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GM Soya Fed Rats: Stunted, Dead, or Sterile

Dr. Mae-Wan Ho *reviews the latest findings on the hazards of GM food and feed amid a continuing campaign of denial and misrepresentation by our regulators*

A fully referenced version of this paper is posted on ISIS members' website. Details here

Alarming findings dismissed by regulators

Female rats fed genetically modified (GM) soya produced excessive numbers of severely stunted pups with over half of the litter dying within three weeks, and the surviving pups are sterile.

These alarming findings came from the laboratory of senior scientist Dr. Irina Ermakova at the Institute of Higher Nervous Activity and Neurophysiology of the Russian Academy of Sciences in Moscow. The experiments began two years ago, and the initial findings hit the world press when Ermakova was invited to speak at the 11 th Russian Gastroenterological Week in Moscow in October 2005.

Preliminary results have been published in a Russian journal [1], in conference proceedings and official reports [2-7], and a fuller paper containing further results is in press [8]. Ermakova has also spoken at numerous public meetings and scientific conferences and in the popular media, both at home and abroad, but regulators have continued to ignore and dismiss her findings.

UK's Advisory Committee on Novel Foods and Processes (ACNFP) has been systematically biased in favour of studies that fail to show significant effects of GM food and feed right from the beginning. Not surprisingly, it continued to cite research that's seriously flawed as evidence against Ermakova's findings [9], and Ermakova has lodged her own protest [10].

One particular study cited by the ACNFP to bolster its GM bias [11] used a batch of GM soya harvested in a middle of a certain field in South Dakota, processed by a commercial company, and fed to mice of indeterminate age and body weight. These factors alone would make the experiments invalid and totally unreplicable. Furthermore, the remarkable similarities in the composition of the GM and non GM diet - both supposed to contain 21.35 percent soya meal – is simply beyond belief. There were no standard deviations to the figures provided; 59 out of 78 of the figures were identical to 2 - 3 significant figures, and the rest differed so slightly that they would have been within standard errors. Could it be that the researchers have been feeding both groups the same diet? There is no evidence that the two diets were different, no DNA tests on the food samples were performed to

ascertain that one was GM and the other non-GM.
This contrasts with the investigations carried out by Ermakova, who has been updating her results on her website (http://irina-ermakova.by.ru/eng/ [12], and urging other scientists to repeat the experiments; all the more important now, as since publishing the initial results, her funding has been cut, and she is strongly discouraged from pursuing this line of research. Suppression and victimisation of honest, independent scientists has now become routine while obfuscation and misrepresentation are perpetrated at the highest levels, most recently by UK Prime Minister Tony Blair, who once again, blames the controversy over GM foods, along with MMR vaccine, stem-cells and BSE (!) on the “anti-science brigade” that “threatens our progress and our prosperity” [13]. Is Blair implying that BSE is not a hazard to human health? Ten years ago, the then UK government was forced to admit BSE was linked to the variant Creuzfeld Jacob Disease in humans, after having repeatedly proclaimed BSE-infected beef was safe for human consumption for 10 years previously [14] (The Inside Story of BSE , *SiS* 32).

Excess stunting and deaths

In the first set of Ermakova's experiments, female Wistar rats weighing 180-200 g were fed their normal dry pellet diet alone, or pellet diet supplemented with genetically modified (GM) soybeans or non-GM soybeans beginning two weeks prior to mating and continuing afterwards through pregnancy and lactation. The female rats were housed three to a cage before delivery, and received 20 g soybeans ground up with 40 ml water each day (5-7 g soya beans per rat per day). Just before delivery, the pregnant rats were individually caged and given 5-7 g soy meal per day plus 1 g extra per pup delivered. When the pups were weaned, the ration of soy meal was increased to 2-3 g for every pup. All rats had free access to the soy meal as well as the pellet food.

There were three feeding groups: the ‘Control 1' given pellet food only, the ‘Control 2' given non-GM soya in addition to pellet food, and the ‘Experimental 1' group given GM soya in addition to pellet food. The GM soya was Monsanto's Roundup Ready (RR) 40.3.2 purchased from the Netherlands , the non-GM soya was Arcon SJ91-330 ADM from the Netherlands, a commercially available variety that was closest to the parental line of RR soya, to which Ermakova had no access.

The RR soya was analysed by PCR and confirmed to be 100 percent GM, while the non-GM soya was contaminated with traces of GM soya (0.08 + 0.04 percent)

The results were startling (see Table 1).

Table 1. Excess stunting and mortality in the progeny of rats fed GM soya

Groups Weeks	Pregnant females Out of Total	Pups	Pups dead at three weeks	Pups stunted at two weeks
Control 1 (Rat chow only)	4/6	44	3(6.8%)	6.0%
Control 2 (Rat chow + Non GM soya)	3/3	33	3(9.1%)	6.7%
Exptl 1 (Rat chow + GM soya)	4/6	45	25(55.6%)	36.0%

Thirty-six percent of the pups from rats fed GM soya were severely stunted, some 5 to 6 times the percentage in the controls. By three weeks, 55.6 percent of the pups from rats fed GM soya had died, the death rate was 6 to 8 times the controls. These results were statistically highly significant ($p<0.00012$).

Further experiments confirmed the results

Further experiments were done, and the results were similar. By then, Ermakova has included a second experimental group of female rats that were fed protein extract from the GM soya (from ADM in the Netherlands). The pooled results are given in Table 2.

Table 2. Pooled results including further experiments

Groups Weeks	Pregnant females Out of Total	Pups	Pups dead at three weeks
Control 1 (Rat chow only)	7/9	74	6(8.1%)
Control 2 (Rat chow + Non GM soya)	5/6	50	5(10.0%)
Exptl 1 (Rat chow + GM soya)	4/9	64	38(51.6%)
Exptl 1 (Rat chow + GM soya protein)	4/6	33	5(15.1%)

Once again, the mortality rate at three weeks was more than 50 percent, 5 to 6 times the control values. The GM soya fed group differed significantly from either controls at $p < 0.001$. Interestingly, mortality rate in the pups of rats fed GM soya protein was 15.1 percent, 1.5 to 2 times the controls, though the difference was not statistically significant. The reduction in mortality rate in the group fed GM soya protein compared with the group fed whole GM soya meal was statistically significant at $p < 0.01$, suggesting that the GM soy proteins are probably not responsible for most of the deaths. But as there are no data on the purity of the protein extract, it is difficult to draw definite conclusions.

The excessive stunting and deaths from GM soya is clear, even though the cause(s) remain unknown without extensive further investigations. One possibility is poisoning from glyphosate herbicides and residues used with RR soya. Glyphosate - and more so in the Roundup formulation - is extremely lethal to many frog species [15] (Roundup Kills Frogs , *SiS* 26), and is linked to late spontaneous abortions in humans, and toxic to human placental cells at one-tenth the recommended agricultural dosage [16] (Glyphosate Toxic & Roundup Worse , *SiS* 26) and/or other causes general to the genetic modification process [17] (see most recent review, Genetically Modified Food Animals Coming). These include toxicities and immunogenic reactions from the transgenes; unknown toxins and RNA transcripts from unintended genetic and epigenetic changes in the RR soya subsequent to the insertion of foreign DNA, and/or continuing transgenic instability [18, 19] (Transgenic Lines Proven Unstable , *SiS* 20; Unstable Transgenic Lines Illegal , *SiS* 21); and unintended horizontal transfer of transgenic DNA from RR soya into the rat germ cells that give rise to the progeny, resulting in lethal and other harmful mutations [20, 21] (Sense & Nonsense in

Horizontal Gene Transfer , *SiS* 16, and many other articles on horizontal gene transfer on ISIS website).

The effects on the progeny of female rats fed GM soya were not limited to the first generation. It persisted into the next.

Surviving pups sterile

When the first generation (F1) pups from the feeding experiments were old enough to breed, they were mated with the intention of producing the next generation. But to Ermakova's surprise, the GM-fed F1 rats were completely sterile when mated with one another, whether they continued to be fed on GM soya or not. When the GM-fed F1 females were mated with non-GM fed males, fertility was restored, but the average size of the litter was about 75 percent of control mating in which neither males nor females were GM-fed (see Table 3).

Table 3. Sterility in surviving F1 rats

Groups Weeks	Feeding regime	Pups
F1 x F1	GM soya supplement	0
F1 X F1	No GM soya supplement	0
F1 females x Control males	No GM soya supplement	72 (~75% control)

The cause of sterility in the GM-fed F1 rats is unclear. The fact that mating with non-GM fed F1 males restored 75 percent fertility to GM-fed F1 females indicates that the GM-associated sterility is largely, if not exclusively, in the F1 males. Could it be a failure of spermatogenesis? This could be ascertained by direct examination of the animals, and in such a case, mating between GM-fed F1 males and control females would give no progeny. The failure of spermatogenesis in GM-fed F1 males could be the result of a physiological maternal effect, or a direct genetic mutation in the maternal germ cells that affects their male offspring only.

Another possibility is a genetic mutation that renders both GM-fed F1 males and females partially sterile. In that case, mating between GM-fed F1 males and control females would also be fertile.

Finally, the genetic mutation could be the result of a 'directed mutation' [22] (To Mutate or Not to Mutate , *SiS* 24) that occurs in a high proportion, if not all of the maternal germ cells

under certain environmental conditions, or else a non-random insertion of transgenic RR soya DNA into the maternal germ cells [23] (Living with the Fluid Genome). The latter can be confirmed by probing the GM-fed F1 rat genomes for RR soya transgenic DNA.

A case of criminal negligence on the part of the regulators

Ermakova's findings need to be fully investigated as a matter of urgency. They must be seen against the backdrop of numerous scientific and anecdotal reports of illnesses and deaths in humans and many species of animals resulting from exposure to a variety of GM food, feed and other products, GM pollen, plant dust and debris (24-29] (Cows Ate GM Maize & Died , Animals Avoid GM Food, for Good Reasons , *SiS* 21; GM Ban Long Overdue , Transgenic Pea that Made Mice Ill , *SiS* 29; More Illnesses Linked to Bt Crops , Mass Deaths in Sheep Grazing on Bt Cotton , *SiS* 30). (For more details, please read Making the World GM Free and Sustainable [30]). Weston A Price Foundation Keynote Lecture November 11, 2006, Westfields Marriott Hotel, Virginia, USA)

Evidence of GM hazards has been emerging since the 1980s, which should have halted the development of many GM crops. By now, our regulators should be answering a charge of criminal negligence at the very least in continuing with their campaign of denial and misrepresentation, while failing to impose a ban on further releases of all GM crops until and unless they have been proven safe by thorough independent investigations.