

Transgenerational effects on the fecundity and sperm proteome in rats exposed to a mixture of pyrethroids at doses similar to human consumption

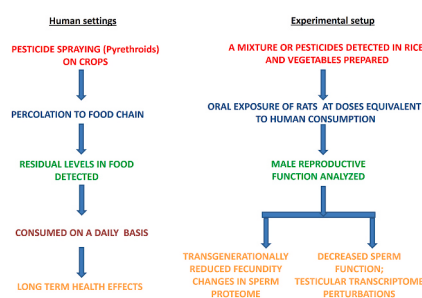
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HIGHLIGHTS

- Toxicological studies for pyrethroids using doses to which humans are exposed are very rare.
- Male rats exposed to mixture of pyrethroids at doses similar to human consumption.
- Transgenerational fecundity, sperm count and hormonal profile were affected.
- Perturbations in the transcriptome profile of genes involved in gametogenesis was observed.
- Sperm proteome changes in treated rats were reflected in later generations (transgenerational).

GRAPHICAL ABSTRACT



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ABSTRACT

Pyrethroid based pesticide usage for crop protection resulted in percolation of these compounds into the food chain. Toxicological studies that reflect exposure to pyrethroids through food in the human settings are rare. We conducted animal experimentations using a mixture of pyrethroids that is equivalent to the amount consumed by average individual through rice and vegetables in the Indian context. Male rats treated with a mixture of pyrethroids for 1–12 months displayed decreased transgenerational fecundity, sperm count, activities of 3 β - and 17 β -HSD and perturbed hormonal profile. At the transcriptome level, the expression of genes involved in spermatogenesis, steroidogenesis, germ cell epigenetic modulators and germ cell apoptosis were altered in the testis. In the sperm lysates of control rats, 506 proteins identified by mass spectrometry. The differential expression of these proteins (treated/control ratio) in the pyrethroid exposed rats was analyzed. Among the 506 proteins, 153 had a ratio of 0; 41 had a ratio ranging from >0 to <0.5; and 10 had a ratio >2.0. Interestingly, the differential expression was transgenerational. 26 proteins that were differentially expressed in the sperm of F0 treated rats continued to remain the same in the F1, F2 and F3 generations, while the differential expression was maintained up to F2 and F1 generations for 46 and 2 proteins respectively. Some of the proteins that continued to be differentially expressed in the later generations are reported to have critical roles in male reproduction. These results indicate that the reduced fecundity observed in the later generations could be due to the continued differential expression that was initiated by pyrethroid treatment in the F0 rats. Results of our study, for the first time, provide evidence that long-term exposure to pyrethroids affects transgenerational fecundity manifested by changes in sperm proteome.

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