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THE INFLUENCE OF AUXILIARY MATERIALS ON HARDNESS, HEAT TREATMENT LOSSES AND SENSORY PROPERTIES OF THE MEAT PRODUCTS

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Abstract

The use of additives in the meat industry must ensure that obtained products are appreciated by consumers, provided good yields are achieved. Thus, the work follows the influence of water, salt, polyphosphate and fat additions, on heat treatment losses, hardness, as well as sensory properties of meat products. Analyzing the experimental results it has been found that with the increase in the percentage of water and fat added, cooking losses increased, while the hardness decreased. Increasing the addition of salt has determined to a decrease in heat treatment losses and increased hardness of thermally treated products. The addition of polyphosphates increasing has generated to a decrease in heat treatment losses and hardness of products. By following the degree of sensory satisfaction, in general, increasing the addition of water, salt, polyphosphates has led to appreciated products, with the exception of the increase in added fat that has led to a decrease in the satisfaction of consumers.

Key words*:meat products, heat treatment losses, hardness.*

INTRODUCTION

Meat and meat products are an important source of food for humans through complex chemical composition. Apart from the high nutritional value, the sensory value of the meat is very important, and the valorisation of the meat in superior meat products from the sensory point of view, implies the study of the factors that generate this quality (technologies, used additives, equipment’s, etc.) (Banu, 2002; Georgescu et al., 2019).

On the other hand, the transformation of meat into meat products must be done under optimum conditions, ensuring a correlation between the quality obtained and costs, the technological losses (boiling, smoking, storage) directly influencing these costs.

The impact of various additives on the quality of the products and the behaviour to the heat treatment was studied. Liu (2000) showed that the proteins of vegetable origin used to obtain meat products have improved the emulsification and water retention capacity of the heat-treated products. Gadekar (2016) the cooking yield of goat meat product significantly improved due to the addition of textured soy protein.

The use of modified starch in meat mixtures improved the stability of the emulsion and reduced the separation of fats (Aktaş N., Gençcelep H., 2006), and Cierach et al (2014) showed that the use of starch reduces heat treatment losses, improving sensory properties, texture and stability of the colour. Trout et al. (1986) considers that polyphosphates and pH are responsible for 80% of water binding capacity and Glorieux S. (2017) studied the reduction of phosphates in meat products in order to limit the impact on health, but without affecting the quality of the products. Zhuang (2016) showed the reduction of heat treatment losses and the increase of the hardness of salted and kneaded meats as the salt concentration increased.

The paper aims to study the impact of the addition of water, fat, salt and polyphosphates on the hardness of meat products, the sensory properties related to the texture and the implications on the losses to heat treatment.

MATERIALS AND METHODS

The study used emulsions obtained from chilled pork, fat (10%, 20%, 30%), water (10%, 20%, 30%), salt (1%, 2%, 3%), sodium nitrite (0.013%) and polyphosphates (0%, 0.3%, 0.5%), the additions being related to meat. Samples with a diameter of 2 cm and a length of 10 cm were boiled at 70^0C for 10 minutes in the thermal center of the product and thermostated for 12 hours at 4^0C. The analyzed parameters were the hardness of the products and losses registered during the heat treatment.
For the determination of the hardness of the products, appreciated by the cutting force, the samples with diameters of 2 cm that have been cut at the texturemeter TA-XT Plus. The cutting was performed perpendicular to the longitudinal axis of the samples.
After the heat treatment, the samples were cooled to 20^0C, weighed and the losses were expressed as juice and fat.

RESULTS AND DISCUSSIONS

The influence of fat addition
Studying the influence of the addition of fat on the quality of meat products, we can say that the fat used has a positive influence, if: the protein tissue of fatty tissue is not fragile and abundant. in this sense, the fat should not contain surplus connective tissue, and the one surrounding the fat cell must be sufficiently resistant, so that at least one damaged fat cell is crushed; the fat is not "oily" at the temperatures used in the technology of manufacture of sausages, because the oily phase expelled from the fat cells forms films on the surface of the meat granules, thus preventing the migration of water to the surface of the rod in the drying processes, prevents the paste from being bound, no consistency is achieved. It's recommended to use strong fat; the fat has a high degree of freshness, the enzymatic hydrolysis of the lipids can lead to a change in the taste, which becomes soapy, and the consistency of the product becomes soft.
Analyzing the losses to the heat treatment registered for the products with different additions of fat, we could find the following:
- the increase of the fat concentration in the meat composition has led to an increase of the losses due to the heat treatment, which indicates that with the increase of the added fat concentration decreases the stability of the emulsion formed during the chopping – mixing;
- thus, the losses increased from 14.49% for the samples with 10% fat, to 29.3% for the samples with 20% fat, respectively 30.28% for the samples with 30% fat (Table 1, Figure 1).

Table 1. Variation of cooking loss depending on the fat and water added

The type of additions		Cooking loss, %
Addition of fat, %	10	14.49
	20	29.3
	30	30.28
Addition of water, %	10	18.71
	20	24.68
	30	27.71

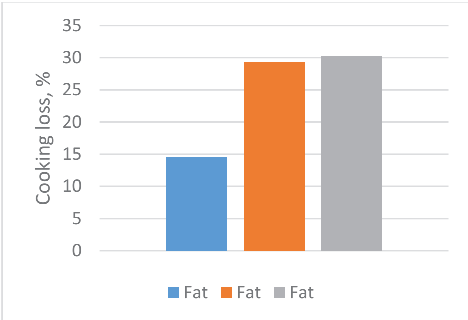

Figure 1. Cooking loss variation depending on the added fat

Analyzing the hardness of the heat-treated samples, it was found that with the increase in the amount of added fat, the cutting forces of the analyzed samples decreased, thus: the samples with a fat content of 10% had a hardness of 1.92 kgf, those with 20% fat 1.51 kgf, respectively 1.12 kgf for samples with 30% fat (Figure 2).
The high hardness values of the low fat samples may be because these samples had higher amounts of muscular tissue and consequently higher concentrations of structural proteins extracted in the fluid phase of the composition, which established bonds between particles, creating a strong and stable matrix after heat treatment.
Sensory analysis of the samples with different fat additions showed that the most appreciated, in terms of taste, succulence, appearance in the

section, were the samples with 10% and 20% fat. The composition with 10% added fat had a good succulence, pleasant taste, which is due to the stability of the emulsion given by the muscular test and the smaller losses recorded during the heat treatment. The composition with 30% fat had air voids, cracks inside the product, islands of fat.

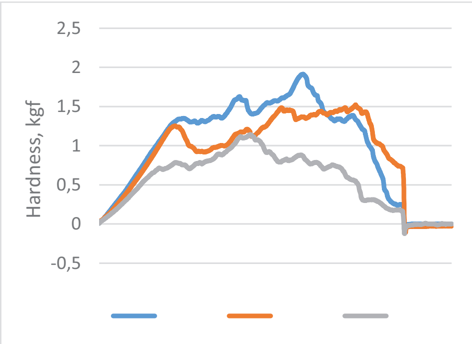

Figure 2. Hardness variation depending on the added fat

Sensory analysis of the samples with different fat additions showed that the most appreciated, in terms of taste, succulence, appearance in the section, were the samples with 10% and 20% fat. The composition with 10% added fat had a good succulence, pleasant taste, which is due to the stability of the emulsion given by the muscular test and the smaller losses recorded during the heat treatment. The composition with 30% fat had air voids, cracks inside the product, islands of fat.

The influence of water addition

Overall, losses from heat treatment are influenced by: the meat pH and correlated with it by the capacity of water retention; the diameter of the heat treated product; the presence or absence of the membrane; the addition of additives that increase the capacity of hydration and water retention (NaCl, polyphosphates); the meat structure that characterizes a certain biochemical phase after slaughter; the temperature and boiling time.

The assessment of the losses due to the heat treatment showed that they vary directly in proportion to the percentage of water added (Figure 3).

The samples with 20% and 30% water recorded higher losses, respectively 24.68% and 27.71%, compared with those with 10% water, which had 18.71% losses. The water retention capacity depends on the pH of the meat, the increase of the pH determines the increase of the water retention capacity.

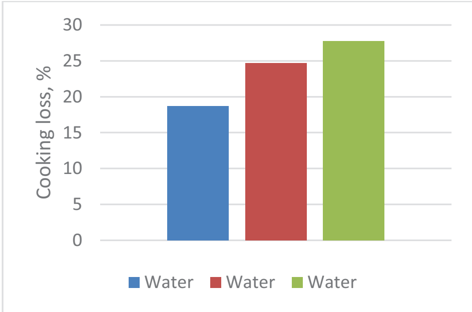

Figure 3. Cooking loss variation depending on the addedwater

The speed of reaching the final pH also influences the water holding capacity. If the pH drop is rapid, while the musculature maintains a temperature higher than 35°C, a denaturing of the myofibrillary proteins occurs and the conformation of the actomyosin molecule changes.

By precipitating the sarcoplasmic proteins over the myofibrillary ones, the groups involved in fixing the water molecules are masked, which diminishes the water retention capacity.

Up to a certain limit, increasing the amount of added water causes the adhesion of the composition to increase, as a result of the passage in electrolytic solutions of a larger quantity of structural proteins. When are added too large quantities of water, the adhesiveness of the product decreases.

Up to a certain limit, increasing the amount of added water causes the adhesiveness of the composition to increase, as a result of the passage in the electrolytic solution of a larger quantity of structural proteins.

When too large quantities of water are added, the adhesiveness of the product decreases.

The analysis of the variation of the cutting force according to the percentage of water added shows that as the percentage of water increases, the cutting force of the heat-treated samples decreases.

Thus, samples with 10% water recorded a hardness of 2.14 kgf, those with 20% water recorded a value of 1.76 kgf, and those with 30% water recorded a value of 1.4 kgf (Figure 4).

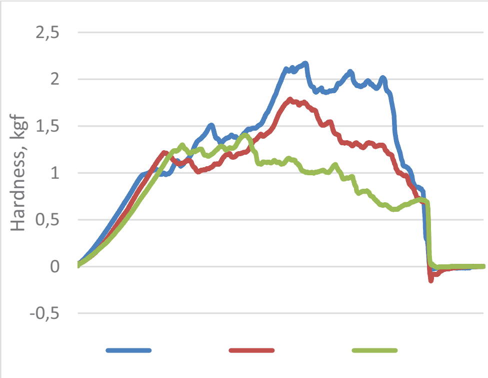

Figure 4. Hardness variation depending on the added water

Compared to the 10 and 20% water samples, the 30% water addition sample has a more pleasing appearance, taste and color, does not show air and gelatin holes. The sample with the addition of 20% water has a well-defined odor and pleasant taste. The 10% water sample had low succulence and the composition did not bind well. Inappropriate binding of the composition with 10% water was explained by the fact that no optimal extraction medium was created for the structural proteins that would ensure a good paste binding.

The influence of salt addition

The addition of NaCl to the meat compositions determines, besides the improvement of the sensory and preservative properties, the increase of the apparent viscosity and the shear stress, the increase of the ionic strength of the environment, which in turn favors the extraction of myofibrillary proteins in the liquid phase.

Increasing the concentration of solubilized proteins favors water binding and reduction of boiling losses, with the improvement of the succulence of the finished products (Figure 5).

Heat losses ranged from 32.65% for 1% salt samples, to 24.44% for 2% salt samples and to 14.59% for 3% salt samples (Table 2).

The variation of the cutting force was directly proportional to the salt concentration of the mixture, with the mention that the differences between the values were not major. Thus, at 1% salt the cutting force was 1.77 kgf, at 2% salt the cutting force was 1.92 kgf, and for 3% salt the cutting force was 2 kgf (Figure 6).

Table 2. Variation of cooking loss depending on the salt and polyphosphates added

The type of additions		Cooking loss, %
Addition of salt, %	1	32.65
	2	24.44
	3	14.59
Addition of polyphosphates, %	0	22.26
	0.3	19.50
	0.5	17.23

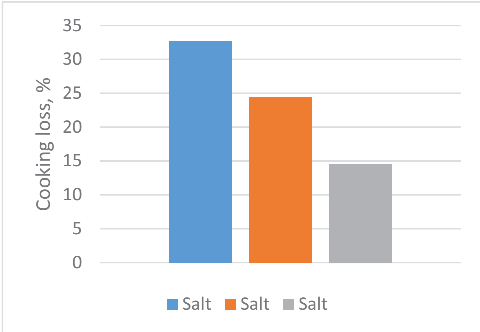

Figure 5. Cooking loss variation depending on the added salt

The increase of the extraction of structural proteins, favored by the increase of the salt concentration, favors the establishment of a greater number of links between the components of the system.

Sensory analysis of the samples showed that the composition with 1% salt added has an inadequate elasticity, consistency and succulence (it's crushed when cut). The 3% salt composition has the best sensory properties (consistency, juiciness, section appearance and smell).

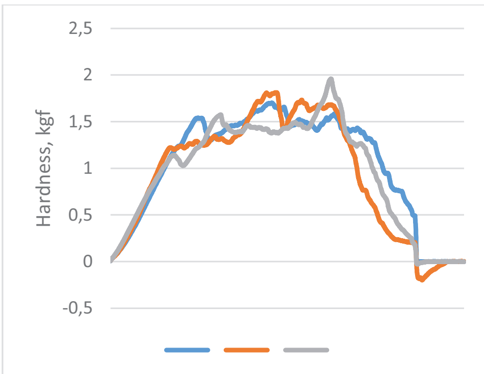

Figure 6. Hardness variation depending on the added salt

The influence of polyphosphates addition

Analyzing the influence of polyphosphates on boiling losses it was found that the highest losses were recorded for the polyphosphate-free compositions.

Polyphosphates favor the binding of water to muscle proteins, which has repercussions on the sensory characteristics, the quality of the emulsions and of finished product yield. As polyphosphate addition increases, water losses are lower: 17.23% for 0.5% polyphosphate samples, 19.50% for 0.3% polyphosphate samples and 22.26% for non-polyphosphate samples (Table 2, Figure 7).

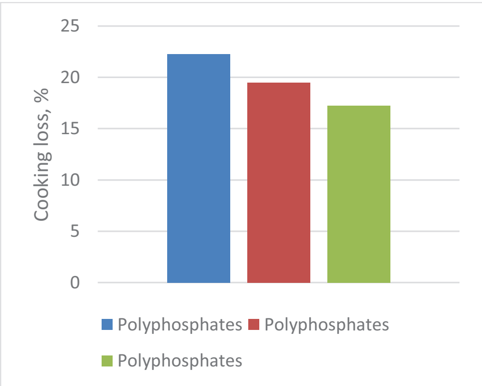

Figure 7. Cooking loss variation depending on the addedpolyphosphates

The addition of polyphosphate resulted in a decrease in the cutting force, with significant differences between samples with and without polyphosphate. The polyphosphate-free composition has the highest cutting force of 2.24 kgf because it has lost most of the water. The sample with 0.3% polyphosphate had a cutting force of 1.51 kgf and the sample with 0.5% polyphosphate, which had a cutting force of 1.24 kgf (Figure 8).

By the addition of polyphosphates the pH of the meat increases, the meat proteins are brought to a pH higher than the isoelectric point, which increases the hydration capacity.

Polyphosphates are capable of forming complexes with $Ca^{2+}$and Mg^{2+} ions which (exist in meat in amounts ranging from9 to 20 mg/100 g of muscle tissue) form bridges between the electrically charged groups of protein chains, thereby reducing the hydration capacity and water retention (Banu, 1997).

The formation of polyphosphate - Ca^{2+}/Mg^{2+} complexes leads to a relaxation of the structure of the miofibrilar proteins, that is, the increase of the capacity of hydration and water binding.

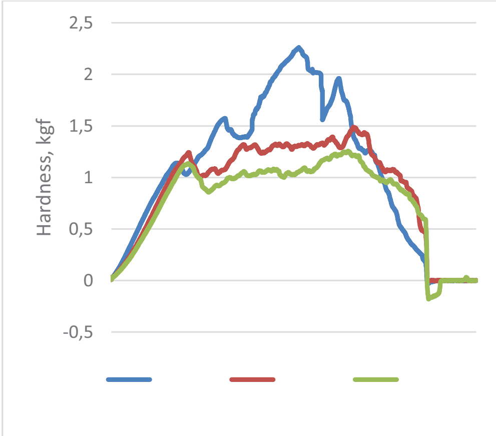

Figure 8. Hardness variation depending on the addedpolyphosphates

The addition of polyphosphates favors the dissociation of the actomyosin complex into actin and myosin, which have a higher hydration capacity.

Sensory analysis of the samples without the addition of polyphosphate emphasized that they do not show succulence and elasticity. The compositions with the addition of 0.3 g and 0.5 g polyphosphate have the corresponding consistency, elasticity and succulence.

CONCLUSIONS

Following the analysis of the obtained results, it was found that with the increase of the fat and water concentration of the compositions the losses to the heat treatment increase and the hardness of the products decreases. The addition of salt and polyphosphates caused the decrease of heat treatment losses. The increase of the salt addition caused the hardness increase, and the increase of the concentration of polyphosphates caused to decrease the hardness of the cooked products. All the additives used have generally improved the sensory characteristics of the obtained products. The increase in the concentration of added fats has led to a decrease in consumer satisfaction.

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