

SESSION 9 - ANALYTICAL METHODS AND MEAT QUALITY ASSESSMENT

From meat characteristics to "integrate quality" Position and function of meat research workers

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Progress in the meat chain may arise from different sources which can be described by some words : innovation, economic pressure, human behaviour. In this environment, different people are able to bring their collaboration and to influence the decision or the nature of investments. The role and position of meat research workers is really multiple, even in some circumstances, they are not well or fully considered, or are confined to their laboratory (called in this case ivory tower) from which they try to escape. The reason is, that sometimes their ideas on future of meat process could introduce disturbances in the equilibrium of the market where some firms or influent people, would impose their way of thinking. Such situation is not really frequent and contacts and exchanges increase between research workers and profession side, where more and more people well trained in science and technology will take leader positions. So the traditional definition of the process and chiefly the sentimental approach of the quality will be progressively replaced by objective and measured characteristics.

• What is QUALITY ?

Every body has his conception of meat quality, but the detailed description of this general concept, offers different aspects owing to the position or function of the speaker along the meat chain. Many advisers or those who have to reach a decision in firms or at official level, place opinions of consumers at the first priority. Certainly the consumer decision to buy meat or meat products forms the basis of the meat industry. But consumers are largely variable and versatile. Behind them, they are some exigences to satisfy from distribution and industrial people who have in charge collecting, slaughtering, chilling, processing and merchandising. Even if we considered them, the economical importance of their exigences must not shade necessary rights of producers or rules of Official Bureaux in charge for controlling quality and safety of foods.

Meat research workers have a permanent duty in this system, not only to explore different aspects of characteristics, which combine for elaborating what every body call QUALITY. They have also to propose explanation for their basis, to furnish apparatus for their measurement and for following their evolution.

• Choosing characteristics :

From these different definitions or from these different needs or requirements, characteristics which are actually important to consider are difficult to choose.

Different levels of security or accuracy of measurements have to be considered.

- At this point of view, breeders or processors try to evaluate carcass composition, genetists and technologists have similar purposes but fatness and lipids contents cannot be only qualified by adjectives even superlatives, sufficient for somebody, because other partners will ask weight and pourcentage.
- When processors try to supply consumers with lipid fixed level products, they must control continously the lipid content of their final products. But to reach the better level of return, it is not at this final step where efficient action is source of income, analysis must be conducted at the level of raw material and at different steps of processing.
- Methods of measurements used in the plant will not be the same as those used by control services. They examine value of products on the market and check if they are in the accepted range of normal products of the same type, or eventually when composition regulation are accurate to judge, if a product is consomnant with them. At the top, in case of contestation and necessity of pleading, methods must be qualified by the Official Bureaux or professional Board (AOAC, CODEX, ISO....).
- It happens also that some characteristics are only considered by a single ring of the chain. For example the possibility of identification of sources of protein used in general products or other mixtures. Numerous and fine research works were done or are in progress, to recognize vegetable proteins, animal type (beef, pork, horse, poultry...) authorized or not proteins, in raw products or since some years in cooked and frozen products (PATERSON, 1984). These methods are irreplaceable for Control and Fraud Services. Research workers may be proud of their accuracy and efficiency. But these methods will never be used by processors who know very well the different meat or proteins they used in their factory.
- Scientists and Technicians, contribute to increase knowledge and try to improve meat processing. Owing to the preceding considerations they must work at different level, establish and perfect different type of analysis and methods of measurements. Tentatively three classes of technics may be considered :

1) Methods necessary for research and increasing knowledge. They are used in laboratories. They are often based on sophisticated principles and need heavy and costly apparatus. They will never be used in factories in their present form.

2) Methods for control. They are established to check different aspect of composition or hygienic level concerning microbiological, toxicological points. Many of them can be difficult to use and generally they are time and product consuming.

3) In the third group there are methods which can be used in different points of the meat chain by non specialist in chemistry, physic or other basical science. These methods are simple, quick enough and non destructive.

At this point arises the problem of sampling. It is a part really important and not yet well solved for meat product in general. The tendency which appears very well is the international standard like produced by ISO, is the necessity of agreement between parties to find what will be controlled and what will be the size and number of samples. This position is more in accordance with possibilities and difficulties to obtain a representative samples in the case of meat products which are presented under so many aspects from carcass to final products.

The value of sampling and its importance change largely in function of objectives : from checking of raw material, to program and to follow a process or for control validity of product at end of processes and offered to consumers. This specific sampling at the different step is logically followed by specific analysis corresponding to the aim of the operation.

Combination of characteristics to Integrated Quality

It is an utopy to want to reach an "universal equation" combining meat characteristics and to obtain an INTEGRATED QUALITY valuable for everybody as the standard meter? Answer is uncertain. From the different point of view of people along the meat chain, elaboration of Integrated Quality seems difficult for multiple reasons. The agreement between different parties to reach the concretisation of the concept I.Q. might be obtained on common characteristics. Even if it is possible the, next step would be to affect each selected characteristic by the appropriate coefficient owing to, not only their economical influence, but also their psycho sensorial value for consumers. Indeed, if that is the case, such characteristics, like origin of the product or way and method of breeding and feeding of animals, even they have not scientifically proved influence on chemical or organoleptic characteristics, would be introduced in this Integrated Quality. The "Label Rouge" in France try to distinguish labelled products between the others, mainly by definition of condition of production. It is perhaps the begining of Integrated Quality, but more must be done to certify with the aposition of the "Red Label" more characteristics such as tenderness chemical composition or possibility of certain type of cooking.

What and When ?

Meanwhile ideal conditions cannot be set up, reliable methods are used to follow main characteristics. In the past and recently descriptions were already given for different objectives (for biological side and production (NAUDE, 1985) or for processor and industrial (JUL, 1973)).

It is really an universal problem and unfortunately not yet resolved in any country nor at international level. Some partial or tentative solutions are in use at different point of the meat system.

From animals to carcasses.

An accurate judgement of carcasses is very important for producers and also for processor. At this level, is determined the of return farmers and for the second, possibility of processing after appearance of some characteristics, signal of chemical composition or physical properties.

Carcass classification in many countries is described officially. An important information was collected about them (KEMPSTER et al., 1982), but a lot of research works continue to be done. Indeed, even some objective principles (like profile) are part of criteria used for classification, it is not really a measure of Quality of carcasses. Progresses are expected from interesting tentatives which are under experimentation to measure conformation, fatness and chiefly fleshing. Angles in different anatomical locations or variation of shape by video camera are used. Important improvements were recently obtained by the use of three dimension system. Images are analysed and numerised. Accuracy is dependent of the size of the pixel, elementary unit of analysis, but this technic is improved day after day.

Meanwhile, this approach is not sufficient even if it is largely used and satisfies official main objectives : definition of prices, international exchange and regulation of the meat market. Already in the present system judgement of fatness is not accurate enough in the case of beef carcass. Only two or three chosen characteristics are not always in correlation with different characteristic of meats, their possible technological uses and finally their organoleptic values. To reach this last objective which is the real motor of the market tow questions appear :

- Will the same characteristics be maintained in the future ?
- Or would they be replaced by set of new ones ?

Just to keep in mind : objectives of mechanisation of grading for beef and pork carcasses are obviously to improve accuracy, without decreasing speed of slaughter lines. Until now, improvement of classification system were limited because standard are applied by men in factory conditions. Can this conception of human

Classification be maintained? Two new questions arise: Does industry try to automatise measurement of actual criterias or have they to propose new aspects or characteristics? It is true that classifications in use, were established twenty years ago from tradition and trade habits. From this period many scientific data were collected. In particular influence of conformation, very high on the market fifty years ago has lost its preponderance over fatness and bone development, because the law of anatomical harmony (BOCCARD and DUMONT, 1960). Instead of the former method, (which is an indirect way to appreciate the real valuable part of carcass: muscles through shape, thickness or other aspects), is it not possible to propose few criteria more direct to have an accurate weight of muscle?

For pork, the scheme is near to hit target by measurements with ultrasonic or optical probes. Meanwhile this success lies in this species because different reasons. Porks are considered in a narrow range of weight Relationship between fatness and lean proportion is closer in pork than in beef. These species offers in a real accessible anatomical situation the major part of their fatty tissue easy to sound.

For beef unfortunately, lean proportion remains to be estimated indirectly by different criteria. At the day before industrialisation of the meat system will achieve, it is really urgent to carry on work, on direct appreciation of meat content of carcasses which is already an obsolete tradeproduct. In United States, Problem of domination of "boxed meat" is an harbinger.

Now it appears clearly that meat by itself, not only by its proportion, but by some criteria of use and sign of organoleptic value, must be carefully appreciate.

At least 2 or 3 items will be important to consider at the end of slaughter line:

- pH value
- color of meat
- stage of maturity.

The first one, for industry, determines keeping ability (NEWTON and GILL, 1981) and, yield of technological processes. Measure of pH, easy in laboratory needs some special precautions at slaughter house (DUTSON, 1984) and because of difficulties to obtain reliable measurements and to computerise them, other criteria and tools were proposed (SWATLAND, 1985) for evaluation of some technical charcateristics.

Color of meat is predictable from characteristics available at the carcass level colour it is an important factor for consumers decision to buy or not (HOOD, 1976).

Processors are directly concerned with these aspects and pay to be sure to have good capacity of processing. On other side it will be important that producers get better gross return in compensation for investment in their farm and efforts at work. This point, true for colour, will be the same for all other measured improvement in any characteristic changed by biological ways at the farm level.

Some factors which influence tenderness can be considered in the same maner.

Tenderness is never measured more accurately than in the plates of consumers, but in slaughter houses some well known factors are to be considered at the carcass level or on raw meat. If it is interesting to prevent alteration of tenderness by measuring temperature in chilling or judge all technological influences by the sarcomere length, it would be more profitable for the futur to control collagen content of animal and to inform consumers on its level of reticulation. Both factors which depress tenderness of meat and on which it is possible to act biologically by selection and feeding of animals, castration of males or level of feeding.

At the carcass level type of animal and anatomy, informs but too coarsly on the collagen level, and unfortunately hydroxyproline determination easy at laboratory is not transferable at abattoir. More, cross linkage of connective tissue, which increases with age and enables it stronger and stronger, is not for the moment taken into consideration. It would be a big increase of the knowledge of technological possibilities to introduce an appreciation of the physiological age of animals or a value of their maturity. By measurement of pigment content, possible with optic probe or reflectometer, and consideration of calcification progress in cartilages from very well defined anatomical sites with convenient physical technics (like X rays) it would be possible to propose reliable scale of maturity. This way is open, but more knowledge on the variation between animals, breeds countries nutrition conditions, season ..., must be done before introduction of such system on the market.

Raw meat and meat products

Similar needs of information concern composition of meat products and raw materials used in processing, especially for lipid content, type, length of chain, ramification, saturation which are subjects to hot discussions between nutritionist, physicians and consumers.

Many technics are available. At carcass level, except in pork, they are mainly indirect and inaccurate. For porks or better for minced meat, numerous apparatus, give data accurate enough for industrial purposes but only in well define conditions. Unfortunately, most of them ask sampling and long time, and industrial people wish to obtain analytical results immediatly on the line for their different processes (PETINATI, 1980).

Water protein lipid contents, but not yet microbiological count, seems accessible with some modern technics.

Two and, very soon, three, analytical procedures will be in competition on the market : Infra-Red, Nuclear magnetic resonance, X-Rays.

Infra-Red

Since 1960, Near Infra-red reflectance has been used for instantaneous and non destructive analysis of different food products. But for meat and meat products experimental data are scarce and results not always concordant. Besides problems of sampling, the absolute necessity of calibration with well known products of the same type, remains, to reach a correct level of accuracy (BONNET et KOPP, 1986). These conditions explain why many people obtained disappointing results with this method which seems very attractive and easy to practice (ONO et al., 1984).

Nuclear Magnetic Resonance

Nuclear magnetic resonance (NMR) methods show great promises. Its principle is based on the magnetic reaction of products placed in an intense magnetic field which orients atomic dipoles. After a magnetic impulsion is given perpendicularly at this field and the position of dipole changed, examination of return at their initial equilibrium, variable owing to the various components, gives information on the composition of products.

Already use for long time for fat, recent extensions are in progress for many components (water, mineral, protein, and even collagen). NMR seems really valuable method. Main objections are : the size of sample to be used, limited by the hole in the magnet and the price of apparatus. Many progresses can be expected in size of the magnet and decrease of the cost.

X-Rays

Largely used in medicine, X-Rays has been rapidly applied to the measure of defect, inside some manufactured product (metallurgy) or in animal husbandry for thickness of the dorsal lard in pork. For some times, apparatus were adapted for successful appreciation of lipid content in minced meat.

Industry actually proposes new detectors. They were designed some years ago for image analysis process. Their use in checking luggage content is well known. To pass from this use to composition of carcasses or products on line with adapted computer seems easy. It is actually in progress for fat, lean content. This

approach is certainly facilitated by a long time and deep knowledge of properties of X-Rays. The ability of industry to propose different apparatus well adapted to various conditions and prices less expensive than for R.M.N. apparatus are excellent reasons for extension.

Fate of physical measurements

Generally speaking, physical methods are more and more considered by industrial people and research workers because they fit well in the industry conditions, but numerous works must be done to fix their use, their accuracy and to establish their relationship with the final step of appreciation of Quality of product: the consumer satisfaction or generally speaking with the organoleptic characteristics of meat and meat products.

The extension of physical method in large plants and big companies, is for them, the possibility to increase homogeneity and constancy of their products. For modern traders, especially for modern distribution, these characteristics are very important, consumers like to find same characteristics in the same product all along the year. For industry, better control of homogeneity and constancy of composition, mainly lipid content, authorize to be near limit of value indicated by regulation ; and every 0.1 of percentage of lipid instead of lean, improves financial interest of the process.

Physical apparatus give always data, but these results do not inform really on the acceptability of the products. Many experiments have been conducted on their participation in the customer habits and satisfaction, but for many characteristics, analytical methods, physical or chemical are unable to inform with certainty. It is necessary to carry on with sensorial analysis by trained panel or by consumers groups. They remain the best and the cheapest method to test the commercial value if not the Integrated Quality of a product.

This problem is permanent and already twenty three years ago JUL (1973) underlined the importance of organoleptic control in the industry.

This necessity is perhaps for small plant, eventually local work shop to keep an economical place on the market. Big firms are able to propose all around the world and at any time same constant composed products. This ability conducts to homogeneity and security, but also to uniformity which is not synonymous with high satisfaction.

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International contact

Meat research workers are not at the end their duty, when basis of characteristics are carefully described and measurements of their variations defined. They will have to meet between themselves, as to day, to exchange their data and methods, to uniformise analytical results in the same form. This minimum international agreement, incorporated in legislations and standards, will facilitate exchanges and trades on true characteristics of quality (KIMBREL, 1985). Already in the past, many workshops at the OCDE or EEC level were successful. Numerous papers on common results published for instance on tenderness and organoleptic characteristics of meat (DRANSFELD et al., 1984). This procedure is excellent for progress in science and also for friendship between meat research workers.

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