Acta fytotechn zootechn, 19, 2016(Special Issue), 140-141
http://www.acta.fapz.uniag.sk

Review

The possibilities of pesticide genotoxicity assessment in bovine lymphocytes cultures

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Article Details: Received: 2016-05-06 | Accepted: 2016-05-27 | Available online: 2016-09-01

http://dx.doi.org/10.15414/afz.2016.19.si.140-141

The exposure of dairy cattle to genotoxic substances may result in mutations, metabolic disorders, immunosuppression and reduced fertility. Potential pesticide genotoxicity can be tested in cultured bovine lymphocytes by broad spectrum of methods including chromosomal aberrations (CA), staining bovine chromosomes with fluorescently labelled DNA probes, micronucleus test (MN test) and Sister Chromatid Exchanges (SCE). In addition, comet assay, real-time PCR (for detection of changes in expression of some genes involved in xenobiotic metabolism), detection of DSB (double-stranded breaks) and biophysical methods of interaction of pesticide compounds with DNA could be valuable.

Keywords: cattle, lymphocytes, pesticides, genotoxicity assessment methods

Pesticides are agrochemicals widely used all over the world to protect crop against different kinds of pests. Every year a vast array of new compounds is introduced into the world market and dispersed in the environment to control pests. Pesticides subsequently persist in the soil, water and food, with toxicity related outcomes to both humans and animals (Carvalho et al., 2006).

Environmental quality control requires the monitoring of various indicators, including the assessment of pesticide residues (Salvagni et al., 2011). In addition to acute effects, substantial concerns exist about chronic effects such as cancer and heritable diseases that might stem from pesticide exposure. An association between pesticide exposure and cancer has been suspected for more than 50 years following reports on the occurrence of elevated levels of skin and lung cancer in European farmers using arsenical insecticides in grape production (Eastmond and Balakrishnan, 2010). Recently, there was observed a more rapid decline in insectivorous birds in locations contaminated with neonicotinoids (Hallman et al., 2014) as well as reduced growth and reproductive abilities of fish and reptiles (Gibbons et al., 2014). Livestock are accidentally poisoned by fungicides applied to grains, potatoes and other agricultural material (Oruc, 2010): the most frequently reported species are cattle, however, clinical cases of poisoning are only occasionally studied in depth (Guitart et al., 2010).

In general, farm animals can be affected by environmental contamination caused by genotoxic agents resulting from the excessive use agrochemicals and by industrial emissions. Exposure of livestock to genotoxic agents may result in mutations, metabolic disorders, immunosuppression and reduced fertility. The exposure of dairy cattle to genomic substances showed a significantly higher count of aberrant cells assessed by cytogenetic analysis of bovine peripheral lymphocytes (Rubeš et al., 1997). Bovine lymphocyte cultures seem to be suitable tool for testing of cytogenetic and genotoxic effects of different kinds of pesticides (Lioi et al., 1998; Šiviková and Dianovský, 2006; Šiviková et al., 2011). The important methods are cytogenetic analysis of chromosomal aberrations *in vitro* using classical Giemsa staining as well as staining with fluorescently labelled DNA probes of specific pairs of cattle chromosomes. Other methods are micronucleus test (MN test), SCE Sister Chromatid Exchanges),

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Comet assay, real-time PCR for detection of changes in expression of some genes important in metabolism of xenobiotics, study of DSB (double-stranded breaks) and biophysical methods of interaction of pesticide compounds with DNA. In conclusion, the broad spectrum of methods available allows relatively detail study of pesticide impact on genetic material of bovine cells.

Acknowledgments

The study was supported by the Slovak Scientific Agency VEGA projects 1/0043/15 and 1/0176/16.

References

EASTMOND, D. A. and BALAKRISHNAN, S. (2010) Genotoxicity of Pesticides. In: *Hayes Handbook of Pesticide Toxicology*. 3. ed. pp. 357-380**.** doi: http://dx.doi.org/10.3923/ijp.2012.473.474

CARVALHO, F. P. (2006) Agriculture, pesticides, food security and food safety. *Environ. Sci. Pol*, vol. 9, pp. 685-692.

GIBBONS, D., MORRISSEY, CH. and MIMEAU, P. (2014) A review of the direct and indirect effects of neonicotinids and fipronil on vertebrate wildlife. *Environ. Sci. Pollut. Res*. doi: http://dx.doi.org/ 10.1007/s11356-014-3180-5

GUITART, R. et al. (2010) Animal poisoning in Europe. Part 1. Farm livestock and Poultry. *Vet. J*., vol. 183, no. 3, pp. 249–254. doi: http://dx.doi.org/10.1016/j.tvjl.2009.03.002

HALLMANN, G.A. et al. (2014) Declines in insectivorous birds are associated with high neonicotinoid concentrations. *Nature,* vol. 511, pp. 341–343. doi http://dx.doi.org/10.1038/nature13531

LIOI, M.B. et al. (1998) Genotoxicity and oxidative stress induced by pesticide exposure in bovine lymphocyte cultures *in vitro*. *Mutat. Res.-Fund. Mol. M.*, vol. 403, pp.13-20.

SALVAGNI, J. TERNUS, R. Z. and FUENTEFRIA, A. M., (2011) Assessment of the genotoxic impact of pesticides on farming communities in the countryside of Santa Catarina State, Brasil. *Genet. Mol Biol.,* vol. 34, pp. 122-126.

ORUC, H.H. (2010) Fungicides and their effects on animals. In: CARISSE, O. (ed.) *Fungicides.* [Online]. retrieved October 16, 2015 from http://www.intechopen.com/books/fungicides/fungicides-and-theireffects-on-animals

ŠIVIKOVÁ, K. and DIANOVSKÝ, J. (2006) Cytogenetic effect of the technical glyphosate on cultivated bovine peripheral lymphocytes. *Int. J. Hyg. Environ.-Health*, vol. 209, pp. 15-20.

ŠIVIKOVÁ, K., DIANOVSKÝ, J. and HOLEČKOVÁ, B. (2011) Induction of SCEs and DNA fragmentation in bovine peripheral lymphocytes by *in vitro* exposure to tolylfluanid-based fungicide. *Genet. Mol. Biol.*, vol. 34, pp. 110-115.