (2005)

In 2004, the European Union (EU) abandoned its informal moratorium on the marketing of new genetically modified organisms (GMOs). Since 18th April 2004 new regulations for genetically modified food and feed apply in the EU, including provisions for labelling and traceability. After receiving positive statements by the European Food Safety Authority (EFSA) the European Commission approved three new products for use as food and feed: (i) genetically modified insect-resistant maize Bt11 for use as food; (ii) herbicide-tolerant maize NK603 for use as feed; and (iii) maize NK603 derivatives for use as food.

Keywords: OGMs, aspectos regulatorios, alimentos.

La presente nota enfoca las opiniones de entidades de la Unión Europea en la fijación de estándares para la aprobación de eventos transgénicos luego de la moratoria que estableció para la evaluación de OGMs.

GMO FOOD. Opening the debate

Food Standards Agency Publications 1-25. (2003).

In July 2002, the Government announced a public debate to help people deepen their understanding of genetic modification. This debate is taking place in the run-up to the Government making decisions on whether to allow genetically modified crops to be grown commercially. The contribution of the Food Standards Agency to this debate is to independently assess people's views on the acceptability of genetically modified food and how this relates to consumer choice.

The aim of this booklet is to provide the basic information you need to take part in this debate. It covers two issues within the Agency's remit, which are to ensure that:

- any such food is thoroughly assessed for safety
- consumers are given as much choice as possible

There is a glossary on page 19 and, to help put genetic modification in context, we have included a timeline that runs throughout this booklet showing how people have been manipulating plants and animals since 10,000 BC.

However, this booklet does not cover environmental issues, such as biodiversity, or economic and social issues. These matters are primarily the responsibility of other Government departments and will be considered in other parts of the wider debate.

Keywords: OGMs, alimentos, opinion pública, aspectos regulatorios, bioseguridad

El presente cuadernillo elaborado por la Agencia de Estándares de Alimentos del Reino Unido de Gran Bretaña se ofrece a la población para interiorizarla y generar opinión con base sólida sobre la elaboración de alimentos a partir de materias primas derivadas de cultivos transgénicos.

LECTURA RECOMENDADA.

General introduction: the role of science in identifying common ground in the debate on genetic modification of foods

Cutberto Garza and Patrick Stover

Trends in Food Science & Technology 14 (2003) 182–190

The purpose of this special issue is to provide an independent analysis of the scientific basis for assessing the benefits and risks of transgenically modified food crops and animals, specifically in relation to their current and future impacts on human health and nutrition worldwide. The transgenic modification of foods is among the major scientific achievements of the last 100 years. It is an advance that has great potential for beneficial and harmful effects; as such, it is appropriate to examine the scientific basis for present and potential uses of the technology and to identify knowledge gaps related to current and future aims and the technologies that enable them.

Keywords: OGMs, alimentos, opinion pública, aspectos regulatorios, bioseguridad

Se trata de un artículo muy general donde se sientan las bases científicas de los beneficios y riesgos del uso de cultivos y animales transgénicos en los alimentos, en aspectos relacionados con la salud y la nutrición.

Consumer attitudes, knowledge and behaviour: a review of food safety issues

Anne Wilcock, Maria Pun, Joseph Khanona and May Aung

Trends in Food Science & Technology 15 (2004) 56–66

Consumers' attitudes have been shown to influence and predict behaviour. This review highlights the diverse consumer attitudes towards the safety of food. The diversity among consumers is based on a variety of factors, including demographics and socio-economic status. The relationship between consumer attitudes, knowledge and behaviour regarding food safety is also examined in this paper. It indicates that different attitudes do not necessarily lead to behaviours that increase the safety of the food consumed. It can be concluded that there exists the need for professional assistance for consumers regarding food safety issues

Keywords: OGMs, alimentos, seguridad alimentaria, opinión pública.

En el presente artículo se revisan las actitudes, el conocimiento y el comportamiento de los consumidores frente a los aspectos relacionados con la seguridad de los alimentos. Se enfocan cuestiones no tecnológicas de los alimentos, sino de quienes los consumen.

How can genetically modified foods be made publicly acceptable?

Gene Rowe

TRENDS in Biotechnology Vol.22 No.3; 107-109 (2004)

A recent study by Lusk suggests that consumers might voluntarily pay more for a genetically modified (GM) food than a non-GM equivalent if made aware of the possible health benefits. However, other research indicates that the acceptability of novel hazards is affected by a variety of factors, in addition to benefits, and that making agricultural biotechnology publicly acceptable will be more complex than indicated by the results from Lusk's study.

Keywords: OGMs, alimentos, seguridad alimentaria, opinión pública.

En el presente artículo se analiza la predisposición de los consumidores a aceptar los alimentos derivados de OGMs, hecho basado en el reconocimiento de la mejor calidad que éstos ofrecerían.

Consumer acceptance of biotechnology and the role of second generation technologies in the USA and Europe

Jayson L. Lusk and Anne Rozan

TRENDS in Biotechnology Vol.23 No.8: 386-387 (2005)

In a recent article in Trends in Biotechnology, Gene Rowe wrote about a study published by Lusk concerning US consumer willingness-to-pay for a second generation genetically modified (GM) food – golden rice genetically modified to contain *b* carotene. That study showed, in contrast to previous research, that consumers might actually be willing to pay a premium for a GM food if it was created to be beneficial to them. Rowe was right to point out that consumer concern for GM food is a complex issue, complicated by individual differences in culture, trust and risk perceptions. Our purpose here is to address some of the issues mentioned by Rowe, in light of previously published research and findings from nationwide surveys we recently conducted in the USA and France.

Keywords: OGMs, alimentos, seguridad alimentaria, opinión pública.

En conexión con el artículo anterior, el presente manifiesta las diferencias entre los consumidores europeos y americanos respecto de la aceptación de alimentos derivados de OGMs.

Safety and Public Acceptance of Transgenic Products

Patrick F. Byrne

Crop Sci. 46:113–117 (2006)

Public acceptance of transgenic (genetically engineered, GE) products is influenced by the perception of direct or indirect risks and benefits and the credibility of regulatory agencies that evaluate food and environmental safety. In North America acceptance of GE foods is holding steady, while knowledge about them remains low. Development of transgenic foods with improved nutritional properties or other quality factors will likely be better received than products that primarily benefit the grower or developer of the product. There is continuing unease about biopharming and the association, by some members of the public, of GE crops with corporate agriculture. Several recent reports have reviewed the U.S. regulatory system for transgenic crops and called for a more coordinated and transparent process that allows for greater public participation. For society to benefit from GE crops, we must move away from the polarized positions that have defined the transgenic debate in the past, to positions of mutual respect that allow a rational discussion of the technology's merits and risks.

Keywords: OGMs, alimentos, seguridad alimentaria, opinión pública.

En el mismo sentido que los artículos anteriores, el presente enfoca la percepción pública de los OGMs y la aceptación basada en la bioseguridad de los mismos. Este artículo analiza el conocimiento de la sociedad sobre estas tecnologías y la actitud sobre la comercialización de alimentos derivados de ellas.

GM food and neophobia: connecting with the gatekeepers of consumer choice

John G Knight, David K Holdsworth and Damien W Mather

Journal of the Science of Food and Agricultura 88 (5): 739-747 (2008)

Resistance to importation of genetically modified (GM) foods in rich countries has deterred governments in many food-exporting countries from approving the planting of GM food crops for fear of damaging export markets for conventional food. Apart from governments that have actively imposed barriers to entry, another level of resistance can arise from food distribution channel members deciding not to import foods which they believe consumers in their markets will not want. GM foods fall in this category in some markets, particularly in Europe. In China and India, the two most populous consumer markets, pragmatic considerations appear likely to overcome neophobia regarding this technology, provided that benefits are adequately communicated to consumers. Choice-modelling experiments show that the same may well be true in Europe.

Keywords: OGMs, opinion pública, alimentos, calidad nutritiva.

El presente artículo de revisión discute la percepción de riesgos de los alimentos derivados de OGMs desde diferentes puntos de vista, en diferentes países claves de esta adopción tecnológica (Europa, China, India, etc.).

Socioeconomic considerations relevant to the sustainable development, use and control of genetically modified foods

Yoshiki Otsuka

Trends in Food Science & Technology 14 (2003) 294–318

The rapid adoption of genetically modified (GM) organisms (GMOs) in agriculture has raised several concerns regarding not only ecological but also the economic and social aspects of their effects. In this chapter, such generic concerns about GMOs are reviewed with reference to sustainable agriculture and rural development (SARD). It is suggested that current GMOs have both positive and negative effects on three indicators of the SARD, namely capital stocks, efficiency and equity. These conflicting effects depend on the socioeconomic conditions of development, use and control of GMOs, in which characteristics of a GM variety are shaped. Particularly, the influences of three problematic policy options, that is intellectual property protection, trade liberalization and biosafety implementation, are examined. Finally, intricate interactions of these policies are discussed.

Keywords: OGMs, desarrollo social, alimentos, cuidado ambiental, opinión pública

Como el título lo sugiere, el presente artículo enfoca las consideraciones socioeconómicas y el desarrollo social en relación a los OGMs y los alimentos. Concretamente se discute la agricultura sustentable desde la perspectiva socioeconómica, la tecnología de ingeniería genética dentro de la sustentabilidad del agro y las condiciones socioeconómicas del desarrollo, control y uso de OGMs.

Societal issues and public attitudes towards genetically modified foods

Lynn Frewer

Trends in Food Science & Technology 14 (2003) 319–332

Public perceptions and attitudes about emerging biosciences and other new technologies are among the most important factors determining the likelihood of the successful development and implementation of technology. As well as considering the psychological determinants of people's perceptions and attitudes,

it is necessary to consider public trust in institutions (both those concerned with regulatory matters and those concerned with the strategic development of science). Failure to do so may have a negative impact on genetic technology and its applications. While it is important to develop best practice in science communication about the risks and benefits of genetically modified food (GMF), this alone will not result in public confidence. Rather, it is becoming important to look at new ways to involve the public explicitly in the debate about technology innovation and commercialization, and to rethink the somewhat uneasy relationship between science and society.

Keywords: OGMs, desarrollo social, alimentos, cuidado ambiental, opinión pública

El objetivo del presente artículo es considerar la opinión pública frente a las biociencias emergentes, en particular la modificación genética trasladada a los alimentos, y considerar qué implicancias y actitudes públicas tienen para la aceptación de productos derivados de OGMs.

Labeling to manage marketing of GM foods

Stuart Smyth and Peter W.B. Phillips

TRENDS in Biotechnology Vol.21 No.9: 389-393 (2003)

Biotechnology has the potential to introduce new food safety risks, liabilities and benefits, and although privately managed supply chains (involving proactive management of the production of branded products) are effective at providing, managing and communicating adequate information about products with well understood risks, products with uncertain risks pose a greater challenge. The demand for increased product information regarding genetically modified content, in particular, places new constraints on food supply chains, frequently resulting in communication failures. Here we assess and reject mandatory labeling as an appropriate response.

Keywords: OGMs, alimentos, etiquetado, evaluación de riesgos, opinión pública

El tema del etiquetado de alimentos derivados de OGMs ha sido un tema central en la discusión de los consumidores y las empresas de alimentos, especialmente porque el sentido de éste tenía una tendencia más discriminatoria que informativa para el consumidor. En el presente artículo se analiza las ventajas y perjuicios que acompañan al etiquetado, y se discute la información que una etiqueta debe acompañar al producto.

Production, Identity Preservation, and Labeling in a Marketplace with Genetically Modified and Non-Genetically Modified Foods

Wallace E. Huffman

Plant Physiology, January 2004, Vol. 134, pp. 3–10

As the demand for food and fiber grew during the past 300 years, because of the Earth's expanding human population and rising per capita incomes, society met this demand first by increasing the land area under cultivation and later by improving crops so that their yields were higher. Before 1900, land was abundant almost everywhere, and in the United States, new lands were brought into production as the frontier moved across the country between 1700 and 1900. In addition, the great crop exchange between different continents permitted high-yielding crops like potatoes (*Solanum tuberosum*) to be grown in Europe and rice (*Oryza sativa*) in the United States. Improvement was by selection of the fittest in the new environment. By 1900, the frontier was closed in the United States, and this increased the urgency of finding new methods for increasing crop yields

Keywords: OGMs, alimentos, etiquetado, evaluación de riesgos, opinión pública, identidad preservada.

En el mismo sentido que el artículo anterior, el presente discute varios aspectos relacionados con la identidad preservada de las materias primas y el etiquetado de los alimentos derivados de OGMs y convencionales. El relato entra en un contexto histórico que incluye las revoluciones verde y genética, la controversia de la modificación genética de las especies y la búsqueda por la información objetiva en los rótulos de los alimentos.

Time to relax GMO regulation in Europe

Jaroslav Drobník

Plant Cell Tiss Organ Culture (2008) 94:235–238

There is enough experience gained during 10 years of genetically modified (GM) crops application to seriously evaluate the ratio of risk to benefit and reduce the existing regulation in Europe. It does not evaluate benefit and the risk of the alternative situation when GM crops are not used. The precautionary principle is applied only to GM crops application, never to alternative solutions of, e.g., pest control. The Eurobarometer 2005 shows how propaganda inseminates public opinion with shameful nonsense. Voices asking for change of this politics come from the European Parliament, British ACRE, EuropaBio, even from Commission, scientists and other European sources, but also from Africa and other developing countries.

Keywords: OGMs, aspectos regulatorios, Unión Europea, alimentos, evaluación de riesgos

Luego de 10 años de haberse liberado, adoptado y cultivado los OGMs en el mercado con una tendencia creciente en el período, las evaluaciones de riesgo ambiental y alimentario efectuadas sobre los cultivos y los productos derivados concluyeron inocuidad ambiental y alimentaria para el consumidor. Lentamente, estos productos serán más aceptados y disminuirán de ser sujetos del debate público al que hasta hoy están enfrentados.

IV. OVGMS en ALIMENTOS. Residualidad y Degradación.

Strategies to assure the absence of GMO in food products application process in a confectionery firm

Antonio Scipioni, Giovanni Saccarola, Francesca Arena, Schiavon Alberto

Food Control 16: 569–578 (2005)

This article describes the strategies and the instruments applied in the development and implementation of a system aimed at assuring the production of food which is neither made of nor derived from genetically modified raw material in a confectionery firm. It was chosen to develop a specific planning method partially taken from HACCP and FMEA techniques, mainly as far as the systematic and rigorous analysis of risks is concerned (in this case, the contamination of raw material and/or their genetically modified derivatives along the food chain). The result is a management system model that food organizations can use to assure the traceability of all ingredients incorporated into their food products and, in the same time, to guarantee that these ingredients do not contain or consist or derive from genetically modified organisms (GMOs).

Keywords: OGMs; trazabilidad, cadena alimenticia, alimentos, PCR, detección de OGMs.

El artículo describe las estrategias e instrumentos aplicados en el desarrollo e implementación de un sistema dirigido a asegurar la producción de alimentos libres de OGMs. Las técnicas empleadas permiten hacer una trazabilidad de las materias primas para garantizar la ausencia de OGMs en tanto se definan los riesgos que puedan objetar la calidad de un alimento.

Quantification of DNA from genetically modified organisms in composite and processed foods

Karl-Heinz Engel, Francisco Moreano, Alexandra Ehlert and Ulrich Busch
Trends in Food Science & Technology 17 (2006) 490–497

Challenges arising from the task to quantify DNA from genetically modified organisms (GMO) in composite and processed foods are reviewed. Examples for distortion of the quantification of GMO due to differences in particle size compositions and heat-induced DNA degradation are discussed. Ligation-dependent probe amplification is presented as a novel approach to tackle the issue of the increasing number of GMO to be screened and quantified. The use of hybrid molecules as easily accessible synthetic DNA-standards for quantitative screening of GMO via real-time PCR is described.

Keywords: OGMs; trazabilidad, cadena alimenticia, alimentos, PCR, detección de OGMs.

El presente artículo de revisión enfoca la cuantificación de ADN correspondiente a transgenes presentes en los alimentos procesados y elaborados. Se destaca en este aspecto la capacidad de la técnica de PCR en tiempo real.

Detection of BT transgenic maize in foodstuffs

Ezequiel Margarit, Martín I. Reggiardo, Rubén H. Vallejos, Hugo R. Permingeat
Food Research International 39 (2006) 250–255

Different foodstuffs for humans and monogastric animals were analysed to detect CryIA(b) gene and quantify the CryIA(b) protein present in the transgenic maize used as an ingredient. Eight out of 32 foods obtained from the market showed to have been elaborated with transgenic Bt maize. Specific primers used to identify the transgenic event revealed that Mon810 was predominantly present in the foodstuffs. A commercial ELISA test allowed the quantification of the CryIA(b) protein in low processed foods, and found that 0.1 ppm was the highest value per gram of food. A Western blot carried out with immunopurified polyclonal antibodies was capable of detecting both the intact or degraded CryIA(b) protein depending on the food assayed.

Keywords: maíz Bt; alimentos; OGMs, detección de OGMs

En el presente trabajo se analizó la presencia de DNA y proteína Bt en alimentos derivados de maíz, buscando y cuantificando los eventos transgénicos autorizados para su comercialización en Argentina. El análisis incluyó tanto a alimentos de las góndolas para humanos como para animales monogástricos.

Degradation of Cry1Ab Protein from Genetically Modified Maize in the Bovine Gastrointestinal Tract

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AND CHRISTIANE ALBRECHT*

J. Agric. Food Chem. 2005, 53, 1453-1456

Immunoblotting assays using commercial antibodies were established to investigate the unexpected persistence of the immunoactive Cry1Ab protein in the bovine gastrointestinal tract (GIT) previously suggested by enzyme-linked immunosorbent assay (ELISA). Samples of two different feeding experiments in cattle were analyzed with both ELISA and immunoblotting methods. Whereas results obtained by ELISA suggested that the concentration of the Cry1Ab protein increased during the GIT passage, the immunoblotting assays revealed a significant degradation of the protein in the bovine GIT. Samples showing a positive signal in the ELISA consisted of fragmented Cry1Ab protein of approximately 17 and 34 kDa size. Two independent sets of gastrointestinal samples revealed the apparent discrepancy between the results obtained by ELISA and immunoblotting, suggesting that the antibody used in the ELISA reacts with fragmented yet immunoactive epitopes of the Cry1Ab protein. It was concluded that Cry1Ab protein is degraded during digestion in cattle. To avoid misinterpretation, samples tested positive for Cry1Ab protein by ELISA should be reassessed by another technique.

Keywords: ELISA; proteína Bt; alimentos, degradación, maíz Bt.

En el presente trabajo se estudió la persistencia de la proteína Bt en el tracto gastrointestinal de bovinos mediante dos metodologías. Si bien los resultados abordados con las dos técnicas (ELISA e inmunoblotting), se concluye que la proteína Bt se degrada en el trayecto digestivo de bovinos.

Rapid degradation of the Cry3Bb1 protein from Diabrotica-resistant Bt-corn MON88017 during ensilation and fermentation in biogas production facilities

Stefan Rauschen, Hang Thu Nguyen, Ingolf Schuphan, Johannes A Jehle and Sabine Eber

Journal of the Science of Food and Agriculture 88:1709–1715 (2008)

BACKGROUND: Insect-resistant transgenic corn is meeting a growing adoption in Europe. Corn is also the major substrate for biogas production, which has vastly increased in recent years. In areas with high insect pest pressure Bt-corn silage will consequently be fed into biogas production facilities. To assess the potential risks of transgenic plants as energy crops we investigated the fate of the coleopteran-specific protein Cry3Bb1 from MON88017 corn in the utilization chain of a farm-scale biogas production facility using ELISA.

RESULTS: The mean Cry3Bb1 protein content in chaffed MON88017 plant material was 15 $\mu\text{g g}^{-1}$. In silage the content decreased rapidly, with less than 20 ng g^{-1} detectable after 8 months. From the start of fermentation in the biogas reactor, only trace amounts of Cry3Bb1 could be detected. Conventional corn harvested alongside MON88017 with the same equipment showed a presence of transgenic plant material of around 0.5%. Analyses performed at two laboratories showed consistent and systematic differences in the concentrations of Cry3Bb1 measured with ELISA due to methodical differences.

CONCLUSIONS: An extensive degradation of Cry3Bb1 was observed in silage despite differences in ELISA measurements. The potential risk associated with the use of MON88017 silage is discussed on this basis.

Keywords: maíz Bt; MON88017; proteína Bt; producción de biogas; silaje; ELISA

Si bien el presente estudio fue realizado para evaluar la degradación de la proteína Bt del maíz transgénico con un objetivo de producción de energía (biogas) luego de una fermentación del material en un silo, los resultados son extensibles y aplicables a lo que ocurre un silaje del cultivo. Las conclusiones indican que la proteína Bt se degrada rápidamente durante el ensilado.

Glyphosate-Tolerant Soybeans Remain Compositionally Equivalent to Conventional Soybeans (*Glycine max* L.) during Three Years of Field Testing

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J. Agric. Food Chem. 53, 5331-5335 (2005)*

Previous studies have shown that the composition of glyphosate-tolerant soybeans (GTS) and selected processed fractions was substantially equivalent to that of conventional soybeans over a wide range of analytes. This study was designed to determine if the composition of GTS remains substantially equivalent to conventional soybeans over the course of several years and when introduced into multiple genetic backgrounds. Soybean seed samples of both GTS and conventional varieties were harvested during 2000, 2001, and 2002 and analyzed for the levels of proximates, lectin, trypsin inhibitor, and isoflavones. The measured analytes are representative of the basic nutritional and biologically active components in soybeans. Results show a similar range of natural variability for the GTS soybeans as well as conventional soybeans. It was concluded that the composition of commercial GTS over the three years of breeding into multiple varieties remains equivalent to that of conventional soybeans.

Keywords: soja, Glycine max L., soja RR, composición, OGMs, alimentos, equivalencia sustancial

El objetivo del estudio se dirigió a evaluar la equivalencia sustancial entre la soja convencional y la soja RR (presente el gen EPSPS en diferente background genético). Los resultados indican que la composición de la soja tolerante a glifosato es substancialmente equivalente a la convencional.

Chemical Composition of Glyphosate-Tolerant Soybean 40-3-2 Grown in Europe Remains Equivalent with That of Conventional Soybean (*Glycine max* L.)

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J. Agric. Food Chem., 55, 6160-6168 (2007)*

The composition of glyphosate-tolerant (Roundup Ready) soybean 40-3-2 was compared with that of conventional soybean grown in Romania in 2005 as part of a comparative safety assessment program. Samples were collected from replicated field trials, and compositional analyses were performed to measure proximates (moisture, fat, ash, protein, and carbohydrates by calculation), fiber, amino acids, fatty acids, isoflavones, raffinose, stachyose, phytic acid, trypsin inhibitor, and lectin in grain as well as proximates and fiber in forage. The mean values for all biochemical components assessed for Roundup Ready soybean 40-3-2 were similar to those of the conventional control and were within the published range observed for commercial soybean. The compositional profile of Roundup Ready soybean 40-3-2 was also compared to that of conventional soybean varieties grown in Romania by calculating a 99% tolerance interval to describe compositional variability in the population of traditional soybean varieties already on the marketplace. These comparisons, together with the history of the safe use of soybean as a common component of animal feed and human food, lead to the conclusion that Roundup Ready soybean 40-3-2 is compositionally equivalent to and as safe and nutritious as conventional soybean varieties grown commercially.

Keywords: soja, Glycine max L., soja RR, composición, OGMs, alimentos, equivalencia sustancial

En el mismo sentido que el artículo anterior, en el presente se evaluó la composición química de la soja RR introgresada en cultivares rumanos y se la comparó con materiales convencionales. Los resultados de este estudio independiente fueron coincidentes con los anteriores, destacando la equivalencia sustancial existente entre ambos grupos de genotipos.

Degradation of Endogenous and Exogenous Genes of Roundup-Ready Soybean during Food Processing

*YING CHEN, YUAN WANG, YIQIANG GE, AND BAOLIANG XU
J. Agric. Food Chem., 53, 10239-10243 (2005)*

Roundup-Ready soybeans have been genetically modified to resist the effects of the herbicidal glyphosate and have become the most prevalent transgenic crop in the world. In this work, Roundup-Ready soybeans were used as raw material to study the effects of critical processing procedures such as grinding, cooking, blending, homogenization, sterilization, and spray-drying on the length of DNA fragments of an endogenous gene (lectin) and an exogenous gene (epsps) examined in material from three soybean foods of bean curd, soy milk, and soy powder and from samples taken during their processing. The results showed that various processing procedures caused degradations of both the endogenous and exogenous genes to different degrees. In the grinding procedure, endogenous gene DNA was degraded from 1883 to ~ 836 bp, and exogenous gene DNA was degraded from 1512 to ~ 408 bp. In the blending and squeeze-molding procedures, exogenous gene DNA was also degraded from about 408 to 190 bp, but there was no obvious action on the endogenous gene. After the endogenous and exogenous genes had been degraded to some degree, such as 836 and 408 bp, respectively, they were not evidently affected by cooking procedure at 100 °C for 15 min. However, the endogenous gene was further considerably degraded from around 836 to 162 bp in the sterilization procedure at 121 °C for 30 s. The effect of the homogenization step on endogenous and exogenous genes was similar to that of the cooking procedure. The coagulation procedure, principally a biochemical reaction, did not greatly affect the exogenous gene but did affect endogenous gene, reducing DNA size from about 836 to 407 bp. Furthermore, the spray-drying procedure, a process of physical shearing, high temperature, and sudden high pressure, distinctly caused degradation of both the lectin and epsps genes, rapidly decreasing the sizes from about 836 to 162 bp for the endogenous gene and from about 408 to 190 bp for the exogenous gene.

Keywords: soja RR; procesamiento; degradación; alimentos

En el presente trabajo se describe la estabilidad de un gen endógeno y del transgén de la soja RR frente a diferentes tratamientos que conducen a la elaboración de distintos alimentos.

Applicability of quantitative PCR to soy processed foods containing Roundup Ready Soy

*Rie Moriuchi, Kimio Monma, Naoki Saji, Naomichi Uno, Kunihiro Kamata
Food Control 18: 191–195 (2007)*

Detection methods for genetically modified organisms (GMO) have been developed among countries, but there are still no practical quantitative methods for the processed foods. Although the quantitative methods in the Japanese standard are now targeted at raw grain, we examined whether the methods may also be applied to processed soy foods. The Roundup Ready Soy (RRS) in soy products by our own or professional making were quantified using real time PCR, and we compared the RRS content with that in raw soybeans. As a result, sufficient copy numbers of the lectin and introduced gene were obtained for quantification from all the soy products. Almost all items showed no significant differences in the RRS content. These findings suggested that the Japanese official quantitative method might be useful for screening in some soy products.

Keywords: OGMs; soja RR; alimentos; PCR cuantitativa.

En el mismo sentido que el artículo anterior, el presente contribuye con un análisis de detección y cuantificación de soja transgénica RR en alimentos procesados.

Presence of genetically modified maize and soy in food products sold commercially in Brazil from 2000 to 2005

Ralf Greiner, Ursula Konietzny
Food Control 19: 499–505 (2008)

Qualitative and quantitative polymerase chain reaction-based methods to detect genetically modified soy (RoundupReady™ soy) and maize (Bt176 Maximizer™ maize, Bt11 maize, MON810 YieldGard™ corn, T25 LibertyLink™ maize) were applied to processed foods sold commercially in Brazil. From 2000 to 2005, 100 food products containing maize and 100 food products containing soy were analysed every single year. The presence of genetically modified soy increased steadily from 13% in 2000 to 78% in 2005. The number of food products containing genetically modified soy in a proportion above 1.0% on the ingredient level, the threshold for labelling according to Brazilian legislation, increased from 11% in 2000 to 36% in 2005. No clear trend was found within maize containing food products. Eight to eleven percent were shown to consist of material derived from genetically modified maize and 4–6% were found to contain more than 1% of genetically modified maize.

Keywords: detección de OGMs; maíz Bt; soja RR; PCR; alimentos transgénicos

En el presente trabajo se describe un estudio dirigido a evaluar la evolución de la presencia de maíz y soja transgénicos en alimentos en Brasil en el período comprendido entre los años 2000 y 2005.

CONSIDERACIONES FINALES

En base a la información volcada en el presente informe, resulta interesante destacar las siguientes reflexiones.

- 1) El desarrollo de cultivos transgénicos estuvo inicialmente orientado a complementar las técnicas convencionales de fitomejoramiento para satisfacer dos objetivos básicos, a saber: mayor producción (productividad) de cosechas y mejor calidad de productos. Estas tecnologías utilizan conceptos de diferentes disciplinas tales como la biología celular y la biología molecular, además de desarrollos realizados para introducir genes de distintos orígenes en los genomas de plantas.
- 2) Los primeros eventos desarrollados de cultivos transgénicos tuvieron que ver con resistencias a adversidades bióticas, tales como las resistencias a herbicidas y a insectos, caracteres gobernados por genes simples de herencia mendeliana. Estos son los eventos hoy autorizados para su comercialización en Argentina y otros países del mundo (soja RR, maíz RR y Bt, algodón RR y Bt, ya sea eventos simples o eventos con genes apilados). Estas aplicaciones, con claros beneficios al productor agropecuario (facilitan el manejo de los cultivos y el control de estas adversidades) fueron incluidas en la llamada Primer Ola de aplicaciones. Se justifican porque al ser caracteres gobernados por genes simples posibilitaron estudiar todos los aspectos relacionados con la introducción de genes (fueron las primeras experiencias desarrolladas, los científicos aprendieron de ellas). En este informe se incluyen (básicamente) estudios de alimentos derivados de este tipo de eventos.

- 3) La Segunda Ola de aplicaciones se refiere a desarrollos más ambiciosos, dirigidos a beneficiar a la sociedad como consumidora de alimentos. Estos desarrollos se refieren a modificaciones en plantas de la cantidad y composición de hidratos de carbono, proteínas, lípidos, minerales y vitaminas, etc. Aquí se destacan desarrollos que mejoran la calidad nutricional de los alimentos, que disminuyen la alergenicidad de los mismos, que ofrecen alimentos más seguros, enriquecidos en compuestos que naturalmente son deficientes. En este informe también se incluyen ejemplos concretos y desarrollados, tal como el conocido arroz dorado (Golden Rice) enriquecido en provitamina A, y otros en evaluación con otros caracteres de interés. Muchos de estos eventos requirieron de la introducción de más de un gen para lograr el objetivo.
- 4) Una Tercera Ola de aplicaciones fue definida para satisfacer demandas de productos más revolucionarios para diversas industrias, como es el campo de las proteínas recombinantes, las plantas como biofábricas, los bioplásticos, los biodetergentes, los biofármacos, los nutracéuticos, las vacunas, anticuerpos, etc., todas aplicaciones que escapan al interés de este informe.
- 5) Volviendo al tema de los alimentos, también se destaca que muchos alimentos no tienen base biotecnológica en sus materias primas, sino en sus procesos de elaboración, donde se utilizan enzimas recombinantes producidas por bacterias. Esta información puede obtenerse visitando la página web de [ArgenBio](#) y del [AmFep](#). Este hecho tiene la ventaja que la proteína utilizada en la elaboración del alimento sea mucho más pura, biosegura y barata.
- 6) Entre los riesgos alimentarios de los cultivos transgénicos se citan: i) la alergenicidad que pueden generar en la población que consume los alimentos derivados de ellos, ii) la generación de resistencia a antibióticos derivada del uso de genes marcadores de selección, y iii) la nocividad de una comida "Frankenstein".
 - Como puede observarse en algunos trabajos incluidos en este informe, en algunos alimentos se detecta tanto DNA correspondiente al transgen introducido como la proteína que el mismo codifica. Es dable observar, que la estabilidad de los mismos (DNA y proteína) depende del grado de procesamiento que la materia prima sufre para convertirse en alimento. En algunos casos es imposible determinar si el alimento derivó o no de un OVG, por lo que se está ante la aplicación del concepto de EQUIVALENCIA SUBSTANCIAL.
 - Más allá de los análisis requeridos para aprobar un evento que tendrá como destino la producción de alimentos (donde se evalúa la posibilidad que el OVG constituya un riesgo de alergenicidad

para los consumidores), la tecnología de transformación genética de plantas ofrece la alternativa de remover los compuestos alergénicos naturales de los alimentos por estrategias de silenciamiento génico.

- Los genes de resistencia a antibióticos utilizados como marcadores de selección no constituyen un riesgo importante para que los consumidores generen estas resistencias en sus organismos, dado que estos antibióticos no son utilizados por humanos, además que la transferencia génica horizontal (pasaje del gen a las células del tracto digestivo) requiere de múltiples etapas coordinadas para que se concrete.
 - El término de comida Frankenstein de los alimentos derivados de OVGMs implementado por grupos ambientalistas radicalizados no concuerda con los objetivos del desarrollo de alimentos más seguros y sanos, más nutritivos y de mayor calidad para los consumidores que estas tecnologías ofrecen concretar. En esta instancia, es conveniente comentar que la aprobación de un evento que tendrá como destino la producción de alimentos debe pasar un examen similar a como lo hace una droga que constituirá un medicamento.
- 7) Los sistemas regulatorios están dirigidos a realizar una evaluación de estos riesgos y para eso hay una institución (en Argentina el SENASA) responsable del proceso. Entre otros aspectos, se evalúa a) los efectos directos sobre la salud (toxicidad), b) las tendencias a provocar una reacción alérgica (alergenicidad), c) los componentes específicos con sospecha de tener propiedades nutricionales o tóxicas, d) la estabilidad del gen insertado, e) los efectos nutricionales asociados con la modificación genética, y f) cualquier efecto no deseado que podría producirse por la inserción genética.
- 8) La opinión pública debe nutrirse de información para tomar conciencia que estas tecnologías ofrecen alternativas económicas en lo que respecta a calidad de alimentos. Al respecto, puede recomendarse la lectura de un artículo titulado "**20 PREGUNTAS SOBRE LOS ALIMENTOS GENÉTICAMENTE MODIFICADOS (GM)**", que contiene preguntas y respuestas preparadas por la OMS en respuesta a preguntas y preocupaciones de una cantidad de Gobiernos de Estados Miembro de la OMS con respecto a la naturaleza y la inocuidad de los alimentos genéticamente modificados.
- 9) Finalmente, se incluyen en el presente informe dos trabajos donde se analizan alimentos derivados de maíz Bt y soja RR en Argentina y Brasil, respectivamente:

