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Is Canada ready ? Evaluating the infrastructure supporting the tracing and identification of genetically modified organisms in Canada

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For the Industry Canada Office of Consumer Affairs

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Executive summary

The process of finding trace elements means being able to put together all the entities which make up the food industry, beginning with the open fields and ending with the consumers' plates. In the case of genetically modified organisms, a system enabling tracing and identification becomes a way to control and validate the information found on a label. Indeed, when a country decides to label genetically modified organisms, the implementation of a system enabling the tracing and identification of these organisms backs up any allegations and by the same token, increases consumers' trust relating to this information.

Canada is currently developing standards on a voluntary basis for the labelling of organisms, whether they are produced genetically or not, and there are no regulations so far to assist in the implementation of tracing and identification, nor is there any system in place to support any methods that can be used to detect these genetically modified organisms. Such standards are necessary to ensure rigour and uniformity in the interpretation of results on one hand and on the other hand, to be in keeping with what is being developed internationally, such as in Europe for example.

A study done by Option Consommateurs to evaluate the infrastructure set up to identify trace elements in genetically modified foods in Canada, shows that the food industry supports the implementation of such a control system, that methods to detect GMOs do exist and that the infrastructure necessary for the implementation of these standards and the accreditation of laboratories to do the analysis is currently in place in Canada.

Option Consommateurs is therefore able to make the following recommendations, after a review of what has been written on the subject of identifying trace elements in genetically modified foods, in the wake of interviews with experts in the field, and of discussions with consumers in the context of a technological workshop that took place to discuss the development of tracing tools, and during which many experts in the food industry came together.

- Option Consommateurs believes that a system to trace and identify genetically modified foods should be put in place in Canada as soon as possible, in order to support any future labelling of these genetically modified foods, whether voluntary or mandatory. Indeed, such a control system would permit the corroboration of any information found on the labels.

- Option Consommateurs recommends that the tracing and identification system which will be put in place, be developed as a tool to gain the trust of consumers, and be unveiled to them through a widespread public education campaign.

- Option Consommateurs recommends that government supported regulations be put in place in Canada, in relation to identifying these trace elements. The government would ensure the implementation of these regulations, with the help of the various entities in the food industry. This regulating context would impose a tracing system on the food industry overall, whereby the different parties involved (farmers, transporters, modifiers) would have to implement a system to trace GMOs and any by- products in all goods.

- Option Consommateurs recommends that any structure that will be put in place to trace and identify genetically modified organisms, be supported by documentation accompanying these products and that these documents as well as any update and safekeeping system of these documents be rigorously managed.

- Option Consommateurs recommends that the standards pertaining to the methods used to detect GMOs be developed to ensure the best quality, rigour and uniformity possible. Such developments should be supervised by consumer, industry and government representatives, under the jurisdiction of an organization such as the Canadian General Standards Board (CGSB) or the Bureau de normalisation du Québec (BNQ), for example. These methods of detection and the standards which support them should be in keeping with those ratified at the international level, as in Europe for example.

- Option Consommateurs recommends that a public network be responsible for accrediting laboratories that do GMO detection. To do this, the network will be able to use the accreditation and authentication infrastructure already in place in Canada, such as the laboratories of the Bureau des normes du Québec (BNQ) or of the Canadian General Standards Board (CGSB), two organizations that are recognized by the Standards Council of Canada (SCC).

- Option Consommateurs recommends that the recognized detection methods used to analyze crops and foods with GMOs be quantity oriented, in order to identify the amount of genetically modified materials. The research and development of more sensitive and specific methods, adaptable to newer genes and applicable on a grand scale, quick and inexpensive, should be encouraged and supported.

- Option Consommateurs recommends that the cost necessary to implement a network to trace and identify genetically modified cultures and foods, be quantified with the help of studies based on European experience in this field, among others.

- Option Consommateurs recommends that these studies be done to quantify the costs that consumers are ready to assume, to ensure a sustained labelling of genetically modified foods and crops, aided by a tracing and identification system.

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1 Introduction

Certain diseases, such as foot and mouth disease, swine fever and mad cow disease, which affect animals, and dioxin in the food industry, have brought about the development of a tracing system, which basically means following up on foods from the field to the consumer's plate. For many industrialized countries, tracing has become unavoidable. In Canada, tracing foods has taken on more and more importance. In Quebec for example, the Bureau de normalisation du Québec (BNQ) is currently developing tracing standards for calf's meat[1]. For different sectors, tracing is representative of the challenge of offering consumers a verifiable quality as well as the opportunity of obtaining information on the source and the salubriousness of the different foods they eat, and the opportunity of identifying them.

The implementation of a tracing system has many objectives including improving on the response time when health related emergencies occur, protecting public health, maintaining the trust of consumers and limiting the economic impact on the food industry when a crisis occurs. In other words, tracing in the food industry is seen as a tool used to manage quality and information for the benefit of the industry's various entities.

Efforts to implement a tracing system are currently being focused on the meat sector for reasons of securing and maintaining public health, among others. In Canada, no regulating system exists, nor are there any tracing standards pertaining to the identification of genetically modified organisms (GMOs)[2], in contrast to Europe where such a system is set up. Various surveys have shown that consumers would like to have a

[1] In 2000, the Quebec National Assembly passed two bill projects into law, the objective of which was to enable the government to demand the implementation of tracing systems from the farm to the table. These Laws are the *Loi sur la protection sanitaire des animaux* (L.R.Q., c.P-42) and the *Loi sur les produits alimentaires* (L.R.Q., c. P-29).

[2] The acronym GMO, short for genetically modified organism, and used in this report, refers to new genetic technologies only. The latter exclusively pertain to direct transfer or changes made to the genetic material with the help of recombinant DNA technology. Indeed, these are methods which currently preoccupy consumers. This acronym is used to lighten the text.

labelling system pertaining to genetically modified foods. Canada is still developing standards for voluntary labelling for foods that are genetically modified and not modifed. These standards are being developed by the Canadian General Standards Board (CGSB). Option Consommateurs has been actively involved since the beginning with the committee handling voluntary labelling, first informally, for information purposes, and then as a voting member. This labelling system will have to include the implementation of qualitative and quantitative tools, in this case a tracing system, to follow up on, detect and quantify the amount of genetically modified materials in products, in the food industry overall. Indeed, identifying and tracing genetically modified foods and crops will corroborate the information printed on the labels.

The report that follows presents the results of the research done by Option Consommateurs concerning the feasibility, in Canada, of implementing a system to identify and trace foods made from genetic materials (GMOs).

This report first attempts to define the concept of tracing, its applications and its consequences for genetically modified foods and crops. Indeed, Option Consommateurs believes it's important to precisely define this relatively new concept so that readers may concretely understand its reach. Afterwards a review of the management tools of a tracing system is presented, such as the current analysis methods used to detect GMOs. Option consommateurs then takes a look at the current European regulations surrounding a GMO tracing system, as well as the steps that France is taking to implement detection standards. The following section attempts to determine the costs related to this system, by taking as an example a few studies done on this subject. The position taken by consumers and the various entities of the food industry is also given, as well as their demands and expectations in relation to a Canadian tracing system for genetically modified foods and crops. This section also includes an evaluation of the Canadian infrastructure which would be responsible for this system, by defining the role played by the various entities of the food industry. Finally, we conclude with the report's highlights, as well as a set of recommendations resulting from Option Consommateur's own analysis of the subject and with what the future holds for GMO tracing.

2 Defining tracing and its objectives

2.1 General definition

Many definitions[3] are currently being used to describe the concept of tracing. The common description is that tracing means being able to put together all the components which make up the food industry, beginning with the open fields and ending with the finished product sold to consumers. Furthermore, a tracing system has to be transparent, trace a product's origins, its history and its components. Tracing facilitates the analysis of undesirable effects on human, animal and environmental health. Indeed, tracing can result in a product being taken off the shelves if it is deemed risky for human health or the environment. The general advantage of a tracing system is therefore to give accurate information in response to consumers' concerns pertaining to a specific product.

2.2 Tracing in the context of genetically modified foods and crops

In the case of genetically modified crops and foods, tracing becomes a way to verify the information that is printed on a label, when a country chooses to adopt labelling practices[4]. It is important to mention that tracing and labelling have different ends, but they can also be combined to complement one another. Indeed, a complete labelling system does not mean that the identity and the past history of GMOs have to be individually established. However, implementing a GMO tracing system could provide certain information that could be used for labelling purposes and make this labelling more rigorous in the eyes of consumers. In order to give information to consumers that is more accurate, a tracing system for the purpose of informing these individuals can

[3] According to ISO 9000-2000 standards, tracing is « retracing the steps relating to the history, the implementation or the locality of what is being examined. In the case of a product, this can be linked to the source of materials, its components, its manufacturing history, its distribution and the locality of the product after delivery». As far as ISO 8402 standards go, tracing is « retracing the steps relating to the history, the use or the locality of an entity (for example, a vegetable, an animal, a food product) with the help of a registered identification system » (Conseil national de l'alimentation, 2001).

[4] Under the jurisdiction of the Canadian General Standards Board (CGSB), Canada is currently working on the development of voluntary labelling for foods that are genetically modified or not modified. Since November 1999, Option Consommateurs has been involved in this process as a voting member.

hopefully be implemented. Indeed, this system must be built as a tool to increase the trust of consumers.

Tracing as such does not require segregation, or in other words separation of crops, during the production and transformation process. The reason for this is that segregation doesn't exclude the crossing of many kinds of GMOs or of GMOs with conventional products. The only thing segregation does provide is strictly qualitative information on what a product is made of. Separating crops and foods that are genetically modified from those that are not means the implementation of identity preserved systems, meaning that storage, transformation and transportation are regrouped under one production type (Conseil national sur l'alimentation, 2001). It's important to define these three concepts, the objectives of which are different, but which can also complement each other. Indeed, identity preserved systems require a form of tracing. In fact, they can almost be considered as a component of tracing.

2.3 Tracing and the "identity preserved" concept

The kind of tracing that supplies only qualitative information on a product's origins, is not as dependable as an identity preserved system. Naturally, segregation, tracing and identity preserved systems that are well controlled and properly structured, would consitute an ideal model to ensure that the labels for genetically modified foods are accurate. Indeed, the implementation of these systems would verify and identify, in a finished product, all ingredients that are derived from genetically modified material. However, the implementation of such rigorous and complex systems would be difficult and expensive. For example, to ensure a high level of segregation, a separate system for genetically modified and non genetically modifed foods must be set up in the entire food industry.

2.4 Following up on raw materials in the food industry

The first step in the food industry is the production of seeds. A tracing system must be used to trace genes from the laboratory up to their commercialization. A registration

number could be used to identify these genes. This coding system must follow up on those seeds all along the production line, meaning in laboratories, during production, in factories and in seed bags. The second step is the cultivation of these raw materials. At this stage, farmers must be able to vouch for the source of their crops. To do this, they must implement an efficient system to separate genetically modified crops from those that are not genetically modified. They must therefore have two separate collecting systems, one for conventional crops and one for genetically modified organisms. There are many obstacles to overcome in this second stage. Indeed, the fact that farmers don't always clean their machines or respect distances has to be considered. In fact, one of the major problems pertaining to the segregation of GMOs and non GMOs is the distance that has to be kept between conventional fields and GMO crops. These distances are unfortunately not yet well defined for all crops. However there are solutions that could compensate for this. One of these solutions could be an efficient organization of these crops, which means that the fields containing the same species of crops could be moved further away. This would mean that pollination between species could be avoided. For example, for corn fields, where it is more difficult to maintain a field without GMOs, there are seed companies that have taken precautions to avoid the problem of cross pollination. For soya, there is no such problem that exists and therefore, it is easier for seed companies to deliver this plant with a 1% contamination threshold (Bullock *et al*., 2000). Also, it is obvious that if these seeds are contaminated at the commercial stage, meaning before they are distributed to farmers, they will still be contaminated in the fields. From a practical point of view, it is impossible for a farmer to remove and inspect all seedlings. Therefore, contamination can occur when seeds are planted, when the seedlings are growing or when they're ready to be harvested. Indeed, harvest time is a very busy period for farmers meaning they don't always take the time to decontaminate their machines when they pause between two fields. To remedy this situation, a farmer could either plant GMOs or non GMOs exclusively.

Generally, after the harvest is completed, seeds are moved by truck or by train for storage purposes[5]. Contamination in trucks is easily avoidable with proper cleaning. To ensure

[5] Certain farmers store seeds in their own silos.

an efficient segregation system, a sample would have to be taken and tested for GMOs. The silo could afterwards be filled up. Silos have to be cleaned and this procedure can become tedious because of the presence of GMO "contaminated" dirt. In order to have GMO and non GMO silos, you also need GMO and non GMO transporters. For example, the forklifts of two Coopératives Grande Prairie in Illinois have implemented this system and have a transporter that is used only for GMOs (Bullock *et al*. 2000). The seeds are afterwards moved by train from the forklift to a domestic processor, and to a forklift used for exports or local markets. Segregation on ships used for exports is more difficult to accomplish, because there is no separation of species on board and it would be very expensive to clean these boats. But this is already being done between trips, for certain crops. For example, the Coopérative fédérée de Québec has an identity preserved system for non genetically modified soya beans exported by ship to Japan either as loose goods or in bags (Dupuis, 2001).

A physical infrastructure is already set up for certain plants, but this is not the case for all conventional plants. In fact, the identity preserved process is currently being used to sort out seeds by category. Their identity is rigorously preserved until they are planted by farmers. Afterwards, it is much more difficult to keep track of them.

Finally, the third step is industrial production, meaning the transformation from raw materials into a marketable finished product. That is the final phase of the food industry production line. In order to preserve the identity of every single item, they would have to be categorized and kept with their own species when they first arrive at the factory. A way of identifying them could be to use a bar code for example.

This description of these different stages shows that it is currently possible for certain specific plants, such as non GMO soya, to maintain their preserved identity for their raw materials. However, this is not currently being done for all varieties of crops. Indeed, to separate and keep tabs on all the raw materials that go into transformed foods, with systems that are unique, is currently not possible and it would also be far too expensive. It is very difficult, almost unrealistic and too complex to keep track of every GMO

(enzymes, bacteria, yeast, etc. that make up foods) individually. However, and this is the main theme of the Option Consommateurs study, it would be possible to develop a GMO detection system, along with a tracing procedure that does not exclude the mixing of genetically modified foods and crops, but that gives precise information on the source of what goes into manufacturing these transformed or not transformed foods.

2.5 Implementing tracing in GMO crops and foods

The implementation of detection and tracing systems in the food industry rests with a combination of documents designed to accompany products, the management of those documents and also on technical analysis. Indeed, records that keep information are a system's memory. To ensure its vigor, each operator along the production line must keep a record of the ins and outs of GMOs and any by-products, exchanged or transformed. Indeed, it's possible to make sure that GMOs are traced along a production line if all the necessary information to identify them is transmitted and kept at each step of their commercialization. Indeed tracing, among others, requires that the following be written on commercial and transportation documents :

- A mention indicating the presence of genetically modified organisms or by-products;

- The identity of each GMO for products that have not been transformed, as well the names and addresses of the supplier and the customer, as the case may be.

To make sure that all of the information is transmitted to properly identify GMOs, the operators must, for each step of the commercialization process, either put the necessary data on labels or supply accompanying documents. A « lone identifier », of whatever nature, must therefore be a part of the information provided on each GMO. This way, the identifier gives access to the data concerning this GMO, notably the methodology used for detection, with the help of a central information register.

The implementation of a tracing and identification system for genetically modified crops and foods can be rather complicated and expensive for certain branches of the industry.

The task becomes more and more difficult as we move along the production line because there are more and more contributors. For example, the proportion of transformed products that incorporate a number of ingredients from various sources, increases more and more. Moreover, there are more and more ingredients and additives used for the manufacturing of certain ingredients. Finally, to ensure the efficiency of this system, it isn't enough to interest only farmers, but also transporters and modifiers who have to vouch for the source, the history and the nature of the product and whether is has been « contaminated » or not.

Other problems can increase the complexity of implementing a tracing and identification system. For example, how do you vouch for the origin and the content of foods when they are not supplied by the raw material market ? If Canada imports a product, how can they make certain that the manufacturer used two separate categories? It can be rather difficult to impose a tracing system on another country. In order to vouch for the source of a product and identify it properly, it's very important to obtain the necessary information from the country that exports this product.

3 TRACING TOOLS

3.1 Tools used to manage a tracing system

The implementation and the efficiency of a tracing system depends largely on management tools that use the many possibilities offered by computer networks to stock, transfer and treat information. The latter are a complement to and adapt themselves to the management and physical tracing of products. As an automatic identification tool, which is a way to exchange information on merchandise and the processes associated to it, it is possible to use a code bar, optical coded writing, radio frequency labels, coding, DNA markers[6], etc. These management tools are relatively simple and easy to put in place.

[6] DNA is the molecule that carries the genetic information on practically all living organisms. DNA even carries survival and reproduction information (Conseil de la science et de la technologie, 2002)

3.2 Molecular GMO detection methods

Analytical detection methods are used to determine what a product is made of and to verify the reliability of the information that was provided, which is necessary for a tracing system. Since there are more and more transformed foods on the market and that it's relatively less complicated to detect GMOs in simple foods (apples, carrots) than in more complex combinations, detection methods that are more and more sensitive and specific have been developed. DNA fragments and proteins that are often denatured during the transformation of foods have to be detected, and sensitive methods are needed. Afterwards, to make sure that GMOs are detected and not other components in the plant, very sepcific methods are needed for every GMO. Finally, since the objective is to detect the quantity of genetically modified material in a specific food, quantitative methods have to be used also, not only qualitative ones. Qualitative methods show if any genetic changes (protein or DNA) have been done to certain foods, but do not show the exact quantity of genetically modified material.

Qualitative methods can be used for finished products, such as samples of products that are already on store shelves. Most of these methods have a detection level of around 0,01% (European Commission, 2000). The first step of qualitative methods could be to determine if certain foods contain genetically modified organisms. Afterwards, it's possible to detect the quantity of genetically modified material in a specific food, so that GMO tolerance levels are met in the labelling standards in effect, in a country where they currently vary between 1 and 5%.

Detection methods are based on the detection of a new protein due to the presence of a new gene and/or the detection of the gene as such. However methods that are based on protein detection are less sensitive than those based on gene (DNA) detection (refer to appendix A for a description of the currently available detection methods).

3.3 What the future holds for GMO detection methods

There are still many challenges pertaining to GMO detection technology. Indeed, this technology has to be sensitive and specific, quantitative, adaptable to new genes,

applicable on a grand scale and at a low cost. For example, the detection methods that will be used to verify the content of a truck or silo must be simple, fast and affordable. Ideally, the results should be available within five minutes after the test is completed. These tests currently don't exist. Research is currently underway to develop ideal detection methods. For example, one technology that could be promising within the next ten years, but that is very costly at the present time, is called DNA-Microarray. This technology can detect many GMO sequences, thereby giving a better overall portrait of simultaneous interaction between many genes.[7]. Nanotechnologies, which are miniaturized tools used to perform various tasks (DNA extraction, amplification, reading of results, for example) are also interesting methods which may become applicable to GMOs in the long run.

4 GMO TRACING IN EUROPE

On July 25th 2001, the European Commission adopted two new regulation proposals, one concerning tracing and labelling of GMOs[8] and products manufactured from GMOs and the other concerning food products and food for animals, which will come into effect in October 2002. The latter repeals the 90/220/CEE guideline pertaining to the voluntary dissemination of genetically modified organisms in the environment. The measures stated in these proposals impose a tracing system in the entire food industry. This implies that manufacturers from now on have to implement tracing for products containing GMOs and any by-products. Furthermore, they have to communicate their presence to the operator that comes next in the production line. For food destined for humans, this obligation extends to ingredients, additives and flavours. A list of all operators who have received GMOs or by-products must be kept for five years. The industry will have to obtain systems which will enable it to determine where the genetically modified products have been and where they're headed. Furthermore, guidelines concerning labelling and

[7] For more information on DNA-Microarray, please refer to the following website : http://www.nutrition.tum.de/nutriogenomics/seite3.htm

[8] Official Publication of the European Community, August 20th 2001. « Regulation proposal made by the European parliament and the Commission in regards to the tracing and labelling of genetically modified organisms and the tracing of products manufactured for human or animal consumption and made from

GMO detection will have to be determined before regulations are put into effect. This will facilitate a coordinated approach pertaining to control and inspection and will provide judicial security to operators.

This regulation proposal will be in keeping with that of the European Union, to make sure that domestic markets work properly. This will avoid an implementation by various countries of different tracing systems, which could impede, among others, the quality of information pertaining to the presence of GMOs.

4.1 Standardizing detection methods within the European Union

Along with these new regulation proposals, the Commission recognized that the perfecting and the validation of methods to detect GMOs and products made from GMOs, constitute an important element for the implementation of legislation in European Union countries. There is currently no uniformity pertaining to detection at the European level because there are no methods that are recognized both by public and private operators in France or in Europe. To remedy this situation, the AFNOR (Association française de normalisation) decided to create a standardization commission and outline the future XP V 03-020[9] standard. This standard is on an experimental basis because industries have expressed their need for guidelines as soon as possible. This standard is the first of its kind at the international level. It determines guidelines as well as analysis requirements. The standardization commission brings together researchers from public institutes, technical research centers, private analysis laboratories, seed manufacturers and representatives from public authorities (Direction générale de la consommation, de la concurrence et de la répression des fraudes and the Direction générale de l'alimentation). Are there any representatives from consumer groups in that standardization commission ?

genetically modified organisms, bringing changes to the 2001/18/CE guideline. » (2001/C 304 E/22)COM (2001) 182 *final* – 2001/0180(COD).

[9] XP V 03-020, food products - detection and quantification of genetically modified organisms and by-products.
XP V 03-020-2, idem – Nucleic acid extraction section
XP V 03-020-3, idem – Qualitative PCR section
XP V 03-020-4, idem – Quantitative PCR section
XP V 03-020-5, idem – Protein section (suspended)

The development of a European standard will take about three years, the process having started in February 1999. To fill the void, the AFNOR Commission decided to publish a reference document for France only. The Commission's goal is to produce three other standards based on nucleic acids. A fifth standard based on proteins remains up in the air, because these techniques do not ensure tracing from the field to the plate whereas nucleic acids do.

Europe is currently ahead of Canada pertaining to the question of identification and tracing of genetically modified foods. Although the regulating process isn't quite in effect, many industries already have tracing systems to answer the needs of their customers, competitors and of consumers. In order to facilitate international commercial exchanges (Japan, Australia…) as well as trade with the European market Canada, in the short run, will have to develop detection standards and a regulating system to support a tracing system for genetically modified foods and crops.

5 THE COST OF A GMO TRACING AND IDENTIFICATION SYSTEM

Certain economic studies, done from 1998 to 2000, attempted to evaluate the cost of GMO tracing and segregation, from the farm to the wholesaler. These studies unfortunately do not take into account the cost related to the transformation of foods in the manufacturing sector, or the distribution of these foods to retail businesses. These studies seem to show that the cost of a segregation and identity preserved system can vary from 6 to 9% of what is paid to soya producers, from 6 to 8% for rapeseed, 16 % for corn and 7 to 10% for sunflower oil[10].

Only one study has attempted to estimate the cost of segregation, an identity preserved system and labelling, from the farm to the consumer's plate. This Canadian study, done by the firm KPMG, evaluates the cost at between 35 and 41 % of the price that producers

[10] CEE, Economic Impacts of Genetically Modified Crops on the Agri-food Sector, Directorate-General for Agriculture. (http://europa.eu.int/comm/agriculture/publi/gmo/fullrep/index.htm)

pay and between 9 and 10% of the retail price for these foods. According to this study, the cost of the pre-transformation stages, meaning the cost relating to farms, storage and manipulation of seeds, is estimated at between 24 and 25% of the price paid to producers. This estimate is therefore about double of what is found in other economic studies done between 1998 and 2000 (Golder *et al*, 2000).

To summarize, although it is obvious that the studies agree that a GMO tracing and identification system will necessarily mean additional costs at certain levels of the food production line, it is currently difficult to precisely say what these costs will be. Furthermore, these costs may vary depending on the tolerance level of different regulatory processes. Indeed, compulsory labelling will be more expensive than voluntary labelling. Also, the lower the tolerance levels are in relation to the contamination of a non genetically modified food by genetically modified materials, the higher the cost will be. The increase in costs will be exponential, not linear. To this end, it would be interesting to base their costs on the experience of the Europeans pertaining to GMO identification networks and tracing, for example.

For consumers it also seems difficult to establish how much they will have to pay for a sustained GMO labelling and identification system. According to Egizio Valceschini, economist and head of research at the National Institute for Agricultural Research, since there is less GMO pressure in Europe (no culture, no imports) than in Canada, GMO and non GMO segregation is possible without no additional cost to consumers with a threshold set at between 0,1 and 1% (Guibert et Devilaine, 2002). However, the situation in Canada is a bit different, because the surface area where GMO fields are cultivated is increasing every year. It is therefore more complicated and expensive to separate GMOs and non GMOs and to avoid product contamination. Furthermore, a system would be implemented in Canada, not for security reasons pertaining to food (as it's the case for the identification of allergen substances) but because consumers have demanded it[11]. It

[11] The regulation system in Canada requires mandatory labelling only when certain characteristics of a specific food or product as such have to be divulged to consumers for health risk reasons or in the case of specific nutritional changes. Labelling products because they are genetically modified (the process therefore has to be labelled) does not yet seem to be a sufficient reason (Royal Society of Canada, 2001).

therefore seems inevitable that they will end up paying for sustained labelling, supported by an authentication and identification system. So far, no study has been successful in calculating just how much consumers are willing to pay out of their pockets for traced and labelled products.

6 CONSUMERS AND GMO TRACING IN FOODS

The concept of tracing genetically modified foods is still a bit of a mystery to the public in general. Consumers have heard more about tracing for meat, for public health reasons. Furthermore, tracing is a complex matter that is difficult for the average consumer to understand. Consulting with the population on their vision of a GMO tracing and identification system was a challenge for Option Consommateurs. This is why we recruited people who had a certain amount of training in the field of food and agriculture, or who had a considerable interest in and/or knowledge of the stakes involved concerning GMOs. This angle has to be considered when the thoughts of the people who took part in the discussion goup are analyzed.

Advertisements were sent by e-mail to different Quebec universities and various environmental organizations (please refer to appendix B for the text), and we were able to recruit five (5) men and two (2) women, for a total of seven (7) people. The discussion was held in our offices and lasted for two hours. The group moderator presented the objective of the Option Consommateurs research project. Four (4) open questions were used for the discussion (please refer to appendix B for a list of the questions). The participants were invited to answer these questions.

All the participants agreed that for different reasons, a GMO tracing and detection system is necessary. First of all, they said that this sort of system would strengthen the labelling process, by helping to eliminate false allegations and by confirming the content as well as the history of a product. This way a tracing and detection system, coupled with labelling, would give consumers the choice of purchasing or not products containing GMOs by

confirming that the information which is provided is accurate. Also, a tracing and detection system could be useful for follow-ups, such as epidemiological studies, after GMO products are put on the market. It's important to mention that the consumers who were questioned were relatively worried about the impact that GMO products could have on people's health and on the environment. They perceive GMO labelling as a food security issue. Finally, participants gave another reason why a tracing and detection system should be implemented : imports and exports with Europe, where a tracing system is being gradually put into place. According to the participants, it is necessary for Canada to be in keeping with European standards on the question of tracing.

As far as the infrastructure which would be responsible for GMO detection and tracing in Canada, certain participants noted that this country already partially has the infrastructure capable of supporting such a system and that there is no need to create a new one. In their opinion, the problem is a lack of political will on the part of the different governmental entities. Consumers manifested a certain lack of trust towards governments. For example, they mentioned that the Canadian Food Inspection Agency is too lax pertaining to GMO products. However, according to the participants, it doesn't matter who will implement a GMO detection and tracing system. The important thing is that this sytem be standardized and dependable in the eyes of consumers and that it be able to ensure proper control. On this subject, one of the participants mentioned that the mistake that was made with organic food, i.e. false allegations and poor authentification, should not be repeated.

The question that was the most debated pertained to the cost of a detection and tracing system for genetically modified organisms. Certain participants said they would be willing to pay more for products that are traced and labelled, as is the case with organic foods, if they can have more choices and stay healthy. Other participants reacted sharpely by saying that the industry should bear the cost of this system, since it is after all the industry that imposed GMO foods on the Canadian population in the first place.

Participants unanimously recognized that the current GMO detection methods, that are an important part of a tracing system, are very expensive and cannot be systematically applied and used in the entire food industry. They suggested that the industry should finance research and development projects to help set up less expensive technologies, that are also more precise and faster.

7 THE FOOD INDUSTRY AND GMO TRACING

Option Consommateurs participated in organizing a technological workshop in order to determine the expectations, the needs and the obstacles as perceived by the various contributors along the food industry's production line pertaining to the implementation of a GMO detection and tracing system, and also to evaluate what infrastructure should be responsible for this system. This workshop was entitled: « Detecting GMOs ; developing tracing tools » and was set up in collaboration with the Plant Productiviy Research Network, McGill University and the Centre québécois de valorisation des biotechnologies (CQVB). It was held in Montreal on February 22nd 2002. More specifically, the objectives of this workshop were the following:

- Identify the GMO detection techniques currently available and assess what is being used elsewhere in the world;
- Give an overview of European regulations surrounding the implementation of a GMO tracing system;
- Determine the expectations, the needs and the obstacles as perceived by the different contributors along the food industry's production line, in preview of the implementation of a GMO tracing system;
- Develop a strategy which will enable the implementation of detection standards in regards to GMO tracing.

Many contributors in the food industry (from researchers to consumers, as well as industries) took part in this event (refer to appendix C for a list of participants). The morning was devoted to an overview of detection technology and the state of the

regulatory process in Europe. Two studies on local businesses, *Unibroue* and *Oléanergie* which export products to Europe, were also brought up. The status of European regulations was given by one of the members of the French Commission responsible for the development of French standards in regards to GMO detection, the French being a model of sorts for the rest of Europe. This person also outlined the steps the French are taking to implement detection standards. During the afternoon, workshops took place on the subject of people's expectations towards tracing and its dangers. Participants were divided into small groups of around eight people and could refer to discussion handbooks, which contained the themes and questions that were to be discussed. Participants had about an hour to discuss these questions (please refer to appendix C for the programme and the discussion handbook). A press release highlighting the day's main points was sent to the media after the workshop (refer to appendix C for the text of the press release).

7.1 An assessment of the technological workshop

Genetically modified plants (GMOs) have been a part of our food industry since 1995. Their use in agriculture remains controversial. Many countries, for example in Europe, have implemented (or are doing so) a regulatory process making a controlled use of these biotechnological products for human and animal consumption possible. One of the objectives of this regulatory process is to trace for the presence of GMOs, in food and in the environment.

Canada does not currently have regulations to determine methods and standards for GMO detection. This regulation void, among others, hinders commerce because local businesses can't have their products tested for GMOs before they are exported.

Following the discussion, workshop participants agreed on the following important items:

- The implementation of an identification and tracing network for GMO foods and crops will be necessary to meet the demands of our foreign and local customers, and in the context of any future labelling, whether voluntary or mandatory.

- Our detection methods and the standards surrounding them will have to be in keeping with those of our customers/competitors.

- GMO detection can be done through private or public laboratories, as long as they are accredited.

- The technological infrastructure used in support of the implementation of a tracing and identification system is currently present and the consensus within the industry will open the door to a quick implementation of detection standards.

- The cost of implementing a tracing and identification system can be quantified based on the experience of Europeans. However, the compliance of local consumers remains to be seen.

Tracing is necessary for Canadian exports, in particular exports to European countries, where this sort of system is already put in place. Although individual labelling systems are developed by each country, where different tolerance levels to GMOs can exist, it's necessary for GMO detection standards to be rigorous everywhere, in order to make commercial trade possible.

Contributors agree that the labelling of genetically modified foods, whether voluntary or mandatory, will require the presence of a system to verify the accuracy of these labels. Tracing becomes the documentation which confirms the allegations. This authentication must however be even among commercial partners and requires standardized methods. In fact labelling, without detection methods, will be not be as useful or as credible.

A public network will be responsible for the accreditation of laboratories (private or public) that offer GMO detection services. This accreditation and authentication infrastrucure is already in place in Canada and it will be possible to use the authentication and accreditation system provided by the Bureau des normes du Québec (BNQ) or the Canadian General Standards Board (CGSB) laboratories. The development of standards for GMO detection can also be supervised by protocol established by these organizations. The development of a consensus among industry contributors is a prerequisite to the setting of such standards. This consensus was already present among the participants.

If a network to identify and trace foods and crops containing GMOs is put in place, the demand for GMO detection testing will increase. Those who supply these detection

services are able to meet the demand as long as standards are put in place and a rigorous system for labortory accreditation is implemented. Tests will have to determine quantities and not only the presence or absence of GMOs. Quantitative testing can't currently be done in the field. However, technologies have evolved and this leads us to believe that this kind of method will be taken into consideration in the next few years.

During the workshop it was suggested that public entities should do a study to quantify how much of the cost consumers are ready to bear pertaining to labelling, supported by a detection system. The question of detection costs worries producers, distributors and consumers. The industry is hoping for a detection system to protect its exports. Furthermore, the industry must agree to bear part of the cost.

Finally, the participants noted the apparent absence of will on the part of governments to implement a regulatory process and would like to see government agencies initiate the development of this process with the help of the food industry.

8 CONCLUSION

The tracing of genetically modified foods and crops is a relatively new subject stemming from the debate currently underway in many nations pertaining to labelling of genetically modified foods. In Canada, there is currently no regulating context surrounding the implementation of a tracing and identification network for GMOs. Standards for voluntary labelling are currently being developed and clearly state that this system is being implemented not for security reasons, but to meet the demands of consumers and reassure them on the impacts of GMOs on people's health and on the environment. The subject of GMO tracing does not seem to be a priority yet for the Canadian government. Since the question of GMO tracing is not very present in the current literature and remains a vague concept for most consumers, Option Consommateurs thought it was important to shed some light on the subject, determine the difficulties pertaining to implementation, and question a few consumers and representatives from the industry concerning their vision and their demands in regards to the Canadian infrastructure that would be responsible for the implementation of a tracing and identification system for

GMO foods and crops. The following section discusses the main points that came out of this study.

8.1 Highlights of the study

This section of the report presents the most important points of the analysis done on the question of tracing and identification of genetically modified foods and crops:

Section 2 : Definition and objectives of tracing

- For genetically modified foods and crops, tracing (a qualitative follow up on these foods from the field to the consumers' plate) becomes a way to control the accuracy of the information printed on a label, when a country chooses to label these products. The implementation of tracing for the purposes of accurate information is desirable for consumers and must be built as a tool to increase trust.

- Tracing does not require the implementation of segregation systems (separation of crops: identity preserved) along the line of production or transformation, because they do not exclude the mixing of many GMOs or of GMOs with conventional products. They only provide qualitative information on the make-up of a given product.

- As you move along the food industry's production line, implementing a tracing and identification system for genetically modified foods and crops becomes more and more difficult:
    1. Because there are more contributors who contribute to the process;
    2. Also, the proportion of tranformed products, which incorporate a large number of ingredients from various sources, becomes bigger and bigger.
    3. More and more ingredients and additives are used to manufacture certain types of foods.
    4. Many key contributors from the food industry have to vouch for the source, the history and the "non contamination" of products, meaning farmers, transporters and modifiers.

- Imports can complicate the implementation of a GMO identification and tracing system. It becomes very important to obtain accurate information from the country exporting the product, in order to correctly identify the said product.

Section 3 : Tracing tools

- The implementation and the efficiency of a tracing system relies in great part on the management tools that make use the many possibilities offered by information networks to store, transfer and treat information.

- Analytical detection methods are used to identify foods and crops that contain GMOs. Certain methods already exist, but research is currently underway to develop more sensitive and specific methods that are quantitative, adaptable to newer genes, applicable on a grand scale and inexpensive. This sort of method currently does not exist.

Section 4 : GMO tracing in Europe

- In July 2001, the European Commission passed a regulation proposal that from now on requires that there be a tracing system in the entire food industry, whereby manufacturers have to implement tracing for foods that contain GMOs as well as any by-products. Also, a standardization commission on detection methods, under the jurisdiction of the AFNOR, is currently being set up. Europe is therefore ahead of Canada in regards to the tracing and identification of genetically modified foods and crops.

Section 5 : Cost of a GMO tracing and identification system

- Studies done on this subject don't always yield the same results. However, it's clear that the implementation of tracing and identification systems for genetically modified foods and crops means more costs for the production line. Studies done to this day do not specify what these costs are.

- No study or survey has succeeded in showing how much consumers are willing to pay for a GMO labelling system supported by a tracing and identification system.

Section 6 : Consumers and GMO tracing

- To summarize, consumers who were questioned are in favor of a GMO tracing and detection system. They want a rigorous and standardized system they can trust. They also want the public to be informed if this kind of control system is implemented.

- However, consumers don't completely trust the Canadian government when it comes to this kind of control system and want a change in attitude in regards to GMOs. Indeed, consumers see the government as defending the interests of the biotechnological industry first and foremost.

- As far as how much consumers are willing to pay for a detection and tracing system is concerned, opinions are varied. On one hand, there are those who are willing to pay more for products that are traced and labelled, if it means investing in their health or having more choices. On the other hand there are those who believe that the industry should absorb any additional cost because they are the ones who put GMOs on the market.

Section 7 : The food industry and GMO tracing.

- Consumers want to have a choice between GMO and non GMO foods and the food industry wants to offer them this choice. Therefore, the implementation of a GMO tracing and identification system for foods and crops will be necessary in Canada, first in the context of any future labelling (mandatory or voluntary) and to meet the demands of foreign and domestic clients.

- GMO detection methods already exist and research is currently underway to develop methods that are more specific, sensitive and that are quicker and less expensive. These detection methods and the standards that surround them will have to be even with those of customers and competitors. Canada currently has no regulatory context that determines methods and standards for GMO detection.

- The detection of GMO foods and crops can be done through private or public laboratories, as long as they are accredited by an official organization, such as the BNQ for example.

- The technological infrastructure necessary to support the implementation of a tracing and identification system already exists in Canada and the consensus reached by industry contributors will make possible a quick implementation of detection standards (that can be elaborated under the jurisdiction of the BNQ or the CGSB for example).

- The cost of implementing a tracing and identification system can be quantified based on the experience of Europeans. However, the compliance of local consumers remains to be seen.

- Many participants noted the apparent absence of will on the part of governments to develop and implement a regulatory process in regards to identifying and tracing GMOs in crops and foods. They would like to see government agencies initiate the development of this process with the help of the food industry.

8.2 Recommendations

The important points that resulted from the analysis on the feasibility of implementing in Canada a tracing and identification system for genetically modified foods and crops, lead Option Consommateurs to make certain recommendations:

- Option Consommateurs believes that a system to trace and identify genetically modified foods should be put in place in Canada as soon as possible, in order to support any future labelling of these genetically modified foods, whether voluntary or compulsory. Indeed, such a control system would permit the corroboration of any information found on the labels.

- Option Consommateurs recommends that the tracing and identification system which will be put in place, be developed as a tool to gain the trust of consumers, and be revealed to them through a widespread public education campaign.

- Option Consommateurs recommends that government supported regulations be put in place in Canada, in relation to identifying these trace elements. The government would ensure the implementation of these regulations, with the help of the various entities in the food industry. This regulating context would impose a tracing system on the food industry overall, whereby the different parties involved (farmers, transporters, modifiers) would have to implement a system to trace GMOs and any by- products in all goods.

- Option Consommateurs recommends that any structure that will be put in place to trace and identify genetically modified organisms, be supported by documentation accompanying these products and that these documents as well as any update and safekeeping system of these documents be rigorously managed.

- Option Consommateurs recommends that the standards pertaining to the methods used to detect GMOs be developed to ensure the best quality, rigour and uniformity possible. Such developments should be supervised by consumer, industry and government representatives, under the jurisdiction of an organization such as the Canadian General Standards Board (CGSB) or the Bureau de normalisation du Québec (BNQ), for example. These methods of detection and the standards which support them should be in keeping with those ratified at the international level, as in Europe for example.

- Option Consommateurs recommends that a public network be responsible for accrediting laboratories that do GMO detection. To do this, the network will be able to use the accreditation and authentication infrastructure already in place in Canada, such as the laboratory system of the Bureau des normes du Québec (BNQ) or the Canadian General Standards Board (CGSB), two organizations that are recognized by the Standards Council of Canada (SCC).

- Option Consommateurs recommends that the recognized detection methods used to analyze crops and foods with GMOs be quantity oriented in order to identify the amount of genetically modified materials. The research and development of more sensitive and specific methods, adaptable to newer genes and applicable on a grand scale, quick and inexpensive, should be encouraged and supported.

- Option Consommateurs recommends that the costs necessary to implement a network to trace and identify genetically modified cultures and foods, be quantified with the help of studies based on European experience in this field, among others.

- Option Consommateurs recommends that these studies be done to quantify the costs that consumers are ready to assume, to ensure a sustained labelling through a tracing and identification system of genetically modified foods and crops.

This study has enabled Option Consommateurs to take stock of the situation and to familiarize themselves with the concept of tracing and identification in genetically modified foods and crops in Canada. However, since this is a relatively new subject and since there are no regulations or standards in Canada, Option Consommateurs was unable to evaluate the efficiency of the Canadian control system, but was only able to identify the contributors and organizations that would be able to participate. To follow up on the study on the Canadian infrastructure pertaining to the tracing and identification of genetically modified foods and crops, it would be interesting to document the capacity of this infrastructure and of Canadian public organizations of implementing GMO tracing and identification in foods. However, this kind of study is difficult to do if no strategy is put in place to develop and regulate tracing and standards for GMO detection. The development of this strategy could be initiated by industries, researchers and consumers as long as the Canadian government supports it.

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10 Appendix A : An overview of currently available GMO detection techniques.

The ELISA method (stands for Enzyme-linked Immunosorbent Assay)

This method uses specific antibodies to detect the protein that is produced by a gene that has been introduced (Vollenhofer *et al*., 1999). It is relatively simple and quick. Furthermore, this method can be automated and used in the field. ELISA kits can be used in the field in less than five minutes and are available in certain companies. However, these kits are available only for a limited number of GMOs and are qualitative, meaning that they only indicate the presence or absence of genetically modified material. They don't determine the quantity. ELISA can be used as a quantitative method but this requires the development of specific antibodies for each targeted protein. Furthermore, the ELISA technique doesn't have a high level of detection, i.e. 5% in comparison to 0,1% with the Polymerase Chain Reaction method (PCR) (Gachet *et al*., 1999). Furthermore, proteins are sometimes present only in certain parts of a plant (leaves, broad beans, pollen, stems) whereas the genetic information (DNA) detected with the PCR method is present all over. Therefore, a vast array of products can be tested with the PCR method but not with the ELISA method.

The Polymerase Chain Reaction (PCR)

The PCR method consists in amplifying DNA to make it detectable. Many foods on the market go through important changes, which reduces the levels of protein and DNA, since they are downgraded into very small fragments. To give a brief description, the PCR method consists first of all in extracting a specific DNA sequence from a sample and analyzing it. To do this, the product that is selected for analysis goes through a grinder in order to obtain a homogeneous sample and the latter is then refined so that its DNA may be extracted. Afterwards, with the help of a specific technique, identical DNA fragments are amplified exponentially. The next step consists in detecting this specific DNA fragment. The PCR method is a very sensitive method that uses equipment that is

present in many laboratories. Important precautions have to be taken in these laboratories concerning contamination. To make sure that the analysis is accurate, many control samples (both positive and negative) have to be taken (Gachet *et al.*, 1999). Positive controls help to check the quality of the preparation of the DNA sample that has to be tested. Negative samples help to make sure that the laboratory has not been contaminated with modified DNA. Even when all these precautions are taken, it can be complicated and difficult to extract DNA from certain foods that have been chemically treated or have gone through a heating process. A problem can also occur with detection that is impeded by the presence of inhibitory substances. These problems occurred during a study done by the French publication « 60 millions de consommateurs », which attempted to determine the presence of GMOs in 103 consumer products (Guibert et Devilaine, 2002). However, the PCR method remains a qualitative method that does not determine the quantity of GMOs in a specific food.

The PCR method in real time

This method is very similar to the PCR method. **The difference is that it can determine the quantity of GMOs in a sample**. It is therefore a quantitative method that laboratories with specialized equipment have recently started using. Very few laboratories currently have this sort of equipment. In the United States, *Genetic ID* detects GMOs with this method, which is still very costly.

11 Appendix B : Documents used for the consumer discussion group.

Announcement

Following up on GMOs from the field to the plate

Option consommateurs, a non profit organization dedicated to defending and promoting the interests of consumers, is currently looking for people for a discussion group on the subject of tracing genetically modified foods.

The tracing of raw materials is in fact a qualitative way to verify the presence or the absence of genetically modified organisms in foods, from the field to the consumers' plates. In other words, a tracing system enables to follow up on the spreading and the labelling of genetically modified foods. Any interested party is therefore invited to come and share their knowledge, their expectations and their demands pertaining to identification networks and the tracing of genetically modified foods and crops in Canada.

- Payment: $25/ person.
- Number of people needed: 20
- Number of people per discussion group: 10
- Date of meeting : the week of February 18th 2002

If you are interested, please contact **Marie-France Huot** at the following number:
(514) 598-7288 extension 227.

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Questions asked during the discussion group:

1. In your opinion, should Canada implement a tracing system for genetically modified foods and crops ? Why ?

2. Does Canada already have an infrastructure (public or private) capable of supporting a tracing and identification network for genetically modified foods and crops ?

3. As per your knowledge and your needs, what sort of tracing and identification model would meet your expectations ? (*this model must be applicable and verifiable!*)

4. In your opinion, is it necessary to develop standards surrounding detection methods and to give accreditation to laboratories ?

12 Appendix C : Documents used for the technological workshop that took place on the development of GMO tracing tools.

PRESS RELEASE

A STEP FORWARD FOR THE IMPLEMENTATION OF GMO TRACING

Ste-Anne-de-Bellevue (Quebec), March 1st 2002- A first meeting of its kind, the technological workshop on « GMO detection, the development of tracing tools » held in Montreal on February 22nd 2002, brought together a whole array of contributors from the food industry, who are directly affected by the GMO debate (from researchers to consumers, as well as industrial representatives). This event, organized by the Plant Productivity Research Network (PPRN), in collaboration with McGill University, le Centre québécois de valorisation des biotechnologies (CQVB) and Option consommateurs, aimed at determining the feasibility of a GMO tracing system for foods made from plant-based products and developing a strategy for its implementation, thereby attempting to accelerate the public regulatory process.

The workshop responded to an urgent need, considering that consumers want to have the opportunity of choosing between GMOs or non GMOs, that the food industry wants to offer them this choice and that GMO detection technology exists. The regulatory context that supports the implementation of standards remains to be developed. The day's assessment will help to outline a series of recommendations to that effect for government entities. Approximately sixty participants worked in groups and came to various conclusions. One of those was that a GMO detection system is possible and desirable, and that it should be accompanied by tracing information on foods, from the farm to the table. The government should regulate standards in keeping with international regulations, especially to protect exports in the face of European restrictions on imports, whether labelling is compulsory or voluntary. These standards should be developed with the assistance of consumers and the industry, the contributors having shown their commitment in participating. Spokespeople for concerned companies such as *Unibroue* and *Atlangene* gave a conference before the debate began.

The PPRN, founded by McGill University, is a multidisciplinary and inter-institutional group that specializes in implementing innovative research structures, the CQVB is a transfer and liaison center that promotes the implementation of technological projects by small and medium-sized firms from Quebec in the field of bio-industries, and Option Consommateurs defends the rights and interests of consumers while providing them with information.

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