Genetically modified organisms and biological risks

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Widespread distribution of genetically modified organisms (GMO) causes great biological risks for human and the Environment. Three kind of biological risks are described usually: ecological, nutrition and agrotechnical. The term genetically modified organisms (GMOs) refers to plants, microbes and animals with genes transferred from other species in order to produce certain novel characteristics (for example resistance to pests, or herbicides). Neither methods are perfect and do not guarantee that the rest of the plant genome remains unchanged. The hazard of genetically modified organisms (GMO) was shown for human, animals and the Environment in many scientific investigations. Four main sources of the hazards of GMO are accepted by scientists worldwide: 1) those due to the new genes, and gene products introduced; 2) unintended effects inherent to the technology; 3) interactions between foreign genes and host genes; and 4) those arising from the spread of the introduced genes by ordinary cross-pollination as well as by horizontal gene transfer (World Scientists' Statement, 2000). Natural infectious agents exist which can transfer genes horizontally between individuals. There are viruses and other pieces of parasitic genetic material, called *plasmids* and *transposons*, which are able to get into cells and then make use of the cell's resources to multiply many copies of themselves or to jump into (as well as out of) the cell's genome (World Scientists' Statement 2000).

Experimental researches showed the negative effect of GMO on insects. Larvae of the monarch butterfly, Danaus plexippus, reared on milkweed leaves dusted with pollen from Bt corn, ate less, grew more slowly and suffered higher mortality than larvae reared on leaves dusted with untransformed corn pollen or on leaves without pollen (Losey, 1999). In an other investigation it was shown that Bt corn could have adverse sublethal effects on black swallowtails in the field. Reduction of life expectancy of ladybirds, fed by pest aphid, planted in GM-potatoes, was found also.

The genetically modified (or transgenic) plants could be used by mammals for their nutrition in the fields of GM-crops. It was shown that consumption of GM-food by animals led to the negative changes in their organs. Experiments, conducted by A. Pusztai (1998), found that potatoes modified by the insertion of snowdrop genes that code for insecticidal proteins stunted the growth of rats and damaged their immune system. Feeding rats with baked transgenic potatoes significantly affected some of their vital organs including the kidneys, thymus, gastrocnemius muscle and others. Negative effect of GM-potatoes, GM-pears, GM-soya on mammals was shown in many other investigations.

For understanding of the GMO dangerous it is better to know the methods that usually used to introduce a new DNA (gene) into the cell of a plant that is going to be modified. There are two standard methods: the “shot-gun” technique and agrobacterium tumefaciens method. Both methods are not perfect and don’t guarantee safety for the Environment those GM-organisms, which were created with their help. Experimental researches in mice showed that ingested foreign DNA survived in the gastrointestinal tract and entered the blood stream of mice. Important data were obtained in pregnant mice that were fed regularly during pregnancy with a daily dose of plasmids containing the gene for the green

fluorescent protein (pEGFP-C1) or bacteriofaphage M13 DNA. Foreign DNA, orally ingested by pregnant mice, was discovered in white blood cells, spleen, liver cells of foetuses and newborn animals. Authors concluded, that maternally ingested foreign DNA could be potential mutagen for the developing fetus (Schubbert et al., 1998).

Our own experiments showed the dangerous of Ready Roundup soya-bean (line 40.3.2), modified by the transgene CP4 EPSPS, for rats and their offspring. Female rats were divided into groups, housed and kept under normal laboratory conditions (3 rats/cage).

Experiments with rat females were repeated three times in four groups: “GM-soya” group, “Trad-soya” group, “Protein-isolate GM-soya” group and “Control” group. One group of female rats of 180-200g weights was allocated to the experimental group, and received 5-7g soy flour prepared by the grinding the raw whole Roundup-Ready soybean seeds. In two other groups females the diet was supplemented with the same amount of soya flour, prepared from protein isolate GM-soya (RR, line 40.3.2) or from traditional soya Arcon SJ 91-330. Soy flour was mixed with water and added to the rat chow for two weeks before mating, during mating, pregnancy and lactation. In a positive control group females have only got the standard laboratory chow, without any supplementation. After two weeks on the diets all females were mated with healthy males of the same age, who have never been exposed to soya flour supplements. Lab chow and water was available ad libitum during the experimental period, for all animals. 30 females and 221 pups were investigated during three series of similar experiments.

Supplementation of the diet of the females with GM soy led to the high mortality of rat pups (51.6%) in comparison with the pups from “Trad-soya” group (10%), “Protein-isolate GM soy” group (15.1%) and “Control” group (8.1%) (Tabl). High pup mortality was characteristic of every litter from mothers fed the GM soy flour. Pups from “GM-soy” group have higher mortality and third of them were sick and weighed several times less, than pups from the control groups. No lethality of females and survived young pups eating the GM-soya flour supplemented diet was observed. The level of mortality was analyzed by the one-way ANOVA, using of Newman-Keuls test for share distribution.

The anxiety (model “light and dark”) and aggression were analysed in females and their offspring. The behaviour of females and young rat pups of GM-group was compared with those of control groups. Obtained data showed a high level of anxiety and aggression in rats from GM-soy group: females and rat pups attacked and bit each other and the worker, who took care about them.

Our data allow us to speculate and presume that the negative effect of GM-soy on the newborn pups could be mediated by three possible factors. Firstly, it can be the result of transformation, and insertion of the foreign genes, which could penetrate into the sexual/stem cells, or/and into cells of the fetus, as it was observed by Schubbert and colleagues (1998). In their experiments the plasmid containing the green fluorescent protein (pEGFP-C1) gene, or the bacteriofaphage M13 DNA was fed to pregnant mice. Using the polymerase chain reaction (PCR) or the fluorescent in situ hybridization (FISH) method, foreign DNA, orally ingested by pregnant mice, was discovered in various organs of fetuses and of newborn animals. GM-soy is one of the plants, created by the help of bacterial DNA plasmids (*Agrobacter tumefaciensis method*). So, we can presume that able for replication plazmids are kept in the cells of GM-plants (in our case in GM-soya). The affecting of sexual cells and reproductive organs of rats by plasmids with foreign DNA

from GM soy could be occurred.

Secondly, the negative effect of GM-soya could be connected with the highly mutagenic nature of the GM transformation process. Also, the instability of gene constructs was described for GM-soya (Windels et al., 2001).

Thirdly, the adverse effect of GM-soya could be mediated by the accumulation of Roundup residues in GM-soya. However, no mortality was observed with female rats, nor with the young pups survived, although they also began to eat the GM-soya, it was supposed that the effect could be mediated by two first factors. Confirmation of this assumption could be also the fact of weak negative effect of protein-isolate GM-soya.

In order to understand the mechanism of GM soy influence on the reproductive performance of mammals and their offspring, it would be necessary to perform complex researches, including histological, genetical, and embryo-toxicological investigations. We had to restrict our experiments only for a short time-span.

At the present time one of the main global goals is the protection of the Environment from the uncontrolled distribution and the contamination of imperfect genetically modified organisms, which can cause the human diseases, the decrease of biovariety, and the destruction of nature.

Table. Mortality of rat pups in three weeks after birth

Groups	Delivered females/total females	Number of newborn pups	Number of died pups	Dead pups/total born (%)
Control	7/9	74	6 p<0.001*	8,1%
GM-soya	6/9	64	33	51,6%
Protein-isolate GM soya	4/6	33	5 p<0.01*	15%
Traditional soya	5/6	50	5 p<0.001*	10%

*- in comparison with GM-soy group

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Proceedings of International Disaster Reduction Conference (IDRC) Davos, Switzerland August 27th – September 1st, 2006, pp.168-172