

## STUDY ON THE FACTORS INFLUENCING HYDRATION AND WATER RETENTION CAPACITY OF MEAT

### STUDIUL PRIVIND FACTORII CARE INFLUENȚEAZĂ CAPACITATEA CĂRNII DE HIDRATARE ȘI DE REȚINERE A APEI

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*Top-quality food produce and high profitability in processing requires high quality in raw materials. Therefore, to achieve these objectives, it is imperative to know the properties of the raw materials, and the factors that influence these properties. The properties of the meat directly involved in increasing economic efficiency and final produce quality are the so-called technological properties: hydration capacity and water retention capacity of meat. These properties are determined by some factors belonging to the intrinsic quality of meat, animal slaughter methods, technological operations applied to the meat, and the auxiliary materials used.*

**Key words:** meat, hydration capacity, water holding capacity

The stage which is the meat, used in the industry, influences decisively the technological characters of the meat, respectively the water holding capacity (WHC) and hydration capacity (HC). A high hydration and water holding capacity is important because it will influence the product tenderness, the taste, the yield in finished product, taking into account that the different treatments to which the meat is submitted will determine cellular juice losses.

The muscular tissue has water content of 70 – 75% from which 65 – 70% is related to myofibrillar, 20% to sarcolemma and 10% is into the interstitial space and it is divided into combined water and free water. The combined water comprises water strongly bound by dipole-dipole electrostatic forces, and the free water is mechanically immobilized by membranes and filaments of protein and it can be removed by slight pressing.

The warm meat is characterized by high pH (7 – 7.2) and high hydration and water holding capacity, the water bound by surface adsorption being reduced in the case of this meat. The space between the polypeptide chains are large and permit the water penetration.

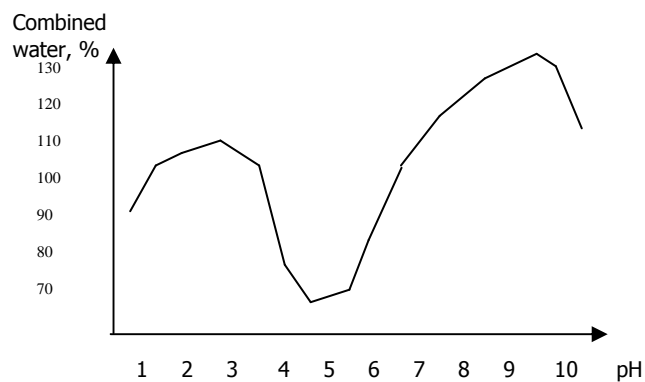
In the next stage, following the glycolysis process, the quantity of lactic acid from meat increases, the pH decreases, the hydration and water holding capacity decreases till a minimum that coincides with the rigidity maximum (this moment is reached in 24 – 48 hours from the animal's slaughtering). The pH at which the water holding capacity is minimum is called isoelectric pH, and it is of 5,1 – 5,2 for the meat proteins. At this pH, the number of negative charges is in equilibrium with the number of positive charges, between the polypeptidic chains there are forces of attraction, so these will be strongly bound and the meat will have a “closed” structure.

Beside these forces between the polypeptide chains there are some other types of bonds hydrogen bonds, disulphide bonds, etc. In this kind of meat with “closed” structure, the penetration of water molecules between the polypeptide bonds chains is impeded.

The hydration and water holding capacity is influenced by a series of factors:

- the pH influences – it is reversible in the domain of pH = 5 – 10, but at pH < 5 this reversibility disappears due to the acid denaturation of some proteins from the muscular tissue.

The variation diagram of the combined water content in function of pH is presented in fig.1



- other factors which influence the technological characters of the meat are: the species, the age, the sex, the state of fattening.

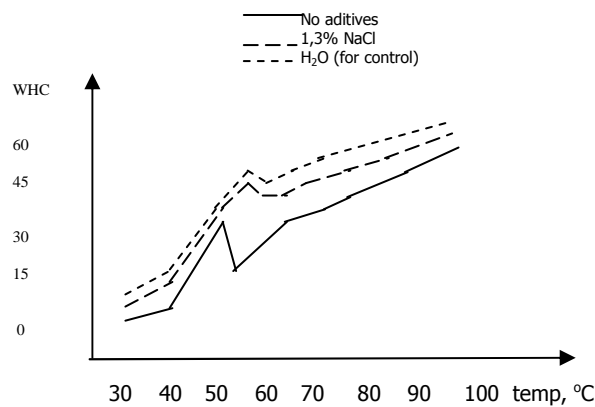
The meat of swine has a water holding capacity higher than the beef, the losses in weight at the beef's depositing being higher. In the case of the bovines, the meat of the young animals and the meat resulted from females has a water holding capacity higher than that of the meat of old animals and males, respectively.

For the meat resulted from the same animal there have been recorded concerning the water holding capacity: the muscles without moving functions have a higher water holding capacity.

- the technological processes influence water holding capacity and hydration capacity. The meat breaking up, by the releasing of a large number of polar groups able to hydrate the water, increases the hydration and water holding capacity. The temperature increasing with 4 – 5°C determines modifications in the proteins structures that lead to the decreasing of the hydration and water holding capacity, fact which imposes the breaking up of the meat to be done in the presence of the ice downs in a short time.

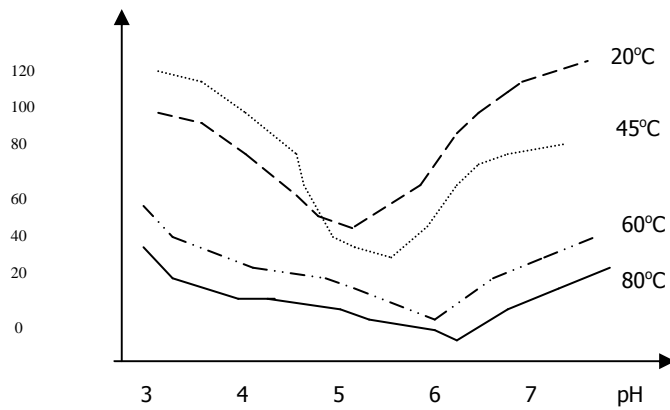
- the salt added in the obtaining of the meat preparations influences the meat technological properties. So, at an addition of 5 – 6% salt results a maximum hydration. For over 6% salt it is produced the proteins structure modification, with the water removing and the water holding capacity – hydration capacity decreasing.

The loss of cellular juice with/ without addition of salt at temperature variation – fig.2 (cellular juice – in % from total H<sub>2</sub>O – with/ without NaCl)



- the thermic treatment. At t = 20 – 30°C water holding capacity doesn't modify. At t = 30 - 40°C the changes are not essentially. At t = 40 - 50°C takes place the sudden decreasing of the water holding capacity in the basic zone as compared to isoelectric pH, and at pH < 4,5 water holding capacity increases; then, the temperature increasing determines the water holding capacity decreasing.

The pH and temperature influence on water holding capacity is shown in fig.3.



- the freezing treatment. At fast freezing, the water holding capacity is higher than that of the slow freezing meat, the losses of juice at thawing being smaller in the first case.

Taking into account the importance of the meat technological characters and the factors which influence them, we can observe that there are situations in which the improving of these properties is imposed. The correction of water holding capacity is possible by the addition of polyphosphates.

The commercialized polyphosphates are mixtures in variable proportions, characterized by solution pH 1% (comprised between 8,3 – 10,4 with the exception of hexametaphosphate – pH = 6,4 and acid pyrophosphate pH = 4,5) and by the content in P<sub>2</sub>O<sub>5</sub> (59,5 – 70%).

The polyphosphates favour the water binding of proteins, influence the emulsions quality and increase the yield in finished product.

The polyphosphates action made:

- the addition of polyphosphates increases the meat pH with 0,2 – 0,5 units, the meat proteins are brought to a pH higher than isoelectric pH, the electric charge of the proteins and so the quantity of bound water increases;

- by the polyphosphates and salt dissolving in the meat water and in the added water, the ionic strength of the solution increases, fact that leads to the extraction of a higher quantity of structural proteins able to bind the water.

- the polyphosphates form complexes with Ca<sup>2+</sup> and Hg<sup>2+</sup>, so impeding them to form bonds between the electric charged groups of proteins polypeptide chains. This thing leads to the breaking up of the proteins' structures, with the increasing of the hidration and water holding capacity.

- the dissociation of the actomyosin in actine and myosin, that leads to the increasing of structural protein solubility and to the increasing of bond water quantity;

Although presents advantages, the utilization of polyphosphates must be done carefully and in connection with the standards, because their using in inadequate conditions can determine different problems:

- the excessive doses in meat pies can lead to the obtaining of a viscons paste instead of a buttery one;
- the phosphates too alkaline produce the collagen gelification, the preparations losing the properties of binding;
- in too high concentrations it is producing the phosphates' precipitation, and appear crystals inside and on the surface of the products salted in brines (pickles) with addition of polyphosphates;
- at the addition of a too high quantity of polyphosphates, the meat preparation can present alkaline or soap taste;
- in case of overdosing with scouring action, can be provoked skin and mucous irritations.

### **Conclusions**

The technological characteristics of meat are extremely important in processing industry, being influenced both by internal and external factors, and knowing these factors is paramount to obtain top-quality produce.

In the conditions of a modern alimentary industry, the using polyphosphates is obligatory in order to obtain high quality products.

Their using must respect the maximum admissible doses in order to do not endanger the consumer's health and the product quality (by OMS 975/ 16.12.1998 maximum admissible is 0,5%).

### **Bibliography**

1. **Banu, C.** and col. (1997)- Procesarea industrială a cărnii, Editura Tehnica, București
2. **Banu, C.** coord. (2000)- Aditivi și ingrediente pentru industria alimentară, Editura Tehnica, București
3. **Georgescu, G.** coord.(2000)- Tratat de producerea , procesarea și comercializarea cărnii, Editura Ceres, București
4. **Kramer, A.**(1973)- Food texture definition, measurement and relation to other food quality attributes,Dordrecht
5. **Moțoc, D., Banu, C.**(1966)- Biochimia cărnii, Editura Tehnica, București