reprinted from:
trends in analytical chemistry, vol. 6, no. 2, 1987

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Analytical chemistry in meat research

A Report on the 32nd European Meeting of Meat Research Workers, Ghent, Belgium, 24–30 August, 1986

Introduction

The European Meeting of Meat Research Workers (EMMRW) was founded in 1955 in Hämeenlinna (Finland) and each year since then scientists and technologists have gathered in a host country to exchange ideas and experiences in meat research.

Initially intended to be European, the congress now attracts scientists from all over the world. In 1986 the 32nd EMMRW was held in Ghent, Belgium for the first time. Finland will be the host country again in 1987 and Australia, Denmark and Cuba have offered to host the meeting in succeeding years. For the 1987 meeting in Finland, the name EMMRW will disappear and be replaced by ICoMST (International Conference of Meat Science and Technology).

The following topics were chosen for the congress held in Ghent: (1) growth promoters in farm animals; (2) slaughter technology and early post-slaughter handling; (3) post-mortem muscle biology and biochemistry; (4) hygiene and microbiology; (5) mean processing: fermented products; (6) meat processing: cured products; (7) meat processing: cooked products; (8) meat and meat products in nutrition; and (9) analytical methods and meat quality assessment.

Analytical chemistry

Papers using analytical chemistry appeared in topics 1, 8 and 9 and will be discussed under these sessions. The main subjects were: analysis of 'boar taint' components, analysis of residues of growth promoters (*e.g.* anabolic and thyreostatic drugs), analysis of heavy metals, minerals, fatty acids and macronutrients (nutritional value), species identification, application of instrumental techniques such as NMR and differential scanning calorimetry (DSC) in meat research and the comparison of different analytical methods.

Session 1

In this session the emphasis was on growing animals to produce more meat in less time. Analytical chemistry was involved in 7 of the 17 papers. First there was a group of 4 papers concerned with the quality of meat from uncastrated male pigs.

Boar taint

The rearing of entire male pigs (boars) instead of the castrated animals (barrows) is economically advantageous, but in some cases, meat from boars can present a strong and unpleasant odour, described as 'boar taint'. One of the compounds claimed to be responsible for this is androstenone, a naturally occurring hormone, and another is skatole. The relative importance of androstenone and skatole was examined in a consumer test by Walstra *et al.* After screening 380 boars for androstenone and skatole content, they found that skatole seemed to be more important than androstenone. Mortensen *et al.* determined skatole in 1000 pig samples with an analytical system capable of handling 150 samples per hour. They found that analysis of skatole was as good as judgement by a trained taste panel. The analysis of androstenone and skatole by high-performance liquid chromatography and high-resolution gas chromatography in meat products was described by Garcia-Regueiro *et al.*, the principal purpose of whose work was to study a simple procedure for facilitating the simultaneous analysis of the principal compounds associated with boar taint. De Brabander *et al.* showed that the androstenone content of pig fat may be decreased be anabolic treatment during fattening. These authors also compared two analytical methods for androstenone determination and found good correlation between enzyme-linked immuno sorbent assay (ELISA) and a gas chromatographic method.

Growth promoters

Following the boar taint papers, another three papers were devoted to the detection of growth promoters. Verbeke and Van Hee presented a poster on the rapid chromatographic purification of anabolics in bovine urine using group fractionation on coupled Polyclar© and cyanopropyl columns. De Brabander and Verbeke determined the residues of the natural thyreostatic drug 5-vinyloxazolidine-2-thione in ruminant tissues after feeding of rapeseed meal. The levels of estrogens in muscle tissues of pregnant cows were measured by Fernandez Suarez *et al.* and compared with levels found in steers implanted with oestradiol. This comparison showed that tissues of non-implanted animals reach natural levels of estrogens which are higher than those found as residues in implanted animals.

Session 8

Session 8 considered meat and meat products from the viewpoint of nutrition. Of the 17 papers, 6 are reported here because they should be of interest to analytical chemists. The first two concerned analysis of macronutrients or nutritional value.

Nutritional value

The macronutrients, amino acid composition and price of commercially produced minced meat in Belgium was studied by Demeyer and Dendooven. The authors concluded that the price of minced meat reflected the nutritional quality to only a very limited extent. Claeys and Demeyer studied the nutritional value of snails (*Helix aspersa*). The essential amino acid content in snail protein (*ca.* 35%) was lower than the meat value predicted from the collagen content in crude protein.

Minerals and heavy metals

There is much interest in Egypt in the nutritional value of native animals. Kamal *et al.* studied the mineral content of 7 Egyptian beef and buffalo meats. The organs of beef and buffalo may be considered as rich sources of phosphorus, and good

sources of iron in human diet, but they are apparently low in calcium. Boiling of the buffalo organs reduced the P, Ca, Na and K contents but increased Zn, Cu, Fe, Mn and Mg contents. The transfer of some heavy metals (Cd, Cu, Hg, Pb and Zn) from 'Ferkelwuhlerde' (a solid waste compost product) into pork liver and kidney was studied by Hauser but no significant differences were found between control animals and animals fed compost root soil.

Fatty acids

Simon and Gandemer found a very important difference in the PUFA (polyunsaturated fatty acids) composition of the lipids from mechanically deboned (MDM) pork and poultry meat. Lipids in MDM chicken contain PUFA of the (n–3) family which are not present in pork MDM. Chicken MDM will therefore be more susceptible to oxidation than pork MDM and consequently have a shorter shelf-life.

Session 9

The last session was concerned with general meat quality and analytical methods. Of the 22 papers in the session, 15 are discussed here. Eight of these were devoted to species identification (SPID).

Species identification

There is a great need for simple and reliable analytical methods to determine the animal species from which meat products are made. The papers were divided into two groups: fresh meat and processed meat products.

SPID of fresh meat

In fresh meat, SPID is mostly carried out on the protein fraction by electrophoretic or immunological techniques. After isoelectric focusing of the myoglobins of undiluted meat juice Hoffman found that most of the 13 species investigated (*e.g.* cattle, buffalo, kangaroo) show two main bands and several minor bands and may be easily identified. Jones *et al.* tested the 'ORBIT' screening system for fresh meat species and added some practical modifications. This agar gel immunodiffusion test seems to be extremely practicable while the cost is relatively low. An indirect ELISA assay for detecting the presence of chicken meat in unheated meat mixtures was described by Martin *et al.* The antigenic extracts comprised soluble meat proteins from cow, horse, pork and chicken. Anatomical location of the meat also seems important. For good quality in processed poultry meat products, breast meat from broilers was preferable to that from spent hens. A histological technique, based on muscle fibre size, which could be used for determining the origin of poultry breast meat was described by Uijttenboogaart and Jansonius.

SPID of processed meat

In processed meat products, the sarcoplasmatic proteins may be denatured, so that electrophoretic and immunological techniques cannot be used. A valuable approach in identification of meat species is the use of the heat-stable fat fraction. Egyptian scientists are very interested and active in detection methods for presence of pork in meat products, since it is prohibited by the Islamic religion.

Nour-el-din *et al.* described the detection of lard in canned mutton. Fatty acid analysis of the triglycerides and the 2-monoglycerides prepared through pancreatic lipase hydrolysis were used to calculate factors for the determination of lard content. Youssef *et al.* studied the lipolysis and fractionation of triglycerides by argentation thin-layer chromatography in lard and beef tallow mixtures. They found that the palmitic acid enrichment factor (2.393 and 0.893 in lard and beef tallow, respectively) could be used to detect 3% lard in beef tallow. An alternative test for adulteration of beef tallow with lard is based on the $C_{18:0}/C_{18:2}$ ratio which is 0.952 and 5.941 in lard and beef tallow, respectively.

The use of cluster analysis in the identification of four animal species (beef, pork, horse and hen) was described by Verbeke *et al.* Using the data of the fatty acid composition of triglycerides and 2-monoglycerides from an earlier investigation a cluster analysis computer program was able to classify the data into the correct species.

Instrumental techniques as NMR and DSC

Tornberg and Larsson measured the changes in the water distribution in beef muscle during cooking by recording the transverse relaxation time of the water proteins in the meat by pulse-NMR. The largest distribution changes were observed between 60°C and 70°C. At the same time water content of the meat dropped from 73 to 53%. Pulse-NMR was also used by Borowiak *et al.* in studying PSE meat (PSE is a meat defect = pale soft exudative meat). They observed significantly different relaxation times for normal and PSE pork two hours after slaughter. Huyghebaert and De Moor studied the physical properties of fats and fatty tissues by pulse-NMR and found that at 5°C a significant proportion of pork fat was still in the liquid phase. DSC was applied by Skala *et al.* to characterize changes which occurred during storage of intramuscular lipids from castrates and boars.

Comparison of methods

Duda and Szot compared 7 methods of protein determination in blood plasma. A densimetric method was recommended for inter-operational control because of its high sensitivity and precision, its low cost and analysis time. Two analytical methods for the determination of hydroxyproline (collagen) content in meat products were compared by Deweghe *et al.* Based on the results of 42 samples, they found that a simplified ISO method was the most suitable for routine analysis.

Residue analysis

Haagsma and Van Elteren investigated the effect of processing methods on residues of sulphamethazine (a sulphonamide drug) in meat products. No decrease of sulphamethazine was observed during preparation of luncheon meat but only 20% of the original amount could be recovered in raw fermented products.

Conclusion

Analytical chemistry is directly involved in nearly 20% of the papers or abstracts presented at the 32nd EMMRW. Analytical techniques were also used in papers not reported here. For instance, gas–liquid chromatography can be used for identification purposes in microbiology. There is no doubt that analytical chemistry plays an important role in meat research, and will continue to do so to an incresing extent in the future.

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