Endocrine disrupters in food from animal origin: Identifying Risks at Sources of Exposure

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Endocrine disrupting compounds (EDCs), as naturally occurring or man-made substances, mimic or interfere with the function of hormones. Growing concerns are related to the adverse effects on reproductive, development, neurological, cardiovascular, metabolic and immune systems in both human and animals as well as environmental effects. Among EDCs; organochlorine pesticides, dioxins and dioxin-like polychlorinated biphenyls (PCBs), bisphenol A, styrene, phthalates, organotins and nonylphenol are considered as high priority due to their persistence. As EDCs are mostly lipophilic; they are found in food from animal origin (FFAO) such as milk and dairy products, eggs, meat etc. In order to develop action plans to address priority for EDCs related to the risks from FFAO, risk assessment though globally accepted farm to fork approach should be considered including detailed evaluation of the contamination from the stages of feed, breeding, slaughter, processing, packaging and storage/distribution. Contamination from feed include sources by natural origin; such as phyto-mycoestrogens (zearalenone, genistein, coumestrol) and goitrogenic glucosinolates; sources by storage, transport and processing (inadequate cleaning) and inadvertent means (malpractice especially in waste management- dioxin and furans). Regarding breeding; contraversing studies reveal the differences in the concentrations of EDCs in free-range and organic farms compared to conventional/entansive breeding as the edible sources and environment (landfill fires, packyard burnings increase the emission of PCDD/Fs) are affected. We have previously presented free range/organic eggs contained higher levels of PCB and organochlorine compound residues as well as diethylphthalate; while dimethylphthalate was found almost in all eggs. Dairy products show more variability since large seasonal variations occur in the fat content; and various factors effect the carry over of these compounds through absorption (lipophilicity, source), metabolism, storage. Contamination during process include food conditioning, heating, packaging steps. Milking units (claws, tubes, chambers made from plastic materials) are also considered as a source for phthalate contamination. Among processing; meat/cheese smoking are important in terms of PAH contamination where time and temperature of the smoking process and design of the processing plant directly effects the risk. Packaging sources include food contact materials (FCMs) leading migration of EDCs dependent of the temperature, storage/contact time, physicochemical properties, packaging size. Examples include phthalates from various polymers (polyethylene plastics in milk bottles; high density PE, low density PE), styrenes in packaging yoghurt, cheese, milk and eggs. We have shown the presence of phthalate residues in different types of yoghurt; where the results reveal 88.5% was contaminated with two or more phthalates. In order to slow the onset of oxidative degradation of plastics, addition of antioxidants (arylamines, butylated hydroxytoluene, BisphenolA), to prevent thermal degredation addition of heat stabilizers (PVC, PVDC), reduce the friction of surface addition of slip agents (waxes) are also potential sources for EDCs. Meanwhile, the effect of cooking on the loss/increase of EDCs are under debate; hence cooking methods even contribute the

concentration such as the levels of PAHs are effected by vertical/horizontal barbecue cooking differ as dripping of fat onto the heat source is a primary contributor. Various aspects are related to these hazards including non-monotonic dose response, mixture and very low concentration effects. EFSA set tolerable/acceptable daily intake of some important EDCs; where these amounts should be considered with the maximum residue levels and the residues. Due to the emerging evidence of the adverse outcomes of the exposure of EDCs, risk-reduction measures for the prevention should be harmonized with the principles and methods of risk assessment in accordance to the specific toxicological endpoints and novel methodologies for screening. Permanent monitoring should be applied; where the risk assessment should be translated into enforceable and controllable legislation for optimal consumer protection in terms of EDC contamination through animal origin sources.

Keywords: Endocrine disrupting chemicals, residue, risk, animal origin food