To:

Shri Ravi S Prasad,
Chairperson,
Genetic Engineering Appraisal Committee,
Ministry of Environment, Forest & Climate Change,
Government of India.

Date – 5th March 2020

Dear Sir,

Subject: GEAC's 138th meeting on 11/11/2019 - Preparation and Formulation of Guidelines for Import of GM Animal Feed including DDGS – reg.

This is regarding the preparation and formulation of guidelines for import of GM animal feed including DDGS, for which GEAC in its 138th meeting took a decision to receive comments and inputs from all (GEAC) members on the report of the Sub-Committee chaired by Dr Lalitha Gowda. At the outset, we urge you to ensure that the report of the Sub-Committee be put out in the public domain so that citizens know what the regulators are actually discussing.

We write to you from the Coalition for a GM-Free India to strongly ***urge you not to allow GM animal feed for import*** as we are in no position to tackle the health and economic impacts of such a decision. Any import of GM animal feed will constitute a stealth GM food not tested in India.

To this day, regulators have not tested for Bt cottonseed oil, nor for HT soybean oil / canola oil which have flooded our food chain. This is a grave lapse on the part of the regulators, wherein they assumed that a one-time testing for glyphosate residues is all that they needed to do in terms of risk assessment!

It is also important to note that there is no labeling regime in place for upholding consumer right to know what they are consuming. Such labeling in fact will be virtually impossible to enforce in India.

HEALTH IMPACTS: In terms of health impacts of GM crops on animals, as you might be aware, from the biosafety dossiers that GEAC itself has from various GM crop developers, impact on animals upon consumption of GM feed, that too from a few short-term studies, has been adverse.

For Bt cotton, for instance, from the developer/applicant's own reports and data, the Supreme Court's Technical Expert Committee (TEC) in 2013 observed that cows that had been given Bt cotton feed showed indications(in the second phase of the treatment) of a possible declining trend in daily milk yield. The TEC noted that this would need further examination including additional studies in order to draw any firm conclusions in the absence of data reporting in greater detail in the reports. Significant differences between Bt and non-Bt cotton fed rats were seen in size of spleen, heart and uterus in females whereas in males, highly significant average lung weight differences were observed. The TEC notes that it is rather rare that a tissue like heart shows reduction in weight and has a similar trend between genders but more pronounced again in females.

In the case of Bt brinjal, Mahyco's own data from a 14-day acute toxicity study on rats showed significant differences in AST levels of rats. "AST levels in both males and females were significantly different between Group 2 (non-transgenic brinjal) and Group 4 (transgenic Bt brinjal) treatments", noted the TEC report, saying that "AST is a marker of organ integrity and increased AST could indicate damage to liver or heart". In the 90-day sub-chronic toxicity study also in rats, serum, blood and organic parameters showed significant differences between non-transgenic and Bt transgenic treatments for female rats.

In the past, late Dr Pushpa Bhargava (the Supreme Court appointed Special Observer in the GEAC), had also raised grave concerns with regard to the GEAC's handling of the phenomenon of sheep and other animal poisoning after grazing on remnants of Bt cotton crops in certain districts of Andhra Pradesh.

It is a separate matter of grave concern that GEAC's so-called Sub-Committees and Expert Committees did not take into account findings from crop developers' dossiers or from the field, that GEAC approved these GMOs and did not spot these issues. It is clear by now that these issues were only observed when testing was done, bio-safety dossiers for these were made available to public and independent experts scrutinized the reports and data.

In an annexure to this letter, we are also attaching more references to published studies on the subject.

Economic Impact: Import of GM animal feed from elsewhere will negatively impact our local producers too. For instance, every year US government subsidizes US farmers tens of billions of dollars for animal feed. Opening India for GM feed imports will be disastrous for our farmers. This will lower market prices for our farmers which will further discourage domestic production of animal feed leading to a vicious cycle. At a time when agrarian

distress is acute, GEAC should not undertake steps leading on to further problems for our producers.

Another recent analysis of global pesticide sales data from 2018 found that $4.356 billion of highly hazardous pesticides were used on soyabean and maize with an estimated three-fourth of world's soyabean and maize production ending up as animal feed. This further illustrates the danger from these to animals and humans alike. https://unearthed.greenpeace.org/2020/02/20/meat-soya-animal-feed-pesticides-hazardous/

The reports of India's intent to permit imports of GM Animal Feed as also animal feeds from animal origins (eg bloodmeal) pose a threat not merely to India's livestock, but also to humans via the entire food chain which includes milk and milk products, eggs, and meat: chicken, mutton, pork and beef. The GEAC states it has done sufficient studies to prove the safety of GM animal feed, which is a complete untruth.

From 2005 onwards soon after Bt Cotton began to be cultivated commercially in India, and the first reports of animal morbidity and mortality post grazing on harvested cotton fields, began to pour in from different parts of the country, there has been absolutely no conclusive evidence produced by the regulatory authorities that the mortality of animals exposed to Bt toxin / protein via grazing on Bt cotton plants, was due to other causes and not Bt protein[1]. **Above all, except for 2008, where Bt toxicity testing was specifically requested and the concerned institution the Indian Veterinary Research Institute responded stating their inability to test for the Bt protein as they lacked facilities, there is no information on whether animal tissues were tested for Bt toxicity in the previous two years.** The absence of protocols and technical facilities to test for and prove/ disprove the role of Bt toxin in animal morbidity/mortality after ingesting Bt cotton,

[1]In 2006 animal tissues of animals that died post grazing on Bt cotton, as also identical samples of the grazed cotton plant were sent by the then Andhra Pradesh Animal Husbandry department to different state and national laboratories to establish the cause of death. The test yielded completely different and contradictory sets of information: 2 laboratories detected Nitrite in the leaf sample, 1 laboratory detected Nitrate in the leaf sample, 1 detected organophosphtes, 1 detected HCN and the other said the sample was negative for HCN. There was no information about the animal tissue results, nor the tests carried out[1].

2) In 2007 in another case of death, the plant sample was tested positive for HCN but the animal tissues tested negative for HCN

3) In 2008, the animal tissues tested at the Indian Veterinary Research Institute, tested negative for phosphine, nitrate/ nitrite, alkaloid, heavy metals, organochlorine /organophosphate.

resulted in the non–testing for the toxin/ immune response. The non-testing resulted in "non-detection" and a negative result. The negative result of having not detected Bt toxin" was subsequently passed off as proof of safety.

Presenting circular arguments of safety as "fool proof evidence, is a clear case of fraud on the part of all the regulatory bodies in India. It is scientifically untenable that without performing any tests to conclusively rule out Bt protein as the cause of death in animals, its non-testing was and continues to be cited as evidence that Bt toxin is safe. This circular argument of "safety" continues to be the basis for GEACto brush of animal deaths as being "unsubstantiated", and for it to have reversed its decision to carry out further risk assessment tests. This also forms the basis of their assurance to the citizens of India of the safety for animals to be fed GM animal feed, and thus the proposal to import GMO animal feed from the USA.

2) Subsequent studies on the effects of Bt toxin on Sheep, were carried in 2007 by a Veterinary University in Andhra Pradesh, and in 2008 by the Central Sheep and Wool Research Institute. Whilst neither of the studies were designed keeping in mind the field observations of the how symptoms were observed in sheep which had been repeatedly exposed to Bt toxin, and were one time studies, and the researchers chose to conclude that no untoward impacts/ effects were detetected, despite the reality of troubling results, which raised several unanswered questions as follows:

The 2007, season-long study by the Sri Venkateshwara Veterinary University found:

i) The presence of higher toxic heavy metals in Bt plants (842.25 ppm of lead in Bt cotton as compared to 134.62 ppm of lead in non-Bt cotton after 45 days), which is 6.25 times higher after 45 days, as compared to the non-Bt cotton[2].

ii) The liver marker AST which is known to increase after hepato-cellular injury, as the author of the experiment indicates, increased in the protocol by 37% in Bt treated sheep in com- parison to the untreated group of sheep fed on regular cotton, by the second month.

The feeding trial study carried out by CSWRI in 2008 designed for only a 3 month period, with a first time exposure of animals to Bt toxin, detected a higher liver weight, testicular weight and fat deposits in sheep fed on Bt diet. These results only served to re-inforce the urgent need for more systematic, comprehensive long-term studies on the effects of GMOs on animals.

The inconclusive nature of Bt toxin in Bt cotton and its impact on animals continue to

[2]Studies on the toxicity of Bt cotton plants incorporated in the feed of small ruminants". Project Re- port. Sri Venkateshara Veterinary University, Tirupati page 27,Table 18

remain. Is Bt toxin acting as a stress factor that is eliciting in a select fashion, a morbid possible allergenic response in the sheep, goats, and other animals, manifested as cold cough, nasal discharge in animals? Is the intense stress a trigger for *Pasteurella haemolytica*, in some of the animals with resultant death? Is the stress factor Bt toxin? Is it some unknown / new to- xin? Is it a new allergenic protein? Is it macro / micro mineral imbalances in the Bt cotton plant, (eg excess or deficiency of Nitrate, Nitrite, Selinium, etc) as a result of the Bt protein, which elicits a response from the animal?

There are a host of contradictions within the "safety" parameters. There is clearly total failure and inability of our existing public research institutions and National Regulatory Bodies (GEAC), to investigate/ test/ rigorously examine, prove or disprove these field observations, preferring to dismiss the reports as "unsubstantiated", "exaggerated, and unscientific", refusing to conduct a single field-based study and instead placing the onus of "proof" on shepherds, farmers and civil society groups who had reported the problem.

There is a clear need for new risk assessment and bio-safety protocols: chronic and long- term toxicity and allergenic tests and inter-generational studies so as to deepen our understanding on long-term implications for human and animal health to understand the unintended effects which often only come to light after several years of exposure of the organism to the GM technology (in this specific case GM cotton containing Bt toxin). There is a clear need to *put into place a reliable and citizen accountable Regulatory and Monitoring mechanism, that will respond to problems when they are experienced, and not ignore / dismiss. There is an urgent need that* India sets up independent labs for testing which are fully functional and certified to international standards. These must be capable of conducting all the required tests. Standardized and exhaustive testing protocols. India institutes capability/capacity for independent oversight, outside of the Regulatory mechanism that is free of any kinds of biases.

II) Regarding the imports of animal blood meal into India, it is the scientific evidence of the threat of feeding animal tissues to animals, and its subsequent effects on human health, which must form the basis of our ban on its imports. The outbreak of Bovine Spongiform Encephalopathy (BSE) or the Mad Cow Disease in the 1980s occurred because the diseased cattle were fed animal tissue. As a result, the World Organisation for Animal Health (OIE) and several countries, for instance Australia, have a total ban on feeding any form of ruminant feed containing animal tissue or blood meal to ruminants. The natural preference of a ruminant is a plant based diet. So feeding a ruminant an animal tissue is not physiologically and anatomically a natural fit, unlike a carnivore. There are cultural ramifications of this as well in India. The UK went against this natural order by feeding herbivores a non-vegetarian diet. The ensuing mad cow disease was caused by this. It

spread to whole herds, which had to be destroyed. This also spread to humans. Similarly BSE has been reported in US as well. We in India should not be emulating such an example.

Any attempt to legalise GM animal feed imports is wrong in principle and unsafe, based on available evidence. We therefore strongly urge you not to allow GM animal feed for import. The downstream impacts are serious, greatly escalating the contamination of our food chain. As mentioned earlier, we are in no position to tackle the health and economic impacts of such a decision. In fact, we urge GEAC to first set right the serious shortcomings in the current biosafety assessment regime (as listed in an annexure to this letter).

Sincerely,

Sridhar Radhakrishnan,

Coalition for a GM-Free India

Annexure 1: Studies which show negative impacts of GM feed on animals

Toxic and allergenic effects found in GM-fed animals (extracted from "GMO Myths and Truths")

Altered blood biochemistry, multiple organ damage, and potential effects on male fertility

Rats fed the GM Bt maize MON810: Ajeeb YG (a variety developed by Monsanto for the Egyptian market) for 45 and 91 days showed differences in organ and body weights and in blood biochemistry, compared with rats fed the non-GM parent variety grown side-byside in the same conditions. The authors noted that the changes could indicate "potential adverse health/toxic effects", which need further investigation.

Gab-Alla AA, El-Shamei ZS, Shatta AA, Moussa EA, Rayan AM. Morphological and biochemical changes in male rats fed on genetically modified corn (Ajeeb YG). J Am Sci. 2012;8(9):1117–1123. https://www.academia.edu/3138607/Morphological_and_ Biochemical_Changes_in_Male_Rats_Fed_on_Genetically_Modified_Corn_Ajeeb_YG_.

Histopathological investigations by the same researchers found toxic effects in multiple organs in rats fed the GM Bt maize for 91 days. Effects included abnormalities and fatty degeneration of liver cells, congestion of blood vessels in kidneys, and excessive growth and necrosis (death) of intestinal structures called villi. Examination of the testes revealed necrosis and desquamation (shedding) of the spermatogonial cells that are the precursors of sperm cells and thus the foundation of male fertility.

El-Shamei ZS, Gab-Alla AA, Shatta AA, Moussa EA, Rayan AM. Histopathological changes in some organs of male rats fed on genetically modified corn (Ajeeb YG). J Am Sci. 2012;8(10):684–696. https://www.academia.edu/3405345/Histopathological_Changes_in_ Some_Organs_of_Male_Rats_Fed_on_Genetically_Modified_Corn_Ajeeb_YG_.

Stomach lesions and unexplained mortality

Rats fed GM tomatoes over a 28-day period developed stomach lesions (sores or ulcers).

Hines FA. Memorandum to Linda Kahl on the FlavrSavr Tomato (Pathology Review PR–152; FDA Number FMF–000526): Pathology Branch's Evaluation of Rats with Stomach Lesions from Three Four-Week Oral (Gavage) Toxicity Studies (IRDC Study Nos. 677–002, 677–004, and 677–005) and an Expert Panel's Report. US Department of Health & Human Services; 1993. http://www.biointegrity.org.

Pusztai A. Witness Brief – FlavrSavr tomato study in Final Report (IIT Research Institute, Chicago, IL 60616 USA) cited by Dr Arpad Pusztai before the New Zealand Royal Commission on Genetic Modification. 2000. http://www.gmcommission.govt.nz/.

There was unexplained high mortality in GM-fed rats: seven out of 40 rats fed GM tomatoes died within two weeks of the start of the experiment.

Pusztai A. Can science give us the tools for recognizing possible health risks of GM food? Nutr Health. 2002;16:73-84. http://www.ncbi.nlm.nih.gov/pubmed/12102369

Stomach abnormalities

Rats fed over a six-month period with a triple-stacked trait GM maize engineered for insect resistance (containing Bt toxins) and glyphosate herbicide tolerance developed abnormalities in their stomachs.

Zdziarski IM, Carman JA, Edwards JW. Histopathological investigation of the stomach of rats fed a 60% genetically modified corn diet. Food Nutr Sci. 2018;9(6):763–796. doi:10.4236/fns.2018.96058

Immune response and allergic reaction

Mice fed GM peas engineered with an insecticidal protein (alphaamylase inhibitor) from beans showed a strong, sustained immune reaction against the GM protein. Mice developed antibodies against the GM protein and an allergic-type inflammation response (delayed hypersensitivity reaction). Also, the mice fed GM peas developed an immune reaction to chicken egg white protein. The mice did not show immune or allergic-type inflammation reactions to either nonGM beans naturally containing the insecticide protein, to egg white protein fed with the natural protein from the beans, or to egg white protein fed on its own. The findings showed that the GM insecticidal protein acted as a sensitizer, making the mice susceptible to developing immune reactions and allergies to normally non-allergenic foods. This is called immunological cross-priming.

Prescott VE, Campbell PM, Moore A, et al. Transgenic expression of bean alpha-amylase inhibitor in peas results in altered structure and immunogenicity. J Agric Food Chem. 2005;53:9023–30. doi:10.1021/jf050594v

Immune disturbances

Young and old mice fed GM Bt maize for periods of 30 and 90 days showed a marked disturbance in immune system cells and in biochemical activity. Bt maize consumption was also linked to an increase in serum cytokines (protein molecules that can influence the immune response), an effect associated with allergic and inflammatory responses.

Finamore A, Roselli M, Britti S, et al. Intestinal and peripheral immune response to MON810 maize ingestion in weaning and old mice. J Agric Food Chem. 2008;56:11533–39. doi:10.1021/jf802059w

A separate study in rats fed GM Bt rice for 28 or 90 days found a Bt-specific immune response in the non-GM-fed control group as well as the GM-fed groups. The researchers concluded that the immune response in the control animals was due to their inhaling particles of the powdered Bt toxin-containing feed consumed by the GM-fed group. They recommended that for future tests involving Bt crops, GM-fed and control groups should be kept separate. This indicates that animals can be sensitive to small amounts of GM proteins, so even low levels of contamination of conventional crops with GMOs could be harmful to health.

Kroghsbo S, Madsen C, Poulsen M, et al. Immunotoxicological studies of genetically modified rice expressing PHA-E lectin or Bt toxin in Wistar rats. Toxicology. 2008;245:24-34. doi:10.1016/j.tox.2007.12.005

Enlarged lymph nodes and immune disturbances

Mice fed for five consecutive generations with GM herbicide-tolerant triticale (a wheat/rye hybrid) showed enlarged lymph nodes and increased white blood cells, as well as a significant decrease in the percentage of T lymphocytes in the spleen and lymph nodes and of B lymphocytes in lymph nodes and blood, in comparison with controls fed with non-GM triticale. T and B lymphocytes are white blood cells involved in immunity.

Krzyzowska M, Wincenciak M, Winnicka A, et al. The effect of multigenerational diet containing genetically modified triticale on immune system in mice. Pol J Vet Sci. 2010;13:423-430. http://www.ncbi.nlm.nih.gov/pubmed/21033555.

Disturbed liver, pancreas and testes function

Mice fed GM soy showed disturbed liver, pancreas and testes function. The researchers found abnormally formed nuclei and nucleoli (structures within the nuclei) in liver cells, which indicates increased metabolism and potentially altered patterns of gene expression.

Malatesta M, Biggiogera M, Manuali E, Rocchi MBL, Baldelli B, Gazzanelli G. Fine structural analyses of pancreatic acinar cell nuclei from mice fed on genetically modified soybean. Eur J Histochem. 2003;47:385–388. http://www.ejh.it/index.php/ejh/article/viewFile/851/971.

Malatesta M, Caporaloni C, Gavaudan S, et al. Ultrastructural morphometrical and immunocytochemical analyses of hepatocyte nuclei from mice fed on genetically modified soybean. Cell Struct Funct. 2002;27:173–80. http://www.ncbi.nlm.nih.gov/ pubmed/12441651.

Vecchio L, Cisterna B, Malatesta M, Martin TE, Biggiogera M. Ultrastructural analysis of testes from mice fed on genetically modified soybean. Eur J Histochem. 2004;48:448-454. http://www.ncbi.nlm.nih.gov/pubmed/15718213.

Liver ageing

Mice fed GM soy over a long-term (24-month) period showed changes in the expression of proteins relating to hepatocyte (liver cell) metabolism, stress response, and calcium signalling, indicating more acute signs of ageing in the liver, compared with the control group fed non-GM soy.

Malatesta M, Boraldi F, Annovi G, et al. A long-term study on female mice fed on a genetically modified soybean: effects on liver ageing. Histochem Cell Biol. 2008;130:967–977. http:// www.springerlink.com/content/cw661u3345p6q464/.

Liver and kidney damage and hormonal disruption

Severe damage to the liver, kidney, and pituitary gland was found in rats fed two Monsanto products – the commercialized GM maize NK603 and tiny amounts of the Roundup herbicide it is grown with – over a long-term period of two years. Additional unexpected observations (which need to be confirmed in experiments with larger numbers of animals) were increased rates of large tumours, especially of the mammary gland in females, and mortality in most treatment groups of rats. Similar toxic effects were found from GM maize that had not been treated with Roundup, GM maize sprayed with Roundup, and Roundup on its own.

Séralini G-E, Clair E, Mesnage R, et al. Republished study: long-term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize. Environ Sci Eur. 2014;26(14). doi:10.1186/s12302-014-0014-5

Liver and kidney damage from Roundup confirmed

Some of the findings of the long-term Séralini study above have been confirmed and extended in followup investigations – namely the long-term damaging effects of a very low dose of Roundup herbicide on the liver and kidneys of the rats.

Mesnage R, Arno M, Costanzo M, Malatesta M, Séralini G-E, Antoniou MN. Transcriptome profile analysis reflects rat liver and kidney damage following chronic ultra-low dose Roundup exposure. Environ Health. 2015;14(1):70. doi:10.1186/s12940-015-0056-1

Mesnage R, Renney G, Séralini G-E, Ward M, Antoniou MN. Multiomics reveal non-alcoholic fatty liver disease in rats following chronic exposure to an ultra-low dose of Roundup herbicide. Sci Rep. 2017;7:39328. doi:10.1038/srep39328

Indications of possible liver and kidney damage from NK603 maize

In another followup investigation of the long-term Séralini study above, in an effort to gain insight into the findings of kidney and liver pathology in rats fed NK603 maize, a full

transcriptomics and metabolomics analysis was conducted of the kidneys and livers from the female animals.

Transcriptomics analysis looks at the gene expression patterns in the organs and metabolomics analysis looks at the metabolites present in the organs. Tissues from the liver and kidneys of three groups of rats were tested:
➜ Rats fed a diet of 33% GMO NK603 maize that had been sprayed once with Roundup herbicide during cultivation
➜ Rats fed a diet of 33% GMO NK603 maize that was not sprayed with Roundup during cultivation ➜ Rats fed a control diet of 33% non-GMO maize that was the nearest available relative to the GM maize, but without the genetic modification (the non-GMO isogenic variety).27

Statistically significant changes were observed in the levels of some metabolites in test groups fed NK603 maize with and without Roundup, compared to controls, including:
➜ The metabolite 3-methylhistidine was found to be elevated in the kidney tissue of animals fed GMO NK603 corn, both with and without Roundup application. This is an indicator of protein catabolism (breakdown), in particular from the degradation of muscle tissue.
➜ In the liver of animals fed GMO NK603 corn, both with and without Roundup application, there was an accumulation of polyamines (putrescine and spermidine), which could suggest an elevated metabolic state. This can signal underlying health issues and/or injury to this organ. Typically, polyamines are highly active in rapidly proliferating cells and accumulate in the regenerating liver. This suggests that the liver may have been damaged and was trying to repair itself. In spite of the above findings, when the dataset as a whole was statistically analysed, it was found that the changes in individual metabolites could have arisen by chance. This does not mean that the significant changes seen were not real, but simply that definitive conclusions cannot be drawn. The results suggest the need for a further study with greater statistical power using larger numbers of animals in order to ascertain whether the subtle changes observed in GM maize-fed groups become clearer.

Mesnage R, Arno M, Séralini G-E, Antoniou MN. Transcriptome and metabolome analysis of liver and kidneys of rats chronically fed NK603 Roundup-tolerant genetically modified maize. Environ Sci Eur. 2017;29(1):6. doi:10.1186/s12302-017-0105-1

<u>Liver and kidney toxicity</u>

A review of 19 studies (including the GMO industry's own tests submitted in support of regulatory authorization of GM crops) on mammals fed with commercialized GM soy and maize found consistent signs of toxicity in the liver and kidneys. Such effects may mark the onset of chronic disease, but longer-term studies are required to assess this potential more thoroughly. Such long-term feeding trials on GMOs are not required by regulators anywhere in the world.

Séralini GE, Mesnage R, Clair E, Gress S, de Vendômois JS, Cellier D. Genetically modified crops safety assessments: Present limits and possible improvements. Environ Sci Eur. 2011;23. doi:10.1186/2190-4715-23-10

In a separate study, the same research group re-analyzed Monsanto's own rat feeding trial data, submitted to obtain approval in Europe for three commercialized GM Bt maize varieties. The reanalysis concluded that the maize varieties caused signs of toxicity in liver and kidneys. The data suggest that approval of these GM maize varieties should be withdrawn from the market because they are not substantially equivalent to non-GM maize and may be toxic.

de Vendomois JS, Roullier F, Cellier D, Séralini GE. A comparison of the effects of three GM corn varieties on mammalian health. Int J Biol Sci. 2009;5:706–26. http://www.ncbi.nlm.nih.gov/pubmed/20011136 http://www.biolsci.org/v05p0706.htm

Toxic effects on liver and kidneys and altered blood biochemistry

Rats fed GM Bt maize over three generations showed damage to liver and kidneys and alterations in blood biochemistry.

Kilic A, Akay MT. A three generation study with genetically modified Bt corn in rats: Biochemical and histopathological investigation. Food Chem Toxicol. 2008;46:1164–70. doi:10.1016/j.fct.2007.11.016

Disturbances in digestive system and changes to liver and pancreas

Female sheep fed Bt GM maize over three generations showed disturbances in the functioning of the digestive system, while their lambs showed cellular changes in the liver and pancreas.

Trabalza-Marinucci M, Brandi G, Rondini C, et al. A three-year longitudinal study on the effects of a diet containing genetically modified Bt176 maize on the health status and performance of sheep. Livest Sci. 2008;113:178–190. doi:10.1016/j.livsci.2007.03.009

Excessive growth in the lining of the gut

Rats fed GM potatoes for only ten days showed excessive growth of the lining of the gut similar to a pre-cancerous condition, as well as toxic effects in multiple organ systems. The GM potatoes were engineered to express a protein (GNA) from snowdrops, which has insecticidal properties. In its natural non-GMO form, the GNA protein is harmless to mammals. As animals fed non-GM potatoes spiked with GNA protein did not suffer adverse health effects, this study clearly implies that novel toxicity arising from the mutagenic effect of the GM transformation process was the likely cause of the problems in the GM potato-fed group.

Ewen SW, Pusztai A. Effect of diets containing genetically modified potatoes expressing Galanthus nivalis lectin on rat small intestine. Lancet. 1999;354:1353-1354. doi:10.1016/ S0140-6736(98)05860-7

Pusztai A, Bardocz S. GMO in animal nutrition: Potential benefits and risks. In: Mosenthin R, Zentek J, Zebrowska T, eds. Biology of Nutrition in Growing Animals. Vol 4. Elsevier Limited; 2006:513–540. http://www.sciencedirect.com/science/article/pii/S1877182309701043.

Intestinal abnormalities

Mice fed a diet of GM Bt potatoes or non-GM potatoes spiked with natural Bt toxin protein isolated from bacteria over two weeks showed abnormalities in the cells and structures of the small intestine, compared with a control group of mice fed non-GM potatoes. The abnormalities were more marked in the Bt toxin-fed group.

Fares NH, El-Sayed AK. Fine structural changes in the ileum of mice fed on delta-endotoxintreated potatoes and transgenic potatoes. Nat Toxins. 1998;6(6):219-233. http://www.ncbi. nlm.nih.gov/pubmed/10441029.

Higher density of uterine lining

Female rats fed GM soy for 15 months showed significant changes in the uterus and ovaries compared with rats fed organic non-GM soy or a non-soy diet. The number of corpora lutea, structures that secrete sex hormones and are involved in establishing and maintaining pregnancy, was increased only in the GM soy rats compared with the organic soy-fed and non-soy-fed rats. The density of the epithelium (lining of the uterus) was higher in the GM soyfed group than the other groups, meaning that there were more cells than normal. Certain effects on the female reproductive system were found with organic soy as well as GM soy when compared with the nonsoy diet, leading the authors to conclude that there was a need for further investigation into the effects of soy-based diets (whether GM or non-GM) on reproductive health.

Brasil FB, Soares LL, Faria TS, Boaventura GT, Sampaio FJ, Ramos CF. The impact of dietary organic and transgenic soy on the reproductive system of female adult rat. Anat Rec Hoboken. 2009;292:587–94. doi:10.1002/ar.20878

Severe stomach inflammation and heavier uteri

A feeding study in pigs fed a mixed diet containing GMO soy and maize over an average commercial lifespan of 22.7 weeks found that the GM-fed pigs had more severe stomach inflammation than pigs fed an equivalent non-GM diet and 25% heavier uteri, which could be an indicator of pathology. GM-fed pigs had a higher rate of severe stomach inflammation – 32% for GM-fed pigs compared to 12% for non-GM-fed. The severe stomach inflammation was worse in

GM-fed males compared with non-GM fed males by a factor of 4.0, and in GM-fed females compared with non-GM fed females by a factor of 2.2.

Carman JA, Vlieger HR, Ver Steeg LJ, et al. A long-term toxicology study on pigs fed a combined genetically modified (GM) soy and GM maize diet. J Org Syst. 2013;8:38–54. http://www.organic-systems.org/journal/81/8106.pdf.

Altered blood biochemistry and gut bacteria, and immune response

GM rice was engineered with a gene from snowdrops to express the GNA insecticidal protein. The GM rice grain was statistically significantly different in composition compared to the non-GM parent rice with regard to many substances such as sugars, protein, starch, minerals, and certain fats and amino acids. This implies that the GM transformation process had brought about numerous unintended changes in gene function, causing alterations in plant biochemistry. Rats fed for 90 days with the GM rice had a higher water intake as compared with the control group fed the non-GM isogenic line of rice. The GM-fed rats showed differences in blood biochemistry, with some measurements indicating potential damage to the liver. The population of gut bacteria in the GM rice fed rats was altered, implying dysbiosis (microbial imbalance), which could lead to severe ill health in the long term. In addition, animals fed the GM rice showed an altered immune response when challenged with an immunizing agent (sheep red blood cells). The authors went to great lengths to dismiss the large number of statistically significant differences, not only in GM rice composition, but also in the physiology and biochemistry of the animals on the GM rice diet. They claimed that these differences were within the range of natural variation or biologically not meaningful. However, an equally valid interpretation of the data is that the GM rice diet resulted in signs of harm to multiple systems of the body, which may escalate into serious harm if the study were extended beyond 90 days to the lifespan of the animals (2–3 years).

Poulsen M, Kroghsbo S, Schroder M, et al. A 90-day safety study in Wistar rats fed genetically modified rice expressing snowdrop lectin Galanthus nivalis (GNA). Food Chem Toxicol. 2007;45:350-363. doi:10.1016/j.fct.2006.09.002

Altered gut bacteria and organ weights

Rats fed GM Bt rice for 90 days developed significant differences as compared with rats fed the non-GM isogenic line of rice. The GM-fed group had 23% higher levels of coliform bacteria in their gut and there were differences in organ weights between the two groups, namely in the adrenals, testes, and uterus.

Schrøder M, Poulsen M, Wilcks A, et al. A 90-day safety study of genetically modified rice expressing Cry1Ab protein (Bacillus thuringiensis toxin) in Wistar rats. Food Chem Toxicol. 2007;45:339-349. doi:10.1016/j.fct.2006.09.001

OTHER STUDIES CITED IN "SCIENTIFIC REFERENCES FOR EVIDENCE OF ADVERSE EFFECTS OF GM CROPS" BY COALITION FOR A GM-FREE INDIA, APRIL 2013

Daniela Cirnatu, A Jompan, Anca Ileana Sin, Corina Aurelia Zugravu (2011) : Multiple organ histopathological changes in broiler chickens fed on genetically modified organism. Rom J MorpholEmbryol 52 (1 Suppl) : 475-480

Diet can influence the structural characteristics of internal organs. An experiment involving 130 meat broilers was conducted during 42 days (life term for a meat broiler) to study the effect of feed with protein from genetically modified soy. The 1-day-old birds were randomly allocated to five study groups, fed with soy, sunflower, wheat, fish flour, PC starter. In the diet of each group, an amount of protein from soy was replaced with genetically modified soy (I – 0%, II – 25%, III – 50%, IV – 75%, V – 100% protein from genetically modified soy). The level of protein in soy, either modified, or non-modified, was the same. Organs and carcass weights were measured at about 42 days of age of the birds and histopathology exams were performed during May–June 2009. No statistically significant differences were observed in mortality, growth performance variables or carcass and organ yields between broilers consuming diets produced with genetically modified soybean fractions and those consuming diets produced with near-isoline control soybean fractions. Inflammatory and degenerative liver lesions, muscle hypertrophy, hemorrhagic necrosis of bursa, kidney focal tubular necrosis, necrosis and superficial ulceration of bowel and pancreatic dystrophies were found in tissues from broilers fed on protein from genetically modified soy. Different types of lesions found in our study might be due to other causes (parasites, viral) superimposed but their presence exclusively in groups fed with modified soy raises some serious questions about the consequences of use of this type of feed.

Tudisco R., Mastellone V., Cutrignelli M.I, Lombardi P, Bovera F., Mirabella N., Piccolo G., Calabro S., Avallone L., Infascelli F. (2010) : Fate of transgenic DNA and evaluation of metabolic effects in goats fed genetically modified soybean and in their offsprings. Animal. The Animal Consortium: 1-10; 4:1662-1671

The presence of DNA fragments in blood and milk from goats fed conventional (control) or Roundup Ready® soybean meal solvent extracted (s.e.; treated) was investigated by using a polymerase chain reaction approach. The same investigation was carried out on blood, skeletal muscle and organs from kids of both groups fed only dams' milk until weaning. Moreover, the possible effects on cell metabolism were evaluated by determination of several specific enzymes in serum, heart, skeletal muscle, liver and kidney. Fragments of the multicopy chloroplast (trnL) gene were found in blood and milk samples from goats of both groups. In kids, the chloroplast fragments were found in samples of both groups. In samples, which proved positive for the presence of chloroplast DNA, fragments of the specific soybean single copy gene (lectin) were detected in several blood and milk samples. The same fragment was also found in control and treated groups of kids. Transgenic fragments were not found in those samples, which were found positive for chloroplast fragments of control groups of either goats or kids. On the contrary, in blood and milk of treated goats, fragments both of the 35S promoter and the CP4 epsps gene were detected. These fragments were also found in treated kids with a significant detection of the 35S promoter in liver, kidney and blood, and of the CP4 epsps gene fragment in liver, kidney, heart and muscle. A significant increase in lactic dehydrogenase, mainly concerning the lactic dehydrogenase-1 isoenzyme was found in heart, skeletal muscle and kidney of treated kids, thus suggesting a change in the local production of the enzyme. Finally, no significant differences were detected concerning kid body and organ weight.

Sharma R, Damgaard D, Alexander T W, Dugan M E R, Aalhus J L, Stanford K and McAllister T A (2006) : Detection of transgenic and endogenous plant DNA in digesta and tissues of sheep and pigs fed Roundup Ready Canola meal. J. Agric. Food Chem. 54 (5) : 1699-1709.

The persistence of plant-derived recombinant DNA in sheep and pigs fed genetically modified (Roundup Ready) canola was assessed by PCR and Southern hybridization analysis of DNA extracted from digesta, gastrointestinal (GI) tract tissues, and visceral organs. Sheep (n = 11) and pigs (n = 36) were fed to slaughter on diets containing 6.5 or 15% Roundup Ready canola. Native plant DNA (high- and low-copy-number gene fragments) and the cp4 epsps transgene that encodes 5-enolpyruvyl shikimate-3-phosphate synthase were tracked in ruminal, abomasal, and large intestinal digesta and in tissue from the esophagus, rumen, abomasum, small and large intestine, liver, and kidney of sheep and in cecal content and tissue from the duodenum, cecum, liver, spleen, and kidney of pigs. High-copy chloroplast-specific DNA (a 520-bp fragment) was detected in all digesta samples, the majority (89-100%) of intestinal tissues, and at least one of each visceral organ sample (frequencies of 3-27%) from sheep and swine. Low-copy rubisco fragments (186- and 540-bp sequences from the small subunit) were present at slightly lower, variable frequencies in digesta (18-82%) and intestinal tissues (9-27% of ovine and 17-25% of porcine samples) and infrequently in visceral organs (1 of 88 ovine samples; 3 of 216 porcine samples). Each of the five cp4 epsps transgene fragments (179-527 bp) surveyed was present in at least 27% of ovine large intestinal content samples (maximum = 64%) and at least 33% of porcine cecal content samples (maximum = 75%). In sheep, transgene fragments were more common in intestinal digesta than in ruminal or abomasal content. Transgene fragments were detected in 0 (esophagus) to 3 (large intestine) GI tract tissues from the 11 sheep and in 0-10 of the duodenal and cecal tissues collected from 36 pigs. The feed-ingested recombinant DNA was not detected in visceral tissues (liver, kidney) of lambs or in the spleen from pigs. Of note, however, one liver and one kidney sample from the pigs (different animals) were positive for a 278-bp fragment of the transgenic cp4 epsps (denoted F3). Examination of genomic libraries from these tissues yielded no conclusive information regarding integration of the fragment into porcine DNA. This study confirms that feed-ingested DNA fragments (endogenous and transgenic) do survive to the terminal GI tract and that uptake into gut epithelial tissues does occur. A very low frequency of transmittance to visceral tissue was confirmed in pigs, but not in sheep. It is recognized that the low copy number of transgenes in GM feeds is a challenge to their detection in tissues, but there was no evidence to suggest that recombinant DNA would be processed in the gut in any manner different from endogenous feed-ingested genetic material.

Agodi A, Barchitta M, Grillo A and Sciacca S (2006) : Detection of genetically modified DNA sequences in milk from the Italian market. Int J Hyg Environ Health 209: 81-88.

The possible transfer and accumulation of novel DNA and/or proteins in food for human consumption derived from animals receiving genetically modified (GM) feed is at present the object of scientific dispute. A number of studies failed to identify GM DNA in milk, meat, or eggs derived from livestock receiving GM feed ingredients. The present study was performed in order to: (i) develop a valid protocol by PCR and multicomponent analysis for the detection of specific DNA sequences in milk, focused on GM maize and GM soybean; (ii) assess the stability of transgenic DNA after pasteurization treatment and (iii) determine the presence of GM DNA sequences in milk samples collected from the Italian market. Results from the screening of 60 samples of 12 different milk brands demonstrated the presence of GM maize sequences in 15 (25%) and of GM soybean sequences in 7 samples (11.7%). Our screening methodology shows a very high sensitivity and the use of an automatic identification of the amplified products increases its specificity and reliability. Moreover, we demonstrated that the pasteurization process is not able to degrade the DNA sequences in spiked milk samples. The detection of GM DNA in milk can be interpreted as an indicator of fecal or airborne contamination, respectively, with feed DNA or feed particles, although an alternative source of contamination, possibly recognizable in the natural environment can be suggested. Further studies, performed on a larger number of milk samples, are needed to understand the likely source of contamination of milk collected from the Italian market.

Heinemann, Jack (2009): Report on animals exposed to GM ingredients in animal feed, prepared for the Commerce Commission of New Zealand.

There is substantial and credible literature that reports the detection of DNA and protein uniqueto GM plants within animals and animal products. In the absence of competent and dedicated testing to the contrary, it is not possible to conclude that animals and derived products are free of GM material when they have been exposed to GM plants through i) feeding, ii) proximity to other animals on GM feed, or iii) subsequent processing. The most consistent finding in the literature is that animals not exposed to GM feed were unlikely to be contaminated with GM material. There is compelling evidence that animals provided with feed containing GM ingredients can react in a way that is unique to an exposure to GM plants. This is revealed through metabolic, physiological or immunological responses in exposed animals. In the absence of appropriate testing, it is not possible to conclude that an effect of growing an animal on GM feed will not persist to the final product even in the absence of residue from the GM material. The cumulative strength of the positive detections reviewed below leave me no reasonable uncertainty that GM plant material can transfer to animals exposed to GM feed in their diets or environment, and that there can be a residual difference in animals or animal-products as a result of exposure to GM feed.

Annexure 2: Regulatory Gaps in Current Framework which must be fixed

- Blinding identity of developer to regulator should be done at the time of sample submission. Breaching of Confidentiality during sampling until results are submitted directly to GEAC to be considered as a civil crime.
- Independent labs with prescribed testing parameters at 0.01% detection must be setup for food, seeds and animal feed – such labs should accept samples from citizens too and not just regulators.
- Testing costs should be paid by the applicant to the Government at the time of processing application/sample submission.
- Samples provided by the promoter cannot be relied upon (as evident from the cases of Bt BN and Bt NHH44). Samples must be independently collected by testing authorities.
- Conflict of interest in members involved in GM regulation existing at various levels in the current process must be tackled.
- Full transparency must be built in with public including on all GM feed, food and seed work being undertaken in the country and its status which must be pro-actively shared on a regulator's website. All biosafety dossiers must be made available to the public – unlike the case of GM Mustard where even after instructions by CIC, full biosafety dossier has yet not been shared more than 3 years after being asked to.
- Regulatory body composition must include members from AYUSH, Department of Animal Husbandry, Dairying & Fisheries, National Biodiversity Authority, Department of Consumer Affairs, Directorate General of Foreign Trade and Department of Food & Public Distribution. This will help in addressing various unaddressed aspects in current regulatory framework.
- All states and districts must be asked to conduct and share SBCC/DLC meeting details to regulators which must be put transparently on the website. And Agriculture being subject of the state; states should be given upper hand to reject GM in agriculture sector if they feel necessary in their state.
- Independent testing to be conducted by regulators – this should include long-term, inter-generational testing and assessment.
- Need assessment and alternative analysis to be performed by neutral regulatory agency before starting any research.
- List of tests to be conducted during biosafety assessment should be comprehensive, as listed above.
- Liability regime that fixes liability on crop/event developer for contamination, import (of products/seeds/animals/feed) and illegal cultivation must be setup – this will help tackle situations such as today when Bt brinjal, HT cotton and GM soybean have been found to be cultivated illegally in India. And large-scale import of illegal GM products is taking place in India which has been reported without any action.

http://indiagminfo.org/follow-on-complaint-on-ongoing-gm-illegal-imports-in-exim-committees-235th-meeting-and-related-issues/

- Learning lessons from the past in India, where various GM crops have been introduced and cultivated illegally without any punitive action against anybody.
- A mechanism to recall any GM feed product released in the environment should be set up.