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The European Food Safety Authority: Using double standards when assessing feeding studies

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Opinions of the authority show a bias in the scientific standards applied to risk assessments of genetically engineered plants

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Content

Summary

Recently published research on chronic (long term) animal feeding trials using genetically engineered maize (NK603) and the herbicide Roundup has been harshly criticised by the European Food Safety Authority (EFSA 2012). The research was led by French Professor Gilles-Eric Séralini of Caen University (Séralini et al. 2012) and although it was published in the peer-reviewed journal *Food and Chemical Toxicology*, the results were criticised by EFSA for not meeting specific scientific standards such as for example set out by the OECD (EFSA 2012a).

However, detailed analysis of former EFSA opinions shows that the authority has not taken a consistent approach when examining such scientific research. On a number of past occasions, EFSA has accepted without question the results from publications, on the risk assessment of genetically engineered plants, that are not in accordance with the scientific standards now being applied by EFSA to criticise the French study. Unlike Séralini et al. (2012), these earlier studies did not conclude that there were any health impacts from eating genetically engineered plants. This inconsistency suggests that EFSA is ‘picking and choosing’ when to apply the scientific standards.

There also is evidence that the food safety authorities of EU Member States are using similar double

standards. For example, the Netherlands Food Safety Authority (NWVA, 2012) referred to a review paper by Snell et al. (2011) in order to refute the findings of Séralini et al. (2012). The review covered 12 chronic feeding studies using genetically engineered plants, and concluded that they did not show any health risks. But an analysis of the studies included in Snell's review shows that none of them met the same scientific standards that are now being applied by NWVA and EFSA to criticise Séralini et al. (2012).

In some respects, the standards used by Séralini et al. (2012) appear to be higher than those of the studies being used by EFSA and NWVA to refute his findings. Séralini's research seems to be the most comprehensive long term health study on genetically engineered plants to date. Also the French national food safety authorities (ANSES, 2012) – despite their criticism - have noted that the range of criteria examined was far wider than other long term studies.

Furthermore, the German authorities (BfR, 2012) have pointed out that this research is the only long term study anywhere in the world to assess the health risks of the herbicide formula Roundup. The response to the findings of Séralini et al. should be new experimentation, rather than ad hoc refutations founded in assumption-based reasoning.

By failing to challenge the scientific standard of studies which do not show adverse health effects from genetically engineered crops, while at the same time attacking studies that indicate evidence of harm, European Union authorities such as EFSA are applying double standards and follow a biased approach. The authorities seem to be influenced by the presumption that genetically engineered plants should be regarded as safe and seem to be using the debate on scientific standards to defend their own opinions.

In view of the findings of Séralini et al (2012), the burden of proof should be shifted back to industry. Genetically engineered maize NK603 and the Herbicide Roundup maize cannot be regarded as being safe, so long as their safety is not proven by further investigations.

Further, in view of the debate arising from Séralini et al. (2012), the standards used in recent years for the risk assessment of genetically engineered plants and pesticides should be revised and reshaped, in order to achieve a higher level of protection for consumers and the environment. In addition, independent risk research should be promoted by EU research programs with a much higher priority.

Introduction

The European Food Safety Authority (EFSA) conducts the risk evaluation of products relating to food safety, including genetically engineered plants using data supplied by the developer's risk assessment. Testbiotech has been analysing the opinions published by EFSA for several years, particularly those relating to genetically engineered plants. We have also analysed the standards of the dossiers prepared by biotech companies in support of their applications for European approval of genetically engineered foods, and whether these dossiers were accepted or not by EFSA. For example, in the case of the market application of Monsanto´s stacked soybean "Intacta" MON87701 x MON89788, we published a detailed analysis (Testbiotech 2012). We have highlighted that research in several of the dossiers forwarded by biotech companies, and accepted by EFSA, does not meet even the very basic scientific standards known as "Good Laboratory Practice" (GLP). In many cases, the data were prepared by the biotech companies and were not subject to any independent quality control.

We have argued that EFSA should not accept this kind of “grey” research coming from industry. Accepting such dossiers leaves too much room for the applicant to escape any sound risk assessment because it allows them to present data that is neither robust, nor reviewed according to usual scientific standards.

On the other hand, there are some circumstances in which a study may be valuable, even if it does not meet all international standards. An interesting example to this case, and one which also involves EFSA, is the controversy surrounding bisphenol-A and its presence in infant feeding bottles. Several independent investigations showed negative health impacts of bisphenol-A, but EFSA claimed that these studies did not meet its scientific standards. In contrast, studies from industry complied with EFSA´s standards but did not show any adverse effects. In this instance, the debate resulted in an interesting decision by the European Commission. In 2010, it decided to ban bisphenol-A from infant feeding bottles (Noorden, 2010) despite EFSA continuing to state that it had not seen sufficient evidence of health impacts to support such a ban.

The case of Bisphenol-A highlights the real limits of EFSA’s remit. The European Food Safety Authority is only the risk assessor. According to the EU regulations, the European Commission is the risk manager and is therefore responsible for taking the final decision on measures affecting market authorisation. When making such decisions, the Commission must observe the precautionary principle, as set out in EU food safety regulation 178/2002. However, the Commission very rarely makes use of its political power, and has been led by EFSA in nearly all other controversial cases.

Following cases such as bisphenol-A, and our experience of EFSA’s approach to applications for the approval of genetically engineered plants, we have become concerned about EFSA’s current practice. With this in mind, we decided to examine how the standards applied by EFSA (2012 a) to the work of Séralini et al. (2012) compared with those applied by EFSA to other feeding studies.

Several types of animal feeding studies are used to assess potential health risks from eating genetically engineered plants. Acute (short term) toxicity tests look for immediate or extreme health impacts. Sub-chronic toxicological studies (90 days) look at health effects over a slightly longer period. Chronic (long term) feeding studies look for general toxicity or carcinogenicity (whether the genetically engineered plant could increase cancer rates). These tests typically last one or two years. In some cases, generational studies are provided, in which successive generations of test animals are studied. In most cases, rats or mice are used for these health studies.

As well as these, studies designed to investigate the nutritional properties of genetically engineered plants may also be conducted. These studies usually last for 42 days with poultry, although pigs, cattle or fish are sometimes used. These nutritional studies are not designed to provide evidence of toxicological effects or specific health impacts. This makes them unsuitable as substitutes for health studies and therefore they should be assessed by different criteria than health studies.

Given the controversy around Séralini et al. (2012), we were interested in the standards that were required of sub-chronic toxicological studies and chronic feeding studies that have been accepted by EFSA. In order to make a fair comparison, we looked at criteria that are important for assessing scientific standards and are easy to compare, such as:

- the number of animals used per test group,
- the number of test groups used in the experiment,
- duration of the experiment,

- identification of the test material (for example, which genetically engineered plant was tested, and which pesticide formulation was used on the test material),
- use of appropriate materials as experimental controls (for example, plants that have the same genetic background as the genetically engineered plant, referred to as the isogenic line).

Overview on research by Séralini et al. and some reactions

On 19 September 2012, researchers from the University of Caen and the University of Verona, led by Professor Séralini, published a paper in the peer-reviewed journal *Food and Chemical Toxicology* (Séralini et al. 2012). The paper described a 2-year feeding study using rats, and investigated the health effects of genetically engineered maize NK603, as well as maize NK603 treated with Roundup (a formulation of the herbicide glyphosate), and Roundup on its own. The researchers reported that female rats fed with maize NK603 or exposed to Roundup suffered from tumours at higher rates than controls, and significantly earlier in the experiment. The results also showed impacts on liver and kidney function for male rats.

On 26th September 2012, the European Commission's health and consumer affairs Directorate (DG Sanco) asked the European Food Safety Authority to review the study. On 28th September, a telephone conference took place between EFSA, the Netherlands Food Safety Authority (NVWA), the German Federal Institute for Risk Assessment (BfR), the French Agency for Food, Environmental and Occupational Health & Safety(ANSES) and the French Haut Conseil des Biotechnologies (HCB) and the Belgian Scientific Institute of Public Health (WIV-ISP). These authorities agreed a strategy on how to assess the study by Séralini and colleagues.

The protocol drawn up by the group (NVWA, 2012) concluded that EFSA and the authorities of the Member States "share the same concerns about the publication of Séralini et al. on reporting and clarity, statistical analysis, sampling size, animal strain etc." This was despite experts from Member States such as Belgium and France were stating at the time that they had not yet been able to reach final conclusions about the study (NVWA, 2012).

On 1st October, both the Netherlands Food Safety Authority (NVWA, 2012) and the German Federal Institute for Risk Assessment (BfR, 2012) published official opinions on Séralini et al., 2012. On 4th October, EFSA published its first statement (EFSA, 2012), and on 19th of October the French authorities published their statements (ANSES, 2012). EFSA announced that a final opinion would be published at the end of October 2012.

EFSA´s criticisms of the research

In its initial response, EFSA listed a number of criticisms of the research, relating to the design of the experiment, the statistical analysis used, and also that not all the results had been published. Similar issues were raised by some of the national authorities (see BfR, 2012; NVWA 2012). At the time of writing, issues relating to the publication of full research results are a matter of continuing dispute, but Professor Séralini has announced further detailed results will be published.

It is likely that the debate about the statistical methods chosen by the researchers will also continue, because Séralini et al (2012) deliberately chose a statistical method different from the models used by the biotech industry. The French researchers are of the opinion that the methods currently used are not adequate, while other experts doubt the validity of the method applied in the paper by Séralini et al. (2012).

However, the European Food Safety Authority focussed its criticism on the design of the feeding trials. In particular, EFSA (2012 a) stated that:

> "Séralini et al. (2012) did not follow the internationally accepted protocols for sub-chronic, chronic toxicity and carcinogenicity studies (e.g. OECD 408, OECD 451, OECD 452 and OECD 453) currently recommended in the EU for food and feed safety assessment. (…)
>
> The strain of rats chosen is known to be prone to development of tumours over their life (…) By conducting the experiment on this strain of rats over two years, which is approximately their life expectancy, the observed frequency of tumours is influenced by the natural occurrence of tumours typical of this strain, regardless of any treatment. This is neither taken into account nor discussed in the Séralini et al. (2012) publication.
>
> The study design includes only one control group which is not suitable to serve as control for all the treatment groups. (...)"
>
> Séralini et al. (2012) draw conclusions on carcinogenicity by reporting on the incidence of tumours based on 10 rats per treatment per sex. There is a high probability that the Séralini et al. (2012) findings in relation to the tumour incidence are due to chance, given the low number of animals and the spontaneous occurrence of tumours in Sprague-Dawley rats. (…)"

Two different issues are combined in EFSA´s statement (2012a). The first issue is the researchers' adherence to international standards, as set out in OECD Guidelines. This includes the number of animals chosen and the number of groups used in the experiment. There is no doubt that the standards required by OECD Guidelines were not completely met in the study by Séralini et al. In particular, the study only used ten animals per test group.

An overview on some of the standards is provided in table 1. It should be recognised that the OECD standards were not developed for testing genetically engineered plants, but for the testing of chemicals. How these standards are applied by EFSA to animal feeding studies for the testing of genetically engineered plants is discussed later on in this briefing.

Table 1: Overview of OECD Guidelines for relevant animal feeding studies (source: http://www.oecd-ilibrary.org/environment/oecd-guidelines-for-the-testing-of-chemicals-section-4-health-effects_20745788)

Number of the Guidelines	Title	Duration	Number of animals/ sex / group
408	Repeated Dose 90-day Oral Toxicity Study in Rodents (also called sub-chronic feeding studies)	90 days	10
451	Carcinogenicity Studies	24 months	50
452	Chronic Toxicity Studies	12 months	20
453	Combined Chronic Toxicity\ Carcinogenicity Studies	24 months	50

The other issue concerns the strain of rats used in the experiment. In brief, we consider EFSA´s statement on this issue to be misleading, particularly the assertion that the spontaneous occurrence of tumours in these rats was “neither taken into account nor discussed in the Séralini et al. (2012) publication.” Seralini et al demonstrate *two* different findings, both an increase in the number of tumours and an earlier onset of tumours in rats fed on the GE plant or the herbicide. Thus the researchers did not just measure the number of tumours over the lifetime of the rats. Further to support their conclusions, Séralini et al. (2012) compared their results to tumour rates in other published studies using this strain of rat. So they do appear to have been aware of the issue, and to have taken it into account.

EFSA´s assessment of subchronic feeding studies

EFSA does not request sub-chronic or chronic toxicological feeding studies when assessing the health risks of genetically engineered plants. But in many cases, results from sub-chronic feeding studies are voluntarily provided by product developers. Séralini et al. (2012) set out in their research to test the value of 90 day sub-chronic feeding trials. Thus they designed their experiment to conform with OECD guideline 408 for 90 day trials, but then extended the length of the test to examine further health impacts which became apparent towards the end of the 90 days period. The researchers used ten animals per group, which is in accordance with OECD Guidelines 408 for sub-chronic feeding studies.

We are not aware of sub-chronic toxicological feeding studies having been accepted by EFSA with fewer than 10 animals in each test group, as required by OECD (OECD Guideline 408), thus in regard of number of animals, the OECD criteria seem to be fulfilled. However the OECD Guidelines also request at least three dose levels. In other words, genetically engineered plant material should be included in the feed of test animals at low, medium or high concentrations. This allows the study to establish if there is a relationship between the dose and any observed health effect. Séralini and colleagues did use three different dose levels in their study. In contrast, and despite OECD guidelines, EFSA routinely accepts 90 days studies with only two dose levels of genetically engineered plants in the animal feed. Indeed, when EFSA originally assessed the safety of NK603 maize, the 90 day feeding study submitted by Monsanto used only two dose levels of the genetically engineered maize (Hammond et al. 2004).

So 90 day feeding studies submitted to EFSA by product development companies do not routinely meet OECD guidelines, and yet the results are accepted by EFSA.

The design of sub-chronic feeding studies that have been accepted by EFSA have also not been in accordance with OECD standards in respect of the numbers of test groups used in the trials. In most cases, biotech companies use many more groups for comparison than is required by the OECD guidelines. The OECD Guideline 408 proposes only one group for comparison and a smaller additional (“satellite”) group for ensuring quality standards, containing only five animals. Monsanto’s feed trials for NK603 maize (Hammond et al. 2004) used ten groups (per sex) but only two of these groups were fed with the genetically engineered maize NK603. All other groups, fed with various maize varieties (not just the isogenic line), were used for comparison and for additional references. Overall, 80 animals were fed with genetically engineered maize, but their data was compared against that from 320 animals from the reference and control groups. As a result, the statistical noise stemming from the additional reference groups threatens to cause a bias in the interpretation of the data, hiding relevant biological effects and significant differences.

90 day feeding studies, such as that by Hammond et al. (2004), follow standards set by industry. Although the OECD guidelines were not adhered to in these studies, the results were accepted by EFSA. Having accepted several industry-sponsored feeding studies using these standards, including those for genetically engineered maize MON810 and MON863, EFSA published its own guidance on 90 day feeding studies for whole food and feed (EFSA 2011). The standards in EFSA's guidance show little difference to those established by product developers which have a vested interest in the outcome of the risk assessment. In effect, the industry standards were adopted as the official standards of EFSA, with the explanation that OECD standard 408 was not adequate for this type of investigation.

So, the experimental designs used for 90 days feeding studies that are accepted by EFSA are not in compliance with the OECD standards. As a consequence, the findings and the methodology of these 90 day feeding studies have been a matter of controversial debate for years (see for example Spiroux et al., 2009).

In conclusion, EFSA does not apply OECD standards to sub-chronic, 90 day feeding studies when these are prepared by industry and do not show health effects from consuming genetically engineered foods. In contrast, the OECD standards have been used by EFSA to attack the research of Séralini et al., 2012.

EFSA´s assessment of chronic and generational feeding studies

One major problem with chronic and generational feeding studies is that very few have so far been conducted using plants that are actually authorised in the EU and assessed by EFSA.

A quite comprehensive (but in its conclusions scientifically flawed) overview by Snell et al. (2011) lists 12 chronic studies and 12 generational studies with genetically engineered plants. But looking at the genetic alterations (called events) that currently have market authorisations in the EU for food and feed (47 events), only three are included in the review by Snell: Bt11, MON810 and Soybean 40-3-2, known as Roundup Ready soybean.

The review by Snell has been used by EFSA to support its position that there are no safety concerns about the genetically engineered plants it has already assessed. Monsanto has included Snell's review in dossiers it has forwarded to EU authorities. And the review by Snell was used by national authorities, such as the Netherlands NVWA, in their response to Séralini et al's. research findings.

Nine feeding studies reviewed by Snell et al. used glyphosate tolerant soybeans such as known as Roundup Ready crops. Five of these studies (conducted by a group of Italian researchers) showed signals of negative health impacts.

Interestingly, out of the studies included in Snell's review, it is those reporting possible negative health impacts that have been criticized and rejected by EFSA on the grounds of problems with the methods used (EFSA 2010). In contrast, studies that did not show any adverse health effects have been accepted by EFSA. At least four of the feeding studies highlighted by Snell et al. were assessed by EFSA during their risk assessments of genetically engineered plants. These studies were accepted without any criticism, even when there appeared to be flaws in their design and execution:

Examples 1 and 2:
In its opinion regarding the renewal of the food and feed authorisation for Monsanto's soybean 40-3-2, EFSA (EFSA, 2010) makes reference to two studies by Sakamoto et al. (2007 and 2008):

> "In the 2-year study, the histopathological investigations did not reveal an increase in the incidence, nor in any specific type of non-neoplastic or neoplastic lesions in the GM soybean-exposed group of both sexes. The investigators concluded that the long-term effects of soybean 40-3-2 are not different than the long-term effects of non-GM soybeans."

In the 2008 study (duration: 104 weeks), 50 animals were used in the test and control group. This is in accordance with OECD standards.
But in the 2007 study (duration: 52 weeks) only ten animals per group were used. This in contradiction of OECD Guidelines 452 for chronic feeding studies, which request at least 20 animals per group. EFSA made no mention of this non-compliance with Guidelines.

Neither the 2007 nor the 2008 study used three dose levels in the experimental diets, contrary to OECD Guidelines. Both studies in fact only used one dose level of genetically engineered plants in the feed. Thus the total number of test groups used in these studies does not comply with OECD Guidelines 452 and 453. EFSA made no mention of this non-compliance with Guidelines.

Furthermore, it is stated that the plant material used in the feeding trials was treated with glyphosate, but no details were given, either of the dose at which it was applied, or which mixture of the herbicide was used.

It is evident that these two studies do not meet OECD standards and do not report their methods to the standard that EFSA has expected of Seralini et al.. Nevertheless these studies, which do not show health impacts, were accepted by EFSA without any criticism.

Example 3:
When discussing Monsanto's soybean 40-30-2, EFSA (2010) referred to a study by Brake & Evenson (2004) describing long term feeding experiments with mice, which included monitoring the next generation:

> "The investigators concluded that diets containing soybean 40-3-2 had no negative effect on foetal, postnatal, pubertal or adult testicular development."

In this experiment, four generations of mice were fed with genetically engineered soybeans. Eighteen male animals from the second generation of mice were taken out of the ongoing experiment for further investigation. These animals were divided into groups of three, and the groups of mice were successively killed and examined after 8, 16, 26, 32, 63 and 87 days. A similar investigation was conducted on 18 male mice from the fourth generation, with the groups of mice being killed and examined after 8, 16, 26, 32 and 63 days.

So, overall the number of animals investigated from each group was less than 20, and only 3 examined animals from the second generation were allowed to live to 87 days, and none from the fourth generation. No data is provided about the health of the animals in the experiment that were not sacrificed in this way, only that the litter size of animals fed genetically engineered material was no different to those fed the control diet.

Furthermore, only one dose level of genetically engineered plant material was used, only male mice were investigated, and the control group of animals was not fed the isogenic line, which is the most relevant material for comparison.

In regard to glyphosate, this study has the same deficiencies as in the studies discussed above (Sakamoto et al., 2008 and 2007), as it did not provide details of what dosage of the herbicide was applied, nor the mixture that was used.

In conclusion, this study also did not meet the standards now being invoked by EFSA to criticize Séralini et al., (2012) because it did not meet OECD guidelines 416 and 422. Nevertheless this study, which does not show health impacts, was accepted by EFSA without any criticism.

Example 4:
In its opinion on Greece's national prohibition of the cultivation of genetically engineered maize MON810, EFSA (EFSA 2012b) refers to research by Steinke et al. (2010):

> "The study of Steinke et al. (2010) reported on the performance of lactating dairy cows in a long-term feeding study with maize MON 810. Two groups, each with eighteen cows, were fed with diets containing 71% of whole-crop silage, kernels and whole-crop cobs from maize MON 810 or its conventional counterpart. (…) The study ran over 25 months and included two consecutive lactations. (…) The long-term study showed that there were no consistent effects of feeding dairy cows maize MON 810 or its conventional counterpart on milk composition or body conditions."

In this study, two groups of cows with fewer than 20 animals were fed over a period of 25 months with genetically engineered maize MON810 (only one dose level). During the investigations, half of the animals were exchanged in each group without giving detailed reasoning. Without a detailed justification for the exchange of animals, it is impossible to validate the study. As it stands, the whole study is of no value to a regulator making a safety determination.

This study also does not meet the standards now being used by EFSA to criticize the work of Séralini et al., (2012).

Assessment of feeding studies by other institutions

Some national authorities, such as the Netherlands Food Safety Authority (NWVA 2012), are also relying on studies which are highly questionable. In their opinion on Séralini et al. (2012) the NVWA also refers to the review by Snell et al. (2011). In this case they stated that Séralini's research findings are in contradiction of previous feeding studies. According to NWVA (2012), the study by Séralini et al (2012)

> "(....) is also not a cogent argument to undermine the conclusions for instance from the study from Snell et al. (...)"

Monsanto also makes use of the review by Snell et al. in a report presented to EU authorities about MON810 maize (Monsanto 2012) as further evidence for safety of its product:

> "The publication of Snell et al. (2011) summarised 12 long-term and 12 multi-generation

studies looking at the effects of diets containing GM maize, potato, soybean, rice or triticale on animal health. Results from the studies did not suggest any health hazards. A number of statistically significant differences were observed in measured parameters but these fell within the normal variation ranges and were considered to have no biological significance."

But reading the review by Snell et al. more carefully, it becomes evident that none of the studies included meet OECD standards for chronic toxicity or carcinogenicity studies (OECD Guidelines 451, 452, 453). Deficiencies include:

- too few animals per test group,
- too few groups for comparison,
- insufficient details on the tested material and not using the correct comparison materials in control groups.
- in several trials animal species are used that are not common for investigations of health risks.

Several of the studies as listed by Snell et al (2011) are even not meant to be toxicological studies - they are nutritional studies, so few conclusions can be drawn on health risks. Thus on the basis of Snell et al (2011) - which also includes many inaccuracies about the feeding studies reviewed – we do not believe it is appropriate to conclude that genetically engineered plants do not need to be subjected to chronic or generational feeding studies.

Discussion

On the basis of the studies discussed in this briefing, we believe that none of them describing chronic feeding studies with genetically engineered plants have met the standards being used by EFSA to criticize the research of Séralini et al., 2012. The comparison with the studies reviewed by Snell et al. (2011) shows that Séralini's research was conducted using comparatively higher scientific standards (see table 2).

Table 2: Selected criteria of some feeding studies with genetically engineered plants that have been accepted by EFSA, in comparison with Séralini et al., 2012.

Publication	Duration of the study	Number of animals per test group	Number of dose levels	Usage of isogenic lines for comparison	Identification of test material
Sakamoto et al., 2007	One year	10	1	Yes	No identification of the specific glyphosate mixture applied to the plants
Sakamoto et al, 2008	Two years	50	1	yes	As above
Brake & Evenson (2004)	Four generations, but animals used for analysis were killed before the age of 90 days	18, but divided into smaller groups of 3 animals each. Only male animals were investigated	1	No	As above
Hammond et al. (2004)	90 days	20	2	yes	As above
Steinke et al. (2010)	Two years	9 (it started with 18, but half of the animals were exchanged)	1	yes	Not relevant
Séralini et al. (2012)	Two years	10	3	yes	The specific glyphosate mixture is identified

In this context, it also should be recognised that the OECD Guidelines are not based on a process that can be considered independent from vested interests. For example, the International Life Sciences Institute (ILSI) is mentioned as a source in the OECD Guidelines. ILSI is an institution funded by the food and biotechnology industries. Beyond this, there is a wider issue of whether feeding studies, even if in compliance with the standards of the OECD, are adequate to assess health risks of genetically engineered plants. That is why according to the EU Commission (2012), the current standards will be reviewed within the next few years:

> "The requirements regarding animal feeding trials in the context of GMO risk assessments should be reviewed in the light of the outcome of this project expected to be available by the end of 2015 at the latest."

In comparison to other studies, Séralini and colleagues used the most comprehensive criteria to assess health impacts, including a high number of samples and measurement of hormone levels (for more details see Séralini et al,. 2012, table 1). The French food safety authorities have also stated that the investigations in Séralini et al., (2012) covered a broader range of criteria than, for example, Sakamoto, et al. (2008). (See ANSES, 2012, table page 15 and also ENSSER, 2012).

With respect to the use of herbicides, the German Federal Institute for Risk Assessment (BfR) states that Séralini et al. (2012) is the first feeding study to examine the long term effects of a herbicide formulation of glyphosate (in this case, Roundup):

> "The BfR has noticed with interest that for the first time a chronic feeding study with glyphosate mixture was conducted. So far there are no such chronic studies available, because the regulations in place globally only request toxicology studies with the active ingredient." (Unofficial translation).

In conclusion, given the greater range and detail of Séralini et al., (2012) investigation than previous studies, and the fact that it is the first to examine a herbicide mixture of Roundup, the findings should not be rejected on assumption-based reasoning, including an inconsistent standard of applied to methodology.

Conclusion and recommendations

While there may be some problems with the methods used by Séralini et al. (2012) in their feeding trials, we believe their findings are still very important.

In comparison with previous feeding studies, mentioned by EFSA and NWVA, the research of Séralini et al. (2012) was conducted to higher scientific standards. The results should be taken seriously and used as a starting point for further investigations, as has been proposed by the French food safety and biotechnology authorities (ANSES 2012).

In contrast to their response to Séralini et al. (2012), when assessing applications for the approval of genetically engineered plants, European and national authorities often appear uncritical of the methods used by studies which do not show any adverse effects from the genetically engineered material. For example, the GMO Panel of the European Food Safety Authority has accepted such studies, even when they do not meet the OECD Guidelines for chronic toxicity or carcinogenicity studies.

From this evidence, it appears as if EFSA and some other EU authorities are taking a biased approach and applying differing standards during risk assessment. The outcome of their opinions seems to be influenced by a presumption in favour of the safety of genetically engineered plants. This feeds a perception of selective evidence gathering by EFSA, and that it favours the applicants who have a vested financial interest in the marketing of pesticides and genetically engineered plants.

After creating a history of certifying the safety of these products, it could be argued that EFSA and national authorities have a conflict of interest when it comes to reassessing their own conclusions. Indeed, their published statements on the work of Séralini et al. (2012) seem to be an attempt to refute any doubts about the safety of genetically engineered products and to defend previous opinions.

Based on our findings, we make the following recommendations:
The findings of Séralini et al. (2012) should be the subject of further experiment and investigation, rather than being dismissed. Given that consumers could be exposed to some of the relevant products each and every day, a high level of precaution is warranted.

In our view, EFSA has not earned a reputation of credibility for taking a final judgment on the research of Séralini et al. (2012). So we recommend that another scientific body be established on a

ad hoc basis to deal with the assessment of this publication. That body should be assembled from appropriate experts free of financial conflicts of interest and independent of past contributions to EFSA decision making.

Genetically engineered maize, NK603 and the Herbicide Roundup maize cannot be regarded as being safe, so long as their safety is not proven by further investigations. In view of the findings of Séralini et al (2012), the burden of proof should be shifted back to the product developer.

In view of the debate arising from the research of Séralini et al. (2012), the standards used in recent years for the risk assessment of genetically engineered plants and pesticides should be revised and reshaped, in order to achieve a higher level of protection for consumers and the environment. Furthermore, independent risk research should be promoted by EU research programs with a much higher priority.

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Resources

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