ANALYTICAL DETERMINATION OF RESIDUES.

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Some twenty years ago most people by mentioning residues in meat would think of persistent chlorinated pesticides as DDT, the industrial product PCB, possibly trace elements as cadmium and mercury and of course residues of drugs. Very few people were able to imagine the great number of compounds or groups of compounds which today are considered problematic or at least indesirable residues in meat.

The great number of compounds is of course closely associated to the increasing use of chemicals in industry and agriculture but also during the years to the development of the analytical procedures enabling chemists to detect less and less residues as far down as to micrograms and even picograms of as well inorganic as organic contaminants.

The development to investigate and detect the great number of compounds has not only taken place because of technical possibilities in the analytical chemistry but also to a great extent because toxicologists, authorities and large groups of the population have wanted to obtain knowledge about the level of chemicals present in the meat or organs from animals which have been treated with chemicals (detergents, pesticides), which have been given drugs directly or in the feeding stuff or which have received contaminants from the surroundings (stable, pesticide treated fields etc.).

Furthermore there is a great interest in the presence of compounds which during the production of meat products may migrate from utensils and packing, which are produced by heating or smoke-curing or which originate from food ingredients added to the meat.

In many countries it is the current opinion that residues of contaminants and especially toxic contaminants must not be present in meat and meat products. For this reason waiting periods are established betwee medical treatment of animals and slaughterin so no residues of contaminants or metabolite should be present. This conception changing as a zero-content has shown to b unrealistic because the analytical metho have been improved to determine very lo residues. For this reason some countrie have established maximum residue limits fo drugs, in the same way as there for som years have been established residue limit for pesticides in meat, and now drug limit are also discussed internationally. Th magnitude of a residue limit for contaminant is of course characterized b the requirement, that residues should b toxicologically acceptable both as regard direct effect and that it should not giv cause to allergy or resistance.

But the magnitude is also to a great exte dependent on requirements of hygienic quali in that way that the residues should be a low as possible even if higher contents woul be toxicologically acceptable.

Mentioned below are groups of compound containing chemicals which today are know to be present as contaminants in meat meatproducts.

Fresh Meat
Fatsoluble chlorinated hydrocarbons (DD and other chlorinated insectides, PC dioxins).
Other pesticides and contaminants which considerable amounts may be present in th feeding stuff (phospheric insecticides, fallo of industrial waste).
Pesticides used against pests on animals, stables or in store rooms containing meat.
Heavy metals from feeding stuff.
Drugs used therapeutically or prophylactica or as growth stimulator.
Mycotoxins from feeding stuff.

Meat Products
Migration of compounds from utensils packing (metals, plast monomers, pla additives).
Compounds added or formed during productio (nitrosamins, chloropropanols, PAH).
Contaminants added from other foo ingredients to the meat (ethylenoxide fro spices or herbs).

Compounds from the groups mentioned are well known as possible contaminants, but it is beyond doubt that most of the groups also include contaminants, about which we today have very little or no knowledge.

Thus we know that meat to which nitrite has been added contains several volatile nitrosamines, which now are relative simple to determine even in the same analytical procedure. But our knowledge is very limited to the contents of non volatile nitrosamines of which several as for the volatile compounds are carcinogenic. These compounds are difficult to analyse, and as they have to be determined separately, it is a troublesome work to obtain sufficient knowledge.

By determination of the polychlorinated biphenyls (PCB) semiquantitative methods have been used for several years to determine the total contents in fat from meat. The contents determined in that way are unfortunately dependent on the analytical method used. Some countries have changed procedure and now make precise determination of 6–8 selected congeners out of the more than 200 congeners included in the group. There is however a disagreement about which congeners you have a special need to determine.

On the other hand there is agreement about the congeners which have to be determined when analysing meat for contents of dioxins and dibenzofurans. Some of the congeners in this group are extremely toxic, but they are present in very low quantities and require very sensitive analytical methods which also are capable of identifying each single congener. This is only possible by using a massspectrometer, and a routine control for dioxin will not be possible.

Interest for residues of drugs in meat has increased considerably during recent years concurrently with the increasing use of drugs in animal husbandry. Until now most effort has been used to determine residues of the mostly used antibiotics as penicillin, streptomycin and tetracyclin. The methods used are normally microbiological, and with these methods it is possible by routine to determine a great number of samples. Without doubt there is a request to be able to determine these and other antibiotics with a higher sensitivity, and then you have to use chemical analytical methods with HPLC and preferably a mass specific detector. Also analytical methods are developed to determine other drugs used therapeutically or as growth stimulators and the methods are going to be used in a routine control.

Today we know only about one mycotoxin which is present in meat and organs: Ochratoxin A. All other known mycotoxins seem to be present only in plant material. But our knowledge about mycotoxins is rather limited, and it is very likely that today unknown mycotoxins could be present as problems in meat or meat products.

A lot of investigations have been made in several countries on the contents in meat of the trace elements: mercury, cadmium, lead, nickel, arsenic and selenium. But there is a need to know in which form these elements are present, i.e. if they are inorganic or if they are organic bound. This is important to know as the toxicity and also the possibility of uptake in the human organism are dependent on the chemical structure of the compound.

By heating of meat and meat products and especially by frying it has been shown that mutagenic compounds are produced, and that the quantity is increased with increasing temperature. Also these circumstances have to be looked into especially to be able to change conditions at the processing to avoid production of such compounds.

The examples show that there still is an increasing need to investigate residues in meat, investigation which include research, monitoring but also to a great extent analytical control. The analytical work is very dependent of this type of work. By research and monitoring are usually used complicated analytical technology which enables us to analyse and identify very low concentrations of contaminants and metabolites. The analytical methods used in the routine control are developing in a way to use automatic equipment when possible, and in the future the analytical chemical methods, using equipment as gas chromatographs, liquid chromatographs, atomic absorption spectrophotometers and mass spectrometers to a great extent will be

supplemented with RIA (radio immuno assay) and EIA (enzyme immuno assay) and other very specific and sensitive methods. The extension of the analytical control activity is of course very dependent on the demands authorities and the general public are making on the quality of meat and meat products for human consumption. If it still is the general opinion that the products by principle must not contain contaminants or only quantities of contaminants at or about the limits of detection of the analytical methods, large resources are required. On the other hand if the attitude is that residues in meat are acceptable but only in toxicological acceptable quantities the analytical control activity will be considerably more simple. This is a political decision only, but in the interests of international trade it is essential that international agreement is obtained on which principle should be accepted.