physical/rheological properties. Viscosity is a fundamental rheological property both of the foods used for feeding, and the for test foods applied in endoscopic and X-ray swallowing studies. The aim of this study was to determine the viscosities of the test foods as well as those of foods used for feeding in order to compare and standardize them. We prepared an increasingly concentrated series of the test foods (jelly, pudding, puree, mush) by adding thickening substance (Resource Thicken Up® (Novartis) made of cornstarch) to water, and then determined the viscosities. We also measured the viscosities of commercially available foods, self-prepared foods of different thickness, and foods with known formulas. From these results we could identify the food formula that corresponded to the test bolus that could be swallowed by the patient without aspiration in the course of a video-endoscopic or X-ray swallowing study. The measurements were taken with a dynamic shear rheometer (UDS200).

ADVANCE METHODOLOGY FOR CONTROL OF CHEMICAL CONTAMINANTS IN FOOD

Rositsa Mladenova
National Service for Plant Protection, Plant Protection Institute,
35, Panajot Volov str., 2230 Kostinbrod, Bulgaria,
e-mail: rmladenova@gmail.com

In order to ensure the safety of food, it is necessary to consider all aspects of the food chain from the primary production through the harvesting and storage to the processing and sales and supply of food to the consumer. The main contemporary tendencies in fast screening of food contaminants and residues are discussed. The main steps of laboratory analysis are mentioned. Besides laboratory available methods for precise and relevant analysis, some practical approaches are presented for early detection of contaminants as immunoassay in different formats. Their advantages and disadvantages comparing to the traditional instrumental methods are outlined.

Sources of chemical contamination of plant foodstuffs

Food is an essential ingredient to life, and access to food is often limiting factor in the size of a given population. Many substances are used to grow the quantity and quality of food needed the human population. Many of the agrochemicals are pesticides (e.g. herbicides, insecticides, fungicides, acaricides, fumigants) that may appear as residues in the food. Other type of agrochemicals that may appear as residues in animal-derived foods are veterinary drugs (e.g. antibiotics, growth promotants, and hormones). Different types of environmental

contaminants (e.g. polyhalogenated hydrocarbons, polycyclic aromatic hydrocarbons, organometallics) can appear in food through their unintentional exposure to the food through air, soil, or water. Food may also be contaminated by toxins from various microorganisms, such as bacteria or fungi (e.g. mycotoxins) or natural toxins already present in the food or that arise from spoilage. Packing components (e.g. styrenes, phthalates) can also leach into food unintentionally. In addition, chemical preservatives and synthetic antioxidants may be added after harvest or during processing of the food to extend storage time or shelf-life of food products. Other chemical additives (such as dyes, emulsifiers, sweeteners, synthetic flavor compounds, and taste enhancer) may be added to the food to make it appear better to the consumer or to alter its taste or texture.

Main aspects of analysis of chemical contaminants

Sample preparation for analysis of chemical contaminants in foodstuffs and foods consists of homogenization, extraction and clean up steps. Homogenization of sample is extremely important in some cases when contaminant is unequal distributed. A common example is mycotoxin analysis due to irregular distribution of fungi infection on the crops. This special feature requires strictly homogenization of high amount of sample and analysis of random portion of it.

The extraction procedure consists of separation of the analytes from the matrix and presentation of the material in a form that can be easily analyzed. The type of extraction step that is used for a particular matrix depends on the nature of the matrix and analytes. In some cases it is possible to extract many analytes by one solvent or solvent mixture (e.g. pesticides, phthalates), but in another case it is necessary to apply different extraction systems for analytes, because if their different structure and behavior (e.g. mycotoxins).

Currently, the common analytical approaches used for detection of chemicals in foods involve gas or liquid chromatography coupled to selective detectors (Hu et al., 2004; Stajnbaher D. et al., 2003). Due to co-extraction of many matrix components which lead to overlapping or masking of signal for analytes, matrix-matched standards should be used and confirmation of positive results is needed for official control purposes.

Nowadays, analytical methods in control laboratories are multi-class, multiresidue methods in order to detect a great number and wide range of contaminants (Anastassiades et al., 2003). In case of veterinary drugs, multiresidue methods are lacking and it is not unusual for single-methods to be used in monitoring programs. Many of common methods are time-consuming, laborious, and expensive, require careful safety precautions, generate hazardous waste, use a lot of glassware and lab space and lack of degree of sensitivity needed for some applications.

Screening techniques for analysis of residues and contaminants

An immunoassay is a biochemical test that measures the concentration of a substance in a sample or sample extract, using the reaction of an antibody or antibodies to its antigen. In case of pesticide residues. immunoassay is particularly suited for polar, water-soluble pesticides and their degradation products that are generally difficult to analyze using conventional analytical methods. Comparisons of quantitative immunoassay with conventional single residue methods using gas or liquid chromatography to analyze specific pesticide/food commodities show that immunoassay can analyze four to five times as many sample in a given time period (Newsome et al., 1981; Newsome, 1985; Newsome, 1987). In addition, immunoassay can be simpler to use than conventional techniques, require less skilled personnel, minimum instrumentation time and comparatively inexpensive equipment. Some notable applications of ELISA give detection of particular herbicides in water and soil samples (Gabaldon et al., 1999; Wright et al., 1999). Nowadays, tests for pesticides are available mostly for herbicides belonging to triazine group - atrazine, cyanazine, but also test kits are developed for carbamates (carbofuran, aldicarb), acidic amides (alachlor, metolachlor), phenoxy acids (2,4-D), aldrin, paraquat ect.

Much more popular are immunoassay tests in mycotoxin analysis because usually different compounds are analyzed by single methods. Using immunoassays, it is possible to reduce time of analysis and to improve laboratory throughput. There are commercial test kits in different format - ELISA kits, strip kits, caps, immunoaffinity columns, available for all regulated mycotoxins. Analysis of animal samples is facilitating by ELISA kits available for some veterinary drugs as chloramphenicol, nitrofurans, corticosteroids and hormones. Usually monitoring of human exposures to polycyclic aromatic hydrocarbons is performing by monitoring of its metabolite benzo[a]pyrene in blood and urine (biomarker). Polyclonal and monoclonal antibodies against its DNA adducts have been developed and used in radioimmunoassays or competitive ELISA assays in order to monitor human exposure to benzo[a]pyrene (Santanella, 1988; Santanella, 1990).

Despite above mentioned advantages, immunoassays may not be as sensitive for some compounds as conventional methods, and they can have lower levels of reproducibility. Because immunoassays are compound-specific they are not suitable for multi-residue analysis. In some cases food matrix requires considerable cleanup work, therefore immunoassay may be no faster than conventional techniques. In addition, for some analytes with small molecules or having non-rigid structure it may not possible to develop antibodies. There are still a lot of discussions regarding cross-reactivity of specific antibodies with other chemicals present in food.

REFERENCES

Anastassiades M., Lehotay S. J., Stajnbaher D., Schenck F. J. 2003. Fast and Easy Multiresidue Method Employing Acetonitrile Extraction/Partitioning and "Dispersive Solid-Phase Extraction"for the Determination of Pesticide Residues in Produce, *J. Assoc. Offic. Anal. Chem.*, 86, 412-431.

Hu X; Juanxin Y, Znigang Y, Lansun N, Yanfei L, Peng W, Jung L, Xin H, XIagang C, Yibin Z. 2004. Determination of multiclass pesticide residues in apple juice by gas chromatography-mass selective detection after extraction by matrix solid-phase dispersion. *J. Assoc. Offic. Anal. Chem.,* 87:972-985

Gabaldon J.A., Maquieira A., Puchades R. 1999. Current trends in immunoassay-based kits for pesticide analysis. *Crit. Rev. Food Sci. Nutr.*, 39:519-538.

Newsome W.H. 1987. Determination of iprodione in foods by ELISA. In "Pesticide science and biotechnology", R. Greenhalgh and T. Roberts (Eds.). London, Blackwell Scientific Publication.

Newsome W.H. 1985. An enzyme-linked immunosorbent assay for metalaxyl in foods. *J. Agri. Food Chem.*, 33:528-530.

Newsome W.H., Shields J.B. 1981. A radioimmunoassay for benomyl and methyl-2-benzimidazolecarbamate on food crops., *J. Agric. Food Chem.*, 29:220-222.

Santanella, R.M. 1988. Monitoring human exposure to carcinogens by DNA adduct measurement. *Cellular biology and toxicology,* **4:** 511–516.

Santanella, R.M. 1990. Immunologic methods for the detection of carcinogen adducts in

humans. *Progress in clinical and biological research,* **340C:** 247–257.

Stajnbaher D., Zupancic-Kralj L., 2003. Multiresidue method for determination of 90 pesticides in fresh fruits and vegetables using solid-phase extraction and gas chromatography-mass spectrometry*, J. Chrom. A*, 1015:185-198.

Wright P.F.A., Apostolou E. 1999. Advances in immunochemical methods of analysis for food contaminants. In "Environmental contaminants in food" C.F. Moffat and Whittle (Eds.) CRC Press. Sheffield. UK. 81-103.

MULTICOMPONENT CHROMATOGRAPHIC METHODS FOR DETERMINATION OF PESTICIDE RESIDUES IN FOOD

Rositsa Mladenova, Deyana Shtereva

National Service for Plant Protection, Plant Protection Institute, 35 Panaiot Volov str., 2230 Kostinbrod, Bulgaria
e-mail: rmladenova@gmail.com