PE4.75 A Protocol for the Assessment of Physical and Sensorial Characteristics of Meat. 265.00

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Abstract—Methods used to evaluate physical and sensorial characteristics could be applied as a quality assurance tool. The objective of the present work was to propose an operative protocol useful to determine efficiently the value of some sensory, chemical and quality parameters related to consumer expectations. In order to define this procedure a set of analysis took place, using M. Longissimus thoracis et lumborum as source of samples. According to the results obtained the final protocol comprises these tests: thawing losses measurement, Meat Cooking Shrinkage (MCS) test, colour analysis, marbling evaluation, aroma test by EN, cooling losses evaluation, tenderness measurement, Water Holding Capacity (WHC) trend evaluation, sensory analysis, fat and moisture content measurement. This procedure permits to evaluate MCS, colour and marbling contemporaneously saving time. Finally it involves some operators work in a consecutive way. Therefore this protocol is a useful tool to define meat quality profile efficiently. Moreover results, obtained from this analysis, permit to define the quality profile of fresh meat and could help meat industry provide appealing products to consumers.

Index Terms— aroma; meat cooking shrinkage; quality; tenderness; VIA system; WHC.

I. INTRODUCTION

Meat has still a central role in our eating. Moreover consumer demands about meat change over the time. A study has shown that nutritional value, wholesomeness, freshness, leanness, physical and sensory traits (such as: colour, juiciness, flavour, and tenderness) were criteria used by consumers to form expectations about the quality of meat, in a purchase situation, and to evaluate the meat quality after preparation and consumption [1]. Therefore methods to evaluate meat physical and sensory traits could be applied as assess quality tool. There are a lot of objective methods which have been proposed by researches for meat quality evaluation but few techniques could be employed in meat industry [2]. The requirements for laboratory methods are well-known: sensitivity, accuracy and robustness. Cheap and fast techniques will be preferred. But complexity and cost of equipment are scarcely real obstacles to the implementation of an analytical method. On the contrary time saving and cost are necessary characteristic for any evaluation technique in the meat industry. Therefore this work proposed a protocol that includes techniques intend to predict technological and sensory qualities, applicable to fresh intact meat, for use in the industry as well as in research laboratories. Several tests took place to define best final operative procedure. Final protocol proposed comprised: thawing losses measurement, cooling losses measurement, marbling evaluation, Water Holding Capacity trend (WHC) analysis, aroma measurement by Electronic Nose (EN), meat cooking shrinkage (MCS) test, tenderness measurements, sensory analysis by panel test, moisture and fat content evaluation. During MCS evaluation colour and marbling were tested too. All these analysis were carried out on the same 5 cm thick meat slice (M. Longissimus Thoracis et lumborum). In this way it could be reduced variability due to the use of different steaks for each analysis. Moreover analysis costs could be reduced. Also this procedure employed some operators that work in a consecutive way. Therefore a lot of tests could take place contemporaneously saving time. According to these observations our procedure could even meet the industrial and commercial requirements because it useful to evaluate, in innovative, objective and quick way a set of parameters important to meat eater.

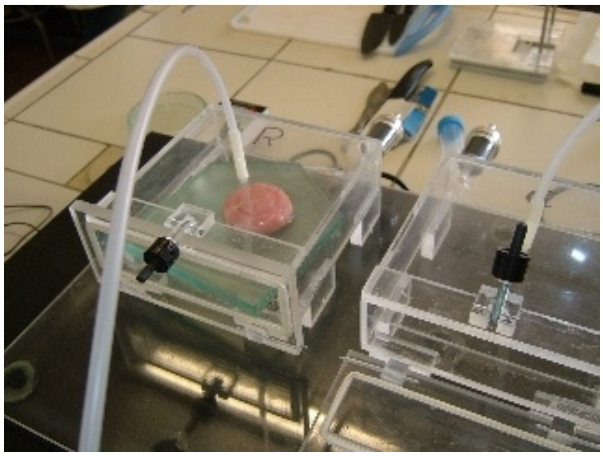
II. MATERIALS AND METHODS

Meat sample M. Longissimus thoracis et lumborum were used as source of samples: a 5 cm thick steak was obtained from this muscle (from the 9th thoracic rib in the caudal direction). Then steak was vacuum packed and stored at 20° C until analysis. Two days before analysis day sample was taken from the freezer and weighed. Then they were put at 4°C to thaw. Thawing losses The day of analysis every thawed sample was taken from the bag, and it was weighed. The bag was gently dry using blotting paper and than it was weighed. The difference between frozen packaged sample and thawed sample, and bag, was thawing loss measure. Colour analysis A 1.8 cm thick slice was cut from thawed sample. The slice was exposed to the air

for 1h. Then colour parameters (L*a*b) were tested using CR331 Minolta Chromameter (Minolta Co. Ltd, Osaka, Japan). Triplicate measurement was made on different sites of the exposed surface. Reflectance measurements were collected from a 0° viewing angle with Commission Internationale de l'Eclairage (CIE) illuminant C lighting conditions [3]. Drip Losses (DL) A second slice (1.5 cm of thickness) was taken from the sample. A rectangular meat piece was obtained from this slice. It was weighed and put in a plastic closed container. This container had a perforated support that permitted the escape of fluid. After a storage period (48 h) at chill temperature (4°C) sample was weighed again [4].

The difference between initial weight and the weight after 48 h storage was DL measurement. It was expressed as percentage of initial weight MCS and aroma (Electronic Nose) A third slice (1 cm of thickness) was cut from initial sample using a knife and a cutting system, based on two horizontal guides. From this slice a circular steak (5.5 cm Ø) was obtained according to Meat Cooking Shrinkage (MCS) protocol [5]. Steak, on temperate glass, was weighed and put in MCS Instrument and so raw sample area was measured by Video Image Analysis (VIA) system (Fig. 1).

VIA system used in this study was inexpensive and suitable for wide use. It was composed of a video camera, a video light, an image analyzer, a monitor and a PC. Moreover colour and marbling were measured. Then steak was put in a plastic box (0.250 L) that was equipped with an active charcoal filter and tubes connected to PEN2 – Portable Electronic Nose (Airsense Analytics GmbH, Germany), (Fig. 2).



After raw meat aroma test took place (for 60 s). Afterwards sample was cooked in an electric forced air convection oven (F.lli Galli G. & P., Milano, Italy) for 600 s at 165°C. During cooking aroma was tested by EN. Then cooked steak was put in another box connected to EN in order to measure aroma (for 60 s). Finally sample was put in a Petri dish, between two filter paper sheets (Whatman No. 597, 125 mm Ø). After 20 minutes cooling at room temperature, steak was taken from the Petri dish and weighed. Then steak was put, on glass support, in MCS Instrument and its area was measured by VIA system.

Cooling losses Petri dish with two filter paper sheets after sample cooling was weight, in order to evaluate cooling water losses.

Compression Previous circular cooked steak was used to obtain three cylinders. These were analysed by a SRR (Stress Resistance and Relaxation) using compression method. This test took place using an Instron 1011 Universal testing machine (Instron, Milano, Italy). Water Holding Capacity trend (WHC) Meat scraps (80 g), obtained from the previous analysis, were trimmed of external fat and chopped before grinding them for 20 s by domestic mincer (DPA141, Moulinex International, French).

Afterwards 250 ± 10 mg of minced meat was weighed on a filter paper sheets (Whatman n°. 1001, 125 mm Ø). Then this sample was put in WHC Instrument, sandwiched between translucent plastic plates and pressed at 500 N for 600 s. Simultaneously total and meat area on the filter paper were measured by VIA system. VIA system used in this study was inexpensive and suitable for wide use. It was composed of a video camera, a video light, an image analyzer, a video monitor and a PC. Three replicates of every sample

were carried out. Between repetitions meat was stored at 4°C in a Petri capsula.

Chemical analysis Minced meat was used, even, to measure moisture and fat content. A 8 g sample was used to determine moisture content by measuring the weight lost after heating at 125°C for 4 h. Duplicate samples were analyzed. Minced meat was used even to evaluate fat content. During this test duplicate samples were distilled in petroleum ether (Sigma Aldrich srl, Milano, Italy), using the Soxhlet method [6].

Sensory Analysis Slice (1.8 cm of thickness), on which colour had been measured, was used in the sensory analysis by panel test. During one day of assessment 5 samples were analysed. The panel consisted of 6 well trained assessment screened for sensory ability (basic tastes, colour vision, odour detection, tactile sensibility). Slices were coded with randomised numbers and served on white plastic plates to the assessors. They, using an eight point rating scale, assessed: appearance, elasticity, colour, marbling and odour. Then steaks were cooked in an electric forced air convection oven (F.lli Galli G. & P., Milano, Italy oven at 165°C, until it reached 68°C internal temperature, which was monitored by HD 9214 thermocouple (Delta OHM, Selvazzano, Italy).

Afterwards the slices were trimmed of any external connective tissue, cut into approximately 1x1 cm samples and put in white coded plastic plates. The plates were wrapped in aluminium foil and served to the panellists. They evaluated, using an eight point rating scale: tenderness (defined as the opposite of the force required to bite through the sample with the molars), juiciness (amount of moisture released by the sample after the first two chews), residue (amount of tissue perceived after swallowing in the mouth), chewiness (length of time required to masticate a solid product into a state ready for swallowing), flavour intensity and overall acceptability.

III. RESULTS AND DISCUSSION

This work proposed an analysis set to describe some fresh meat characteristics very important to the consumers like meat shrinkage after cooking (MCS). MCS was the difference between the raw and cooked areas of the meat sample, expressed as a percentage of the raw area. In this way shrinkage was evaluated directly without using cooking losses measurement. MCS Instrument also gave meat colour and marbling evaluation. So instrumentally colour analysis could be avoided. During MCS test aroma was measured by Electronic Nose. Aroma it is important because there is relationship of odor to meat palatability. EN use permitted to test aroma in objective and fast way. Also this method tested aroma in consumer conditions. Because aroma was measured in three different moments (before, during and after cooking) that are the moments in which meat eater usually perceives the meat aroma. Infect consumers perceives it when they buy (raw meat), cook (meat cooking) and eat (meat cooked) a steak. Tenderness, like aroma, is one the most important attributes consumers use to judge meat quality palatability and acceptability.

In this protocol tenderness was tested on the same sample using compression instead Warner Bratzler (WB) Shear test. Compression was faster then WB analysis because it was not necessary cooking a steak, because MCS circular sample was used. Moreover we can see, that several quality traits: MCS, colour, marbling, aroma and tenderness could be tested in a consecutive way using only the same small circular sample (5.5 cm Ø). The procedure comprised, even, Water Holding Capacity measurement. WHC of meat is one of the most important factors affecting meat quality, because it affects the weight change during transport and storage, drip loss during thawing, weight loss and shrinkage during cooking, and juiciness and tenderness of meat. In order to accelerate all procedure Water Holding Capacity measurement by Video Image Analysis (VIA) system was used. Because VIA system has great repeatability, less variation due to operators and is less time consuming than planimetry [7].

WHC measurement by VIAL could substitute others procedures for testing WHC like: drip loss in raw, whole meat. According to these observations we proposed the protocol describe in the follow paragraphs. A 5 cm thick slice is obtained from M. Longissimus thoracis et lumborum. It is frozen stored vacuum packed until analysis day. After slice thawing (48 h at 4°C) thawing losses are measured. Then a steak (1 cm of thickness) is cut from this slice. It is used as a source of a circular sample (5.5 cm Ø). Sample is weight and then, put on a glass support, it is introduced in a box, connected to EN and aroma is measured (for 60s). Then sample is put in MCS-Instruments. Here colour, marbling and raw area

measurements take place by VIA system. Next it is introduced in electric oven (at 165°C for 600 seconds). During cooking aroma is measured by EN. Afterwards cooked aroma sample is tested (for 60 s). Then it is put in a Petri dish, between two filter paper sheets, to cool at room temperature (for 20 minutes).

Finally cooled sample is again weighed and put in MCS Instrument to evaluate cooked area. Petri dish with filter paper sheets are weight too. Then from this circular sample three cylinders are obtain to do TPA by compression method. A second steak (1.8 cm of thickness) is cut from initial sample and it is storage at 4°C until sensory analysis beginning. Finally meat scraps and residues are chopped and minced by mixer. Minced meat is used for chemical analysis (moisture and fat content) and WHC trend test. WHC is measured on 250 mg sample, weight on a filter paper sheet. Then sample is put in WHC Instrument, sandwiched between translucent plastic plates and pressed for 600 seconds. The total area is measured by VIA system. Three replicates of every sample carried out.

IV. CONCLUSION

The world of meat faces a permanent need for new methods of meat quality evaluation, because expectations of consumers for meat quality grow constantly. This factor induces researches to find and improve techniques in order to deepen meat feature understanding [2]. This work proposed an analytical protocol to predict technological and sensory qualities from measurements carried out on fresh whole meat. The protocol comprised: thawing losses measurement, colour analysis, Meat Cooking Shrinkage evaluation, aroma test by Electronic Nose (before, during and after meat cooking), cooling losses, tenderness measurement, Water Holding Capacity trend measurement, chemical analysis (moisture and fat content) and sensory analysis. Among these methods MCS is a directly measurement of meat shrinkage after cooking. This test comprised VIA system that had proven, even, ability to asses at the same times other quality traits: colour and marbling. Aroma was measured by EN during MCS procedure, saving time.

Finally on MCS sample tenderness is evaluated too. Therefore all these tests took place in a consecutive way, using only a small sample. This factor allowed to reduce analysis cost and to save time. Finally WHC was evaluated by VIA system. In this way it was possible to obtain an accurate measurement and within few minutes for sample. In conclusion this protocol could be an efficient tool to describe fresh meat quality profile. Also it could even meet the industrial and commercial requirements because it is useful to evaluate, in innovative, objective and quick way a set of parameters important to consumers and related to meat eater expectations. Finally it could permit to obtain results that could help meat industry to provide more appealing fresh meat to the consumers.

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