INVISIBLE ATTRIBUTES OF THE QUALITY OF MEAT PRODUCTS – RISK ANALYSIS AND THE ROLE OF MONITORING PROGRAMS.

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Background

A wider recognition of the high level of complexity of food safety and quality (means protection of the consumer health and combats dishonest trade practices and fraud) issues and increasing demands from consumers for maximum protection are other factors forcing regulatory authorities to adopt a more systematic and scientific approach to meat and meat products hazards. In our times of globalization of world economy, protection of food from contamination, spoilage, and adulteration is no longer limited to being primarily a domestic issue; but authorities has to respond to increasing demands for facilitation of international trade.

Risk analysis is an applied science that is of increasing importance to these activities as a means of facilitating the distribution of both pre-harvest and post-harvest inspection resources proportional to the probability of public health and animal health hazards, establishing internationally harmonized standards and provision that are consistent and science-based, and improving the safety and wholesomeness of meat and meat products in local and international trade.

For the consumer as well as for producer the recognition of **unseen** microbiological and chemical contamination are important sources of hazards to human health and has led to more systematic approach to combat these hazards. The abnormalities, which could be detected by human senses, are governing consumer choice, and these hazards or lack of quality could be easily avoided by producer and consumer choice.

Origin and fate of chemical contaminates in meat and meat products.

It has to be stressed that the consumers are occasionally terrified by news in the media that our food is contaminated by compounds dangerous to our health or well being. Usually the products of animal origin are worse in terms risk for consumer health as those of plant origin. In the recent years the consumers were frighten with the BSE in beef or recently with spread of food and mouth disease or dioxins in feed or anabolic steroids residues.

One can say with no doubt that live animals – intended to be used for human consumption – are not producing toxins themselves in contrast to plants, which could contain some chemicals that are known to be toxic to both animals and humans. Some of these chemicals evolved in plants to protect them from insects, plant pathogens, and other organisms

Meat and meat products may contain non-natural substances, residues, as a consequence of human activities, intentional and unintentional, legal or illegal. These substances originated from environment, from air, soil or water (heavy metals, chlorinated hydrocarbons (OC), polychlorinated biphenyls (PCB), dioxins and furans); from veterinary drugs or feed or feed additives (ochratoxin A, aflatoxins); and from technological processes as polycyclic aromatic hydrocarbons (PAHs) or heterocyclic aromatic amines (HAA). Some of them could occur due to the preservation or careless storage like oxysterols and could affect nutritional value of products. (Oxysterols are formed *in vivo* through enzymatic and non-enzymatic processes, and exert wide spectrum of biological activities, which include among others: cytotoxicity against a variety of cells *in vitro* and *in vivo*, inhibition of DNA synthesis, immunological effects)

Chloroorganic pesticides and polychlorinated biphenyls belong to the group of xenobiotics which due to its persistence in environment and lipophylic character are dangerous for human beings and animals. The most commonly they are detected in animal origin products due to their lipophilic character.

The vast majority of these persistent pollutants are characterized not only by toxicity and persistence but also by ability to bioaccumulate and/or bioconcentrate in different tissues and organs of animals. Especially the lipophilic chloroorganic residues could accumulate in animals fat tissues. Other compounds such as PAHs undergo metabolic activation in mammalian cells to diol-epoxides forms which can exert genotoxic effects by covalent binding and adduct formation with cellular macromolecules, including DNA and hemoglobin or albumin. During that process PAHs do the most damage. Other group of PAHs such as nitro polycyclic aromatic hydrocarbons, could act as direct mutagens, but according to the recent reports their levels in food, including meat products, are approximately ten times lower then levels of PAHs. Probably the research on the presence of these group of compounds in foods will be intensified in near future.

For the majority of contaminants in animal origin products, as well as for plant origin, are established internationally accepted values regarding maximum acceptable residues (MRL). For other like PAHs, NPAHs and HAA's such levels are not well-known or levels are recognized by scientific community which constitute a health risk. For example for benz(a)pyrene, the most commonly studied and determined representative of PAHs, legal limits adopted in Germany and some other countries for smoked foods are 1 ppb (1 microgram/kg).

Control and monitoring of chemical residues

The control of residues from animal drugs, pesticides and herbicides, environmental contaminants, and compounds originating during processing, storage or distribution and even preparation to eat, is an important factor in food safety.

Residue control also plays a key role in the international trade of animal-derived food and products. For these reasons, most developed nations maintain systems of residue control both for internal production and import/export purposes. These systems are similar in design, scope, and application. For many years residue control and monitoring systems have emphasized random, statistically determined, nationwide monitoring of a wide range of compounds and food animals and products. Today, at the beginning of the new centry, the problems addressed by comprehensive monitoring have largely dissipated. With few exceptions, chemical hazards in food are either nonexistent or occur in such small concentrations that adverse health affects are unlikely to result in the exposed population. Maximum Residue Limits (MRLs) include large safety factors, and violations are generally a matter of noncompliance with a regulatory level rather than a significant public health concern. The current pattern is one of very specific

problem areas, such as certain compounds, distinct classes of animals, or particular conditions for misuse. A important factor in the current world economy is the significant expense of comprehensive monitoring, particularly when it is related to the limited significant benefits that accrue.
Public health risks and regulatory concerns would be met more efficiently by a more selective and discriminating residue control system based on scientific principles.
Risk-based residue control systems, aimed at specific problem areas, would direct resources to where there are genuine needs and thus provide cost-effective results.
There are both a public health concern as determined by science, and a public anxiety regarding chemical residues, which may not be scientifically based. There is a widespread consumer perception that no residue is acceptable. Risk-based, scientific residue control systems should be based on evaluations of compounds in terms of their use, relative toxicity, and capacity to expose animals or humans to their residues, as well as food consumption factors. The compounds to be targeted and the varying emphasis given to them should be determined by local residue concerns, trade factors, and international scientific guidance.

Risk analysis
Risk Analysis consists of the following elements: risk assessment which include hazard identification, hazard characterization, exposure assessment, risk characterization; risk management risk evaluation, risk management option assessment, implementation of management decision, monitoring and review and risk communication. The Hazard Analysis and Critical Control Point (HACCP) (which could be recognized as a risk management activity) approach is becoming an internationally recognized means of addressing food safety.. HACCP could provide the practical instruments needed. The goal of this approach would be an effective quality assurance system where all parties involved participate in the common attempt of preventing violative residues through proper use and avoidance of environmental contaminants. Other elements of an acceptable control system could include relation's buyer-seller, liability, and traceability of animals, feeds and ingredients. One could predict that further evolution of HACCP will be directed to creation QACCP (quality analysis – approach critical control points) where also quality aspects will be addressed and managed.
For the proper implementation of risk communication to the consumer education is a crucial aspect as well as clarity, transparency and understandability of the provided information or explanation. There is a need for a residue control system based upon sound scientific principles and aimed at those residues that present potential public health risks or regulatory concerns. Risk-based residue control systems would direct resources to where there are genuine needs and thus provide cost-effective results
Food is a good indicator of the quality of the environment, the quality of which is also of a important concerns of societies, in which it grows or is produced. It picks up the contaminants from air, water, soil, machinery and other sources.

Food quality monitoring program of meat products – experiences from program carried out in Poland
The chief purpose of the program has been to establish a better basis for assessing the health risk associated with the levels of some groups of chemical contaminates present in polish origin food. Food, which is free of residues and contaminants, has never existed and does not exist anywhere, safe food does.
In the system which was developed in Poland increased attention is given to the critical parameters which either could be defined as a chemical residues levels or presence of nutritionally important compounds. In respect of meat products the attention is given to levels of chlororganic residues, PAHs, heavy metals and arsenic, and quality of fat (fatty acids pattern, trans isomers of fatty acids, CLA). (Available financial resources limit such choice).
Respective government ministers publish the permissible residue levels of pesticides, metals, nitrate and other chemicals in food in Poland in ordinances issues. In the event of the group of components not regulated by low the common approach of different international organizations as OECD, WTO, FAO/WHO and other countries is applied. The most important in execution of the program is to identify the sources of chemical contamination in food chain in order to undertake appropriate action.
Our data are confirming the declining trends, observed in many countries in the Europe during the last twenty years, of the levels of OCPs and they are not create toxicological danger for consumer. (The number of the meat products above 50% of MRL is less then 0,5% of whole sampled population, 1000 samples per year). The processing of meat does influence the level of neither of OCP nor PCB found in raw meat. In average the level of ΣHCH, HCB and Σ DDT is below 15 % of tolerance level. The levels of PCB are slightly higher in the products sampled from south regions of Poland as compared with other regions.
The PAHs can occur as contaminates in different types of food, including vegetables, fruits, cereals, vegetable fats and oils but in general the levels of benz(a)pyrene are below 1 ppb. Meat products can contain PAHs predominantly due to smoking and heat treatment such as grilling, broiling etc. The average level of contamination of higher molecular weight PAH such as benz(a)pyrene or benz(g,h,i)perylene are at least several times lower as compared with low molecular weight PAHs. In the case of smoked and grilled product detailed analyses revealed that important components in analyzed PAHs were methyl, dimethyl and ethyl substituted polycyclic compounds. The levels of PAHs for grilled products are higher compared to smoked, and are characterized by higher variations, what could be attributed to different grilling techniques used. The use of modern smoking chambers helped to decrease level of contamination of the products with PAHs as compared with traditional smoking kilns.
The levels of heavy metals (mercury, cadmium, lead) and arsenic are within the MRL and are not causing any hazard to the consumers. The highest variations in the residue levels were observed for the cadmium contents. The samples from southeast regions of Poland were characterized by higher levels (but well below MRL). Similar pattern was observed for the cadmium content in plant origin products and soil samples. During the past few years the levels of lead were reduced dramatically due to the common use of unleaded fuel.
It could be concluded that food-monitoring system could be utilized as important and vital tool to collect data and evaluation and hazard assessment of human exposure to unwanted food and risk management.