HEATING RATE OF CANNED CURED PSE AND DFD PORK

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INTRODUCTION

PSE meat, due to its characteristics, causes numerous problems in meat industry. It has been known that meat with PSE properties is not a suitable raw material for certain meat products, first of all heat treated ones, because of low water holding capacity (WHC). According to numerous examinations of many authors, DFD meat shows contrary characteristics regarding the water holding capacity. Therefore we set the task to examine the extent to which this property of PSE and DFD meats will influence the heating rate of muscle substrates, i.e. mixtures, specially because in literature there are not sufficient data on the influence of these factors on the heating rate. Namely, our task was to investigate whether cured PSE, namely DFD pork will have the same heating rate.

MATERIALS AND METHODS

Pork muscles (M. semimembranosus and M. semitendinosus) completely trimmed off from visible fatty and connective tissues, were used for the experiments.

PSE muscles were taken from sides (being previously cooled at +4°C for 24 hours), the mentioned muscles of which had pH_1 value equal to or lower than 5.80 (Wirth, 1978).

Muscles were used as DFD muscles when their pH_{24} value was equal to or higher than 6.34 (Wirth, 1978).
The above mentioned muscles of hogs being prior to slaughter i/p injected with 10 ml of 0.001% adrenaline solution and having the pH_{24} value equal to or higher than 6.30, were also used for the experiments.

The pH value was determined with a pH-meter, Model 29 (Radiometer - Copenhagen) with combined electrode, directly in muscles,

The muscles were comminuted by being passed twice through the grinder with a 8 mm plate.

The experiments were performed with 6 muscle mixtures, the composition of which is given in Table 1. In present study, the term muscle mixture comprises the mixture of minced muscle, NaCl, polyphosphate preparation (TARI P 22) and added water or without added water.

Table 1 - Composition of muscle mixtures

Components of muscle mixtures	MUSCLE MIXTURES					
	I	II	III	IV	V	VI
Muscle	PSE 95.5	PSE 80.5	PSE 65.5	DFD 95.5	DFD 80.5	DFD 65.5
NaCl	4.0	4.0	4.0	4.0	4.0	4.0
Tari P 22	0.5	0.5	0.5	0.5	0.5	0.5
Added water	-	15.0	30.0	-	15.0	30.0

Homogenization, namely mixing of mixture components, was performed in semi-industrial baker mixing machine for 10 minutes.

For each experiment, the above mentioned muscles from five pork sides were used.

Three samples from each mixture were filled in round cans (73 mm in diameter, 74 mm in height) and kept at +4°C for 24 hours prior to heat processing. Thermocouple was inserted in the geometrical center of the can and the temperature readings were taken on the instrument produced by Ellab - Copenhagen.

Heat processing was performed in water bath (± 0.2°C) at 80°C, till the obtainment of 70°C in the center of experimental cans.

Determination of heating rate of muscle mixtures was carried out by the method described by Ball and Olson (1957). The time-temperature curves were constructed so that the values for logarithmic temperature scale - obtained by dividing the temperature differences (T_1 - T) with (T_1 - T_0), (where T_0 represents the initial temperature of the substrate, T_1 - temperature of the heating medium, and T - temperature of the substrate for the given time), were plotted on the Y axis, and the time was plotted on the X axis. Greater part of so plotted time-temperature curve will be asymptotic to a straight line if the heating temperature and thermal diffusivity are both constant. The number of minutes (denoted as f_{min}), required that the straight line passes one logarithmic cyclus, can be computed from the slope of the straight line to the X axis. The slope of the straight line depends on the heating rate. In the case of faster heating, the slope is bigger and the f_{min} time is shorter and in the case of slower heating the slope is smaller and the f_{min} time is longer.

WHC of muscles and muscle mixtures, prior to and after heat processing, was determined by the filter paper press-method according to Grau and Hamm (1953) and WHC was expressed as the percentage of bound water calculated on the muscle without additions (bound water in % of muscle).

Chemical analyses were performed according to the AOAC procedures (1975).

All experiments were repeated three times. Taking into consideration that there were not significant differences between repeatings, the results were presented as mean values.

RESULTS AND DISCUSSION

Figure 1 shows that muscle mixtures, prepared from DFD meat, have higher WHC than those prepared from PSE meat.

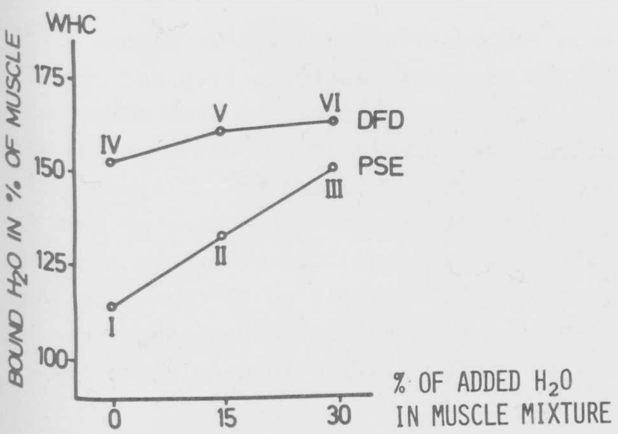

Fig. 1 - Influence of added water on holding capacity (WHC).

In addition, it is seen that muscle mixtures with higher quantity of added water have higher WHC, what was specially noticeable in substrates prepared from PSE meat, whereas in mixtures prepared from DFD meat this fenomenon was less expressed.

Our results regarding the higher water holding capacity of DFD meat, namely meat with higher pH value, are in compliance with the findings of numerous authors (Beecher et al., 1965; Borchert and Briskey, 1964; Briskey and Wismer-Pedersen, 1961a;Briskey and Wismer-Pedersen, 1961b; Goutefongea, 1967; Kastenschmidt et al., 1964; Meyer et al., 1963; Rahelić and Rede, 1965; Sayre and Briskey, 1963; Sayre et al., 1964).

The finding that higher quantity of added water in muscle substrates results in the increase of WHC, as seen from Figure 1, can be explained also by the influence of increased quantities of common salt and polyphosphate preparation. Namely, muscle mixtures with 15% of added water contained 4.97% of NaCl and those with 30% of water - 6.11% of NaCl, calculated on the muscle without additions. The quantity of added polyphosphate preparation, expressed as P_2O_5, was 0.373% namely 0.456%, calculated on the muscle without additions, in mixtures with 15% namely 30% of added water. Our finding is also corroborated by the results of the influence of sodium salts at pH 5.5, namely 6.4, and these pH values were just those at which our experiments were performed (Brendl and St.Klein, 1970; Hamm, 1957; Hamm, 1962; Schut, 1969). In addition, our results are in agreement with the results of Hamm (1957) showing that the increased quantity of added water increases the water holding capacity of meat in muscle substrates.

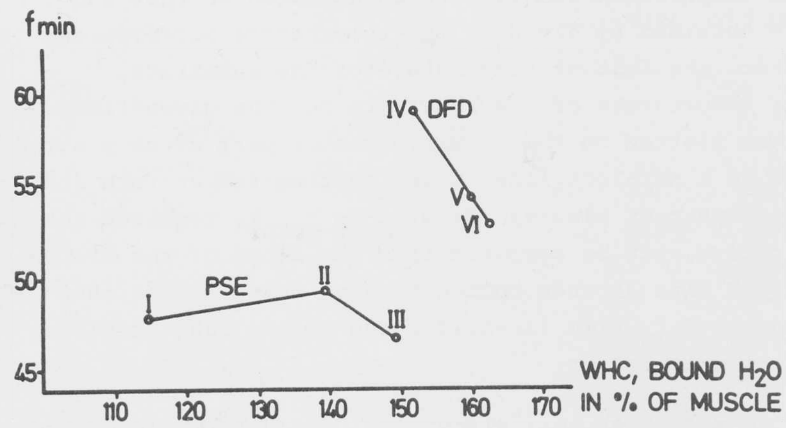

Fig. 2 - Influence of water holding capacity (WHC) on heating rate (f_{min}) of muscle mixtures.

The results presented in Figure 2 show that muscle mixtures prepared from DFD meat are heated slower (higher f_{min} values) in relation to those prepared from PSE meat, in all our experiments. Higher quantity of added water results in faster heating of substrates, what was particularly noticeable in substrates prepared from DFD meat, whereas in mixtures prepared from PSE meat this appearance was less regular.

It has already been shown (Panin et al., 1979) that muscle substrates with higher pH values are heated slower in relation to those with lower pH values. The reason for this phenomenon can be found, first of all, in the influence of pH on WHC. Namely, these results as well as the previous results (Šuvakov et al., 1978) have demonstrated that muscle substrates as well as meat with higher WHC are heated slower. This was explained by the phenomenon that muscle substrates, which bind well water, do not release it easily on occasion of heat denaturation and, consequently, the possibility of the appearance of microconvection is reduced, and that is the reason for slower heating of muscle substrates prepared from DFD meat. There are also data (Hill et al., 1967; Panin et al., 1979; Šuvakov et al., 1978) showing that higher quantities of added water, namely total amount of water, accelerate the heating of muscle substrates.

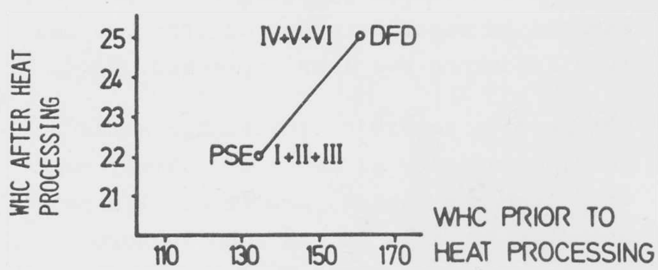

Fig. 3 - Water holding capacity (WHC) prior to and after heat processing of muscle mixtures (arithmetic means).

From the results presented in Figure 3, it can be seen that mixtures prepared from DFD meat retain higher WHC even after heat processing in relation to mixtures prepared from PSE meat. This can be explained first of all by the protective action of common salt on thermostability of muscle proteins (Woods, 1969) as well as by the datum that raw PSE meat with low WHC releases more juices during heating (Hagemeister, 1969; Meyer et al., 1963).

Muscle mixtures, prepared from meat of hogs being prior to slaughter treated with adrenaline in order to provoke DFD characteristics, gave identical results to those obtained in muscle mixtures prepared from DFD meat of untreated animals, and therefore these results were not presented.

We point out that none of experimental canned muscle mixtures showed cooked-out juices. This is quite understandable if we take into consideration the high quantity of added common salt as well as the addition of polyphosphate preparation (TARI P 22), calculated on the muscle without additions.

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