

Yes indeed, most Americans do eat GMOs every day!

Commentary

While teaching a course on Crop Biotechnology at Huazhong Agricultural University (Wuhan, Hubei Province, China) this past October, I was asked by one of my students if it is true that American farmers grow genetically modified crops (GMOs) only for export, and that GMO-foods are not sold in the USA. The student implied that Americans thought that such crops were “good enough” for developing countries but not good enough for themselves.

AMERICANS HAVE BEEN EATING GMO-FOODS FOR 17 YEARS

Needless to say, I was dumbfounded by this question because Americans have been eating GMO foods since 1996 and I could not imagine where this idea came from. By asking around, I discovered that this information is publicized extensively by TV personalities and on social media. Apparently, several Chinese reporters traveled to the US and enquired in supermarkets whether they sold GMOs, whether people knew that they were eating GMOs and whether they were for or against GMOs in the human food chain. They received variable answers, of course. Some Americans don’t care, many don’t know and some object to eating GMOs. Some opinion polls show that many Americans would like GMO-containing foods to be labeled. However, it is known that people’s answers to questions in opinion polls are highly dependent on how the questions are posed and whether an explanation is given before the question is asked (PEW 2013). According to a 2006 study carried out by the PEW Charitable Trusts, 58% of Americans were unaware that they were eating foods with GMO-derived ingredients. Somehow, the “research” done by the Chinese reporters who came to America was asserted so often and so widely distributed that it became the “urban legend” that Americans do not eat GMOs. As a scientist who has been involved with the GMO issue for 15 years, I can state quite categorically that most Americans eat GMO-derived foods nearly every day! Furthermore, Americans have been eating GMO foods for 17 years, so far with no ill effects as far as we know.

THE GM CROP REVOLUTION STARTED IN THE USA AND SPREAD WORLDWIDE

The GM crop revolution started in the USA although the Belgian geneticist Prof. Marc Van Montagu and his coworkers contributed enormously to the basic research that underlies plant transformation and its application. GM crops are now grown in 28 countries on 170 million hectares, with more than 50% of this area in various developing countries, including China (James 2011). In the USA, the GMO adoption rate for soybeans is 95% and for maize it is 75% (USDA 2013). These crops usually contain two different transgenes, one for insect

resistance and one for herbicide tolerance. It is likely that in the future GM crops will contain more than two transgenes (Ow 2011).

The importance of GMO crops to help improve global food security was emphasized by the award for the World Food Prize to three scientists whose research was seminal to this aspect of crop improvement: Drs. Rob Fraley, Mary-Dell Chilton and Marc Van Montagu. Even in the European Union, where governments have been very reluctant to approve GMO crops, such crops are now grown in 5 different countries. The adoption rate for maize in Spain was 30% in 2012 (ISAAA 2012). There is a growing understanding that GMOs with insect-resistance genes reduce the need for pesticides and that this improves the health of farmers, especially in countries where pesticides are still applied with hand-held sprayers.

FOODS FROM GM CROPS ARE JUST AS HEALTHY AS FOOD FROM TRADITIONAL CROPS, BUT IN THE USA THEY ARE NOT LABELED

If grocery store workers in the USA are unaware that GMO foods are sold in their stores, it is because such foods are not specifically labeled. In America, the Food and Drug Administration has the authority over food labeling and it has concluded that there is no scientific evidence to support the idea that GMO foods pose any greater risk to human health than conventional foods. This point of view is supported by the World Health Organization, and national medical or health organizations, by scientific academies and by the scientific community at large all over the world. It is important to note that all GMO crops have passed scrutiny by certification boards that examine their health effects, in all countries! No GMO crop has ever been turned down for health safety reasons (In some cases, research was halted voluntarily by the company because it was realized that the gene that was being transferred to a food crop came from a food plant known to elicit allergic reactions in people; however, these GMOs never reached the stage where government approval was requested).

The knowledge that GMOs do not pose health risks is the reason that GMO foods are not labeled in America, although many countries have a labeling requirement. However, companies are allowed to voluntarily label foods and some foods are labeled as “Does not contain GM ingredients” or “GMO free”. To be sure that such statements are correct, we will need to develop standardized procedures to detect genes or proteins of GM crops (Zhang and Guo 2011). This may not be easy because many food products may not contain any proteins produced by the transgenes or any DNA.

Voluntarily labeling according to the method of production or processing is widespread in America. For example, some foods are labeled as “kosher”, “halal”, “organic”, “free of

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gluten”, “free of lactose” or in some other way to appeal to certain customers who have dietary requirements. These labels are intended to capture certain market. People who believe the (mis)information put out by certain organizations about GMO foods will look for the label “GMO free”. Labels are meant to give the customer neutral information, but because of the fear-mongering that has been done by certain organizations, the public sees GMO labels as “warnings” rather than simply as “information”. Organizations opposed to GMO crops and foods suggest that labels will give consumers a choice. This is true in theory, but experience in Europe shows that as soon as stores start selling GMO foods, demonstrators show up trying to dissuade shoppers from patronizing such stores.

SOME PAPERS PURPORT TO SHOW THAT THERE ARE HEALTH RISKS FROM GMOS

Occasionally, papers appear in the peer reviewed scientific literature to purport GMO foods are not safe for human health. The news media, the bloggers and organizations opposed to GMOs seize on these occasional papers and publicize them widely. However, scientific research is a self-correcting human enterprise, which means that published papers are subject to scrutiny by many scientists who may try to repeat the results. Unfortunately, when retractions or corrections are published in scientific journals, the news media, bloggers and anti-GMO organizations are usually silent. But scientists take note. Two recent cases illustrate this point.

In 2012, Séralini and his coworkers presented data from which they concluded that the herbicide glyphosate and maize that is resistant to glyphosate (Monsanto’s Roundup-Ready maize) causes cancer in rats. The paper was published in *Food and Chemical Toxicology* (Séralini et al. 2012) and was seized upon immediately by TV personalities, newspaper reporters and anti-GMO organizations as proof that GM-derived foods are dangerous. Scientists who read the paper were appalled by its poor quality and the journal editor received numerous letters detailing the deficiencies of the paper. Four months later, the journal published a retraction and letters from prominent scientists detailing the weaknesses of the paper.

A finding unrelated to GMOs, but raising the possibility that plant nucleic acids when ingested by humans could regulate human genes, was published recently (Zhang et al. 2012a). A Chinese research group of 28 scientists from Nanjing University found specific microRNAs of plant (rice) origin in mouse and human serum and plasma. These microRNAs target important human genes and could regulate their expression. As it has been shown that nucleic acids are readily digested by intestinal enzymes, this conclusion appeared somewhat unusual. In addition, a recent survey (Zhang et al. 2012b) of a large number of studies that examined datasets of small RNAs found in mammals did not show the presence of any plant microRNAs. A feeding study carried out by Dickinson and collaborators with mice that tried to repeat the Zhang et al. data failed to do so (Dickinson et al. 2012). This is how science is supposed to work if indeed it is self-correcting. Will the newspaper reporters, the blogosphere and the social media take note of these follow-up papers? Probably not.

MOST FOODS IN US STORES CONTAIN SOME GMO INGREDIENTS

So, where in American grocery stores and supermarkets are the GMO foods? First, we have to remember that there are only four GM food crops that are widely grown and may be consumed as food: soybeans, maize (corn), canola (oilseed rape) and sugar beets. There are no GM fruits or vegetables on the market, except the Rainbow variety of papayas grown in Hawaii and some squash varieties. Recently, the Canadian company Okanagan Specialty Fruits asked for approval from the USA and Canadian governments for its non-browning GM apples. Thus, in the section of the grocery store of fruits and vegetables, there are essentially no GMO foods. The situation is quite different in the section of the store that has packaged foods. Maize starch, soybean protein and the oil from canola, maize and soybean are all widely used in packaged foods and in soft drinks. Maize-derived high fructose syrup is now the main sweetener in America and Americans like everything sweetened! So soft drinks and many baked goods (cookies, cakes, breads, etc.) have GM corn derived sugar. Soy protein is used extensively to make sauces, as is maize starch, and such sauces are present in many frozen prepared foods. Oils from canola, maize and soybean are of course sold for frying, and are used to make margarine or consumed as salad dressing. Altogether, about 70% of all the items in the grocery store that are packaged, bottled or frozen have some GM ingredients. The proportion of GM ingredient may vary from less than 1% to 100% depending on the product.

So, Americans eat the GM crops that they grow, but do they also export them? Certainly, but GM and non-GM may in some cases be mixed in the process of collecting grain from the farm transporting it and shipping it. Every year China imports 60 million tons of soybeans and about one third of this comes from the USA. Soybean sales to China represents 22% of the annual US production. China is the USA’s number one soybean buyer. The USA also exports GM maize—about 15% of its total production—with Japan, Mexico and South Korea as the main trading partners. Although Japan does not grow GMO crops, it buys GMO maize for processing into food products (see Bloomberg.com for details). The major reason why Japan buys GMO maize appears to be the price differential between GMO maize and non-GMO maize. GMO maize which generally has a special (trans) gene for insect resistance and one for herbicide tolerance is cheaper to produce than conventional maize. Thus, most of the GM crops grown in the USA are used in the USA for human food and animal feed, but a fair proportion of the production is exported to other countries.

WHY ARE THERE SO FEW GM CROPS ON THE MARKET?

Why have companies or government laboratories not made other GM crops? Why is there no GM wheat, potatoes, strawberries or lettuce? GM crops other than the few that are now sold (mainly canola, soybeans and maize) have been made but their introduction may be on hold for several reasons. The costs for doing all of the R&D to create a GM crop and the costs for testing it for safety are very high. So high in fact, that companies will only do this kind of work if they can be sure to recover their investment. In other words, if the crop has

a large market and if it has a problem that can only be solved by GM technology. This eliminates many fruits and vegetables from being considered for improvement by biotechnology. Some major crops do have problems that can only be solved by GM technology or could be improved by GM technology, but market forces may prevent their introduction. For example, in the USA, the fast-food restaurants (McDonalds, KFC, Burger King, Jack in the Box etc.) sell huge quantities of French fries and are the principal purchasers of potatoes. Monsanto created a GM potato that was resistant to the Colorado potato beetle. It was briefly successful and grown annually on more than 20,000 hectares. However, after one of the fast food companies announced that it would not use GM potatoes, the others had no choice but to follow, as they did not want to lose even a small percent of their customers. The result was that Monsanto withdrew its successful GM potatoes from the market. Similarly, potatoes have been engineered to be resistant to late blight caused by *Phytophthora infestans*, but have not been introduced to market yet. As a result, farmers continue to spray pesticides against this devastating disease.

Creating a GM crop is not particularly difficult, although after the first transformed plants are produced, a lot of breeding work has to be done to develop varieties for the different regions of a country. What is expensive is to do the safety tests that all national governments require. Developing countries can easily create their own GM crops. Indeed, India created insect resistant eggplant (brinjal) (Choudhary and Gaur 2008) and China created insect-resistant (Bt) rice (Ye et al. 2008 and references therein). Unfortunately, the governments of these two countries seem to lack the political will to go ahead with commercialization, thereby depriving their citizens and farmers of the clear benefits of GM technology. The benefits for both big and small farmers have been documented in several studies.

OPPOSITION TO GM CROPS

Opposition to GMOs is basically an economic issue, not a health or environmental issue. Organizations that promote organic agriculture want to increase their market share at the expense of traditional farmers. Stores that sell primarily organic produce make a point of telling their customers that they do not sell products with GMO ingredients with the goal of attracting more customers. "Green" organizations prosper by scaring people without really explaining why they should be scared. This will increase the donations that keep these organizations alive. These organizations never use their resources to back up their claims with scientific data. TV personalities and bloggers want to increase their popularity and seize on popular issues without spending any time to tell the other side of the story. Popular TV personalities command better time slots and better salaries. Newspapers can't bore

their readers with scientific details and will sell more copies if they are slightly sensational and follow the lead of others who are "in the news".

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