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CONSUMER CONCERNS ABOUT MODIFIED ATMOSPHERE AND VACUUM SEALED MEAT FRAUD: FACT OR FICTION ?

PREOCUPĂRILE CONSUMATORILOR CU PRIVIRE LA FRAUDA CU ATMOSFERĂ MODIFICATĂ ȘI CARNE SIGILATĂ ÎN VID: REALITATE SAU FICȚIUNE ?

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ABSTRACT | REZUMAT

Nowadays, consumers are increasingly concerned about the quality and safety of the marketed animal-origin foodstuffs. The abundance of assortments from the same category, different prices, chemical composition, and origin of food products sometimes make it difficult to select and buy a particular type of product. In addition, suspicions of food fraud sometimes arise, the most common of which relate to nutritional composition, substitutions of ingredients, the addition of unauthorized compounds, or differences in weight between the values on the label and the actual weight of the product chosen. In the manuscript, the authors intended to clarify issues related to the weight of vacuum and modified atmosphere packed and sealed meat, based on solid data available in the scientific literature, which may have different values, compared to the weight on the label applied to the packaging.

Keywords: meat juice, package, modified atmosphere, fraud

În societatea contemporană consumatorii sunt din ce in ce mai preocupați de calitatea și siguranța alimentelor aflate pe piață. Abundența sortimentelor din aceeași categorie, varietatea de prețuri, compoziția chimică și originea produselor alimentare îngreunează uneori selecția și achiziționarea unui anumit produs. În plus, uneori apar suspiciuni privind fraudele alimentare, între care cele mai frecvente sunt legate de compoziția nutrițională, substituiri ale unor componente, adausul unor substanțe nepermise sau existența unor diferențe de greutate între valorile înscrise pe etichetă și greutatea reală a produsului ales. În articolul de față, autorii si-au propus să clarifice aspecte legate de greutatea cărnii ambalate în vid și în atmosferă controlată, în baza unor date solide disponibile în literatura științifică, care poate avea valori diferite, comparativ cu gramajul înscris pe eticheta aplicată pe ambalaj.

Cuvinte cheie: suc de carne, ambalaj, atmosferă modificată, fraudă

CONSIDERATIONS ON RAW MEAT JUICINESS

Meat is a foodstuff of animal origin, consisting mainly of striated muscle tissue, with a high moisture content in relation to its weight (7, 19, 20, 24).

In meat, water is distributed in three compartments: intracellular water, intercellular water, and surface water. Intracellular water is the largest part, around 65-70%, is distributed inside muscle cells and is bound by sarcoplasmic and myofibrillar proteins. Intercellular water is distributed between muscle cells, comprises 20-25% of the total water in meat and is associated with connective tissue. Surface water is free or loosely bound to proteins outside muscle cells and has the lowest proportion (5-10% of total meat water) (15).

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Meat juice expelling and loss of water is the phenomenon by which part of the water in meat is naturally released as fluid, either during storage or during thermal cooking. This process is influenced by a number of intrinsic factors (relating to the meat) but also by extrinsic factors of a physical, chemical, or biochemical type that influence the water holding capacity of the meat. Water holding capacity is defined as the ratio of the amount of water retained by the meat to the initial amount of water in the meat, even under external pressure. The higher the water holding capacity, the lower the meat juice exudation and vice versa (19).

One of the methods of preserving meat is vacuum packaging. Alongside the benefits of these methods (increased shelf-life, improved sensory properties), some undesirable effects are also known, for example, the expelling of meat juice. Meat juice is the blood fluid found inside and on the surface of muscle cells and is made up of water, proteins, minerals, pigments, and other substances. This fluid is responsible for the juiciness, tenderness, and taste of meat (10, 14, 18, 22, 26).

Expelling of the meat juice occurs as a result of the

pressure difference between the inside and outside of the package. By removing air, the pressure is reduced, which leads to an increase in muscle cell volume and a decrease of osmotic pressure. As a result, water migrates from the inside of the cells to the outside, where it accumulates as liquid in the package. Thus, the expression of meat juice is a natural biochemical process that cannot be interrupted, and the amount of juice expelled can be influenced by several factors described as follows (10, 22, 26).

The differences between the weight of meat immediately after slaughter and the weight of chilled meat, vacuum-packed or in a controlled atmosphere, are the result of a natural process, represented by the expelling of meat juice, a process that occurs as a result of the cutting of muscle fibres and interstitial tissue during the slicing or chopping of meat and that meat processors are unable to prevent, as it is a natural, organic process (16, 17).

FACTORS INFLUENCING MEAT JUICE EXPRESSION

Intrinsic factors

The amount of water (meat juice) contained in muscle tissue is particularly significant and varies according to the species, age of the animal, sex, fat cover, and the category of muscle being sliced/chopped and then packed (26). Specifically, the composition of muscle tissue is water (63-76%) and dry matter (24-36%), which is composed of total protein (18-23%), nitrogenous extractive substances (1.0-1.7%), nitrogen-free extractives (0.7-3%), lipids (0.5-5.5%) and minerals (0.8-1.8%) (1). It is clear that the amount of juice in meat is also expressed differently, depending on a number of factors, such as: (i) meat quality and fat content of the meat. High quality meat with a high protein and fat content has a higher water retention capacity compared to low quality meat with a high water and connective tissue content. Therefore, the less fat the meat has, the more muscle juice (water) is expelled (5, 13); (ii) the breed of the animal. In the *Suidae* family, breeds of pigs with a low carcass fat content have been selected over the years, in order to maximise the meat yield. In slaughterhouses, it has therefore become compulsory to classify pig carcasses, with superior classes (S and E classes) being preferred by meat producers, as they have a low-fat content; (iii) age at slaughter. Raising pigs in advanced intensive rearing systems and feeding of concentrated forage has led to a substantial increase in weight gain/day, which has contributed to reaching the optimum slaughter weight in a shorter period. For this reason, the age at slaughter has decreased, which influences the amount of meat juice released. Myofibrils in the muscles of young animals have increased moisture, compared to the muscle fibres of adult animals. These differences were reported in both pork and poultry meat, and the at slaughter age decreased to even less than 40 days. It is important to emphasise, for example, that chicken breast expresses more meat juice than chicken thigh, which is a type of meat with a higher fat content; (iv) reducing the slaughter age of the animal is a requirement demanded over time by the food availability for the global population, caused by rapid population growth. Basically, we are talking about the concept of food security, which involves ensuring food resources for the population and preventing food crises (2, 3, 6, 21).

Extrinsic factors

Refers to physical factors (pressure, temperature, gravity, contact surface, transport) that act on the cell structures and connective tissues of the meat, changing its permeability and elasticity. For example, during the vacuum packaging of meat, the atmospheric pressure is reduced, resulting in an increase in muscle cell volume and a decrease in osmotic pressure. This enhances the intercellular and surface water expulsion in the package. Furthermore, during meat cooking, high temperatures cause muscle cells to shrink and denature proteins, which reduces intracellular water holding capacity and favours its expression at the meat surface (9, 15, 19, 25, 26). The transport of meat can accelerate the syneresis process, especially in the case of vacuum-packed meat, due to the gravitational pressure exerted by placing the vacuum-packed meat packages stacked on top of each other.

As regards packaging temperature, meat packaged at a lower temperature, close to the freezing point, has a higher water retention capacity than meat packaged at a higher temperature, which facilitates cell swelling and juice expulsion. Furthermore, the longer meat packed in a controlled/vacuum atmosphere is kept in the pack, the greater the expression of meat juice, as the maturation and degradation processes of the meat reduce the water holding capacity (8, 10, 25, 27).

Concerning the temperature as a physical factor influencing the expression of meat juice, we point out that the temperature of the meat after the meat is obtained is about 37°C and even higher, then gradually decreases to the refrigeration temperature. If the meat product delivered to retail stores is stored at too low a temperature, leading to ice crystals forming in the muscle cells, the water holding capacity will be reduced and meat juice expression will be increased. Also, if meat is exposed to wide temperature variations, leading to freezing and thawing cycles, the structure of the muscle cells will be affected, and meat juice expression will be enhanced (8, 25).

Biochemical factors (enzyme activity, microbial activity, lipid oxidation) act on the composition and inte-

grity of muscle cells and connective tissue, altering the water content and distribution in the meat. For example, during the period of stiffness, enzyme activity causes a decrease in ATP and an increase in lactic acid in muscle cells, which leads to an inherent contraction of myofibrils and a decrease in intracellular water holding capacity. During meat spoilage, microbial activity causes a breakdown of proteins and lipids, resulting in an alteration of their structure and colloidal properties, facilitating the exudation of water from the meat (4).

Another important element influencing the differences between the weight on the label and the actual weight of the contents is the weighing method: static and/or dynamic. In the case of static weighing, the weighing object is stationary in relation to the measuring device, and weighing is carried out after the object is stable. Static weighing is performed in a stationary state and the weighing accuracy is high, but the weighing speed is slower than that of dynamic weighing. In dynamic weighing the state of motion of the object does not need to be changed and the object is weighed rapidly during the action. Dynamic weighing is carried out in motion, the weighing accuracy is high and the weighing speed is fast. However, the weighing accuracy is somewhat lower compared to static weighing accuracy.

STATED WEIGHT ON FOOD PACKAGING VS. ACTUAL WEIGHT OUT OF THE PACKAGING: WHAT NEEDS TO BE KNOWN ?

Supporting the previous points, the differences in grammage that occur when weighing meat packed in a protective atmosphere/vacuum are inherent, since metabolic processes are not stopped by packing in a controlled atmosphere or by vacuum, but continue, but in a slower way. Thus, the shelf life of chilled meat can be prolonged by packaging the product in a preservative gas environment or by removing oxygen to inhibit the growth of spoilage bacteria (12).

Modern methods of ultra-rapid chilling meat aim to reduce weight loss through dehydration, as the rapid drop in meat surface temperature decreases moisture evaporation, and cellular juice remains in large quantities in the meat. The syneresis process continues in both controlled and vacuum-packed meat, leading to a decrease in the weight of the raw material, with the juice expressed either as absorbent weight in the case of meat packed in a protective atmosphere, or free in the case of vacuum-packed meat. It is also important to point out that the absorbents are not placed in the packaging trays in order to mask these losses, but to give the finished product an appropriate commercial appearance throughout its shelf life. This results in a difference in grammage, which can neither be attributed to the producers nor controlled or influenced by them, between the grammage specified on the label by the food industry operator, resulting from weighing the product at the time of packaging, and the grammage detected after weighing the packaged product following destructive testing (11, 23, 27, 28).

Last but not least, the provisions of the IML 8-01/ 7.06.2001 Instructions for legal metrology on the prepackaging of certain products according to mass or volume (Annex 2) (29), which will be reproduced below, supplement the scientific arguments described above concerning the differences between the weight indicated on the label of meat packed in a controlled atmosphere or vacuum and that found at the time of the checks. Verification of the weight of meat products by the consumer using the destructive method does not provide accurate information, since the weighing is static, using a scale without metrological verification, and does not take account of the natural processes taking place in the meat or of the fact that the naturally draining serous-vinolent liquid is present in the absorbent used. As a general rule, weight verification by the destructive method should not be applied to batches of less than 100 units. For batches of less than 100 units, non-destructive weighing should be carried out.

Therefore, by weighing less than 100 units by the destructive method, the lot cannot be considered non-compliant. The mere finding of a discrepancy in the grammage of a single product in a lot should not automatically lead to the conclusion that the whole lot shows discrepancies between the grammage indicated on the packaging and the grammage obtained from the weighing carried out during the verification. In this respect, in accordance with the legal requirements, the verification of pre-packaged products will be done by sampling in two steps: (1) verification of the actual content of each unit of pre-packaged product in the sample; and (2) verification of the average of the actual content of the pre-packaged units in the sample.

Furthermore, the evaluation process should also take into account the maximum perishability limits that can be granted to the goods in the marketing process, as specified in the legislation in force (30).

Perishability means the losses that occur during transport, handling, storage and distribution of goods, caused by natural processes such as: drying, evaporation, volatilisation, spraying, hydrolysis, cooling, freezing, melting, oxidation, adhesion to the walls of wagons or vessels in which they are transported, decomposition, leakage, soaking, thickening, spreading, crumbling, breaking, including fermentation or other biophysical processes, in trading chain.

In Annex 1 of GD no. 831/2004 for the approval of the Norms on the admissible limits of perishability of goods in the marketing process, the admissible limits of perishability for food and non-food products are mentioned (30), in the case of pork the following limits

of perishability are specified: (i) 0.15%, during transport, (ii) 0.25% during storage and up to (iii) 0.45% at the point of sale, which represents a value of 0.85% of the weight of the meat.

CONCLUSIONS

Differences between the grammage on the label of meat packed in a controlled atmosphere or vacuum and that found during verification are influenced by the existence and action of factors that cannot be controlled or influenced by the producer, the most important of which are: the biochemical processes occurring in the packaged chilled meat; the different weighing method, i.e. dynamic weighing carried out in the factory compared to static weighing carried out in the shops/home; the sensitivity of the device used to measure the weight, i.e. the tolerance of the scale on which the labelling was carried out compared to the tolerance of the scale on which the check was carried out in the shops/home; and the weight tolerance of the packaging provided by the packaging manufacturers, which can fluctuate between 5 and 10%. A further percentage loss of up to 0.85% may come from perishability limits, which may be applied to foodstuffs at the retail stage, in accordance with the legislation in force.

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