HEATING RATE OF MUSCLE HOMOGENATES CONTAINING HIGHER AMOUNT OF WATER

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SUMMARY: Muscle homogenates containing different amounts of added water (0.0; 24.58; 43.33 and 49.49%) and stuffed in cans (diameter 73 mm; hight 100 mm) and heated in water bath on 80°C, until the measure point of 70°C was reached - had different heating rates. The highest heating rate (lowest f values) was obtained in the homogenates with highest amount of added water. Corresponding experiments with the homogenates with 0,5 g polyphosphate preparation additions per 100 g of homogenates, had a lower heating rate compared with the homogenates without this addition. The differences in the heating rate between corresponding homogenates (with or without added polyphosphate), ranged from 1 min. 45 sec. to 5 min. 48 sec., depending on the amount of added water. f value, the parameter of heating rates, was 9 minutes higher in the homogenates without added water and with 0.5 g of added polyphosphate, compared to a homogenate without polyphosphate and containing 49.49 % of added water.

INTRODUCTION: There is a growing demand for low-calorie meat products on the market today. This specially refers to the consumers who are not physically active enough and whose health is affected by being overweight.

There are two ways of making a low-calorie meat product. First way is to make a product with as low amount of fatty tissue as possible (1 g = 9 Kcal = 37 681 kJ). The other possibility is to incorporate higher amount of water in the product than in standard formulations.

The initial results (Šuvakov et al., 1978; Panin et al., 1979; Radetić et al., 1980; Šuvakov et al., 1988) showed that the addition of higher amounts of water accelerates the heating of muscle mixtures, as well as of muscle homogenates, adipose tissues and water. Therefore, we aimed at examining the heating rate of muscle homogenates during heat treatment, with increased amount of added water and reduced amount of fat.

MATERIALS AND METHODS: The homogenates marked with letters B_1 - B_8, were prepared of chilled (48 h at 4°C) beef (of 18 month old steers), derived from the deboning and routine trimming of butt muscles from the excessive connective and fatty tissues. Ice on -6°C was incorporated in the homogenate contents. The used polyphosphate preparations are the product of the firm Guilini - GmbH - Ludwigshafen (TARIK 2). Common salt is the product of chemical firm Tuzla (95.5% of uniodized common salt).
The composition of homogenates is given in the table 1.

Table 1. - Homogenate composition (grammes)

Homogenate mark	Meat	NaCl	Ice	Polyphosphate preparation
B_1	98,33	1,67	0,0	0,0
B_2	73,75	1,67	24,58	0,0
B_3	55,00	1,67	43,33	0,0
B_4	48,84	1,67	49,49	0,0
B_5	98,33	1,67	0,0	0,5
B_6	73,75	1,67	24,58	0,5
B_7	55,00	1,67	43,33	0,5
B_8	48,84	1,67	49,49	0,5

All homogenates were made in the following way: Meat was minced through the mincer with 3 mm diameter holes. Preweighted amounts of components were homogenized in the mixers (Helly-Jolly plant chopper) in 3 minutes.

Chemical composition of homogenates is given in the table 2.

Table 2. - Chemical composition of homogenates (%)

Homogenate mark	Water	Proteins	Fat	Ash
B_1	68,47	19,06	10,01	2,46
B_2	75,62	14,70	7,35	2,33
B_3	81,12	11,04	5,58	2,26
B_4	83,68	10,10	4,00	2,22

Chemical analysis of homogenates B_5-B_8 have not been made, since we were dealing with nearly identical homogenates as B_1-B_4. The only difference was, that homogenates B_5-B_8 contained 0,5 g per 100 g of polyphosphate preparation.

The system ELLAB, Copenhagen type CTF-84-A2, was used for temperature recording. Thermo-couples with 5 cm long ends were installed in the centre of the lid. The temperature was recorded every 2 minutes. The temperature of water bath, during thermal treatment, was 80°C (± 0.5°C). The thermal treatment lasted until 70°C were reached in the measure point. After thermal treatment, the cans were cooled in running tap water (+ 18°C) in the course of one hour and then in a refrigerator at +5°C for the next 23 hours. After that, the quantity of cooked-out juices (jelly) was esteemed.

The quantity of cooked-out juices is given in the table 3.

Table 3.-The quantity of cooked-out juices (%), mean values.

Homogenates							
B_1	B_2	B_3	B_4	B_5	B_6	B_7	B_8
0,0	0,0	2,44	9,17	0,0	0,0	0,0	3,42

f values were computed by using the method of Ball and Ollson (1957) and presented in numbers of minutes and seconds.

Chemical analysis were made according to AOAC (1975) procedures.

RESULTS AND DISCUSSION: Table 4 shows f values of experimental canned muscle homogenates heated at 80°C until 70°C were reached in the measure point.

Table 4.- f values shown in numbers of minutes and seconds.

Homogenate mark	Lowest f value	Highest f value	mean f value
B_1	54' 24''	56' 42''	55' 33''
B_2	50' 56''	52' 56''	51' 56''
B_3	46' 08''	47' 35''	46' 51''
B_4	45' 30''	47' 36''	46' 33''
B_5	56' 38''	57' 02''	56' 38''
B_6	54' 48''	55' 52''	55' 17''
B_7	51' 53''	53' 25''	52' 39''
B_8	47' 32''	47' 38''	47' 35''

f values shown in the table 4 are valid for the period of heating, starting from the eighteenth minute until the end of thermal treatment. In that period of heating, time-temperature curves plotted on semilogarithmic paper, became rectilinear.

Table 4 shows that the homogenate B_1 (meat and salt) had lower heating rate then homogenate B_2 (24.58% of added water). Homogenate B_3 had higher heating rate (43.33% of added water), while homogenate B_4 had the highest heating rate (49.49% of added water). Homogenate B_5 (meat, salt and phosphate preparations) had the lowest heating rate - its f value was higher 1 minute and 17 seconds then homogenate B_1. The lowering of

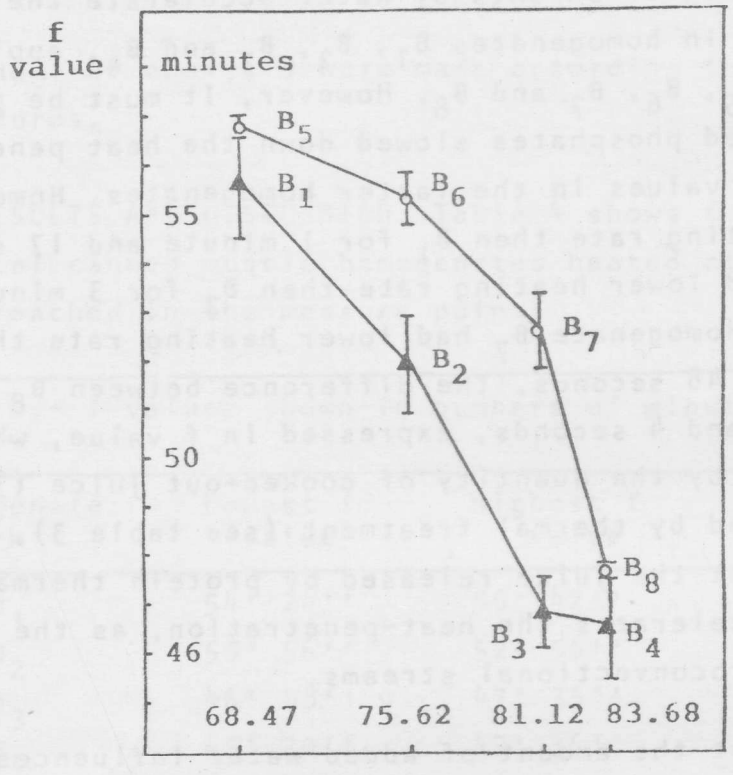
heating rate can be explained by its higher water holding capacity caused by the added polyphosphate. The observed regularity that higher amounts of water accelerate the heat penetration in homogenates B_1, B_2, B_3 and B_4, applies to homogenates B_5, B_6, B_7 and B_8. However, it must be pointed out that the added phosphates slowed down the heat penetration, causing higher f values in the latter homogenates. Homogenate B_5 had lower heating rate then B_1 for 1 minute and 17 seconds. Homogenate B_6 had lower heating rate then B_2 for 3 minutes and 21 seconds. Homogenate B_7 had lower heating rate then B_3 for 5 minutes 48 seconds. The difference between B_8 and B_4 was 1 minute and 4 seconds, expressed in f value, which can be explained by the quantity of cooked-out juice (3.92% and 9.17%), caused by thermal treatment (see table 3). It is well known that the juice released by protein thermal denaturation, accelerates the heat-penetration, as the result of increased microconvectional streams.

To what extent the amount of added water influences the heating rate of homogenates, is best illustrated by the fact that homogenate B_4 (49.49% of added water), had higher heating rate than B_1 (no added water), i.e., it had lower mean f value for 9 minutes. The difference in f value, when homogenates B_5 and B_2 were compared, was 9 minutes and 15 seconds.

Fig. 1 shows the influence of total amount of water in homogenates on f values.

Fig. 1 clearly demonstrates how a higher amount of water lowers f values in all experimental homogenates. However, the regularity of f value dicrease is disordered by the separated juices released by thermal disrupture of protein matrix, causing structural changes of homogenates. Therefore, the regularity of heating rate increase, caused by the increase of water content, is valid as long as the homogenates are thermostable, i.e., as long as the certain added water limit is not exceeded.

Fig. 1. - the influence of total amount of water in homogenates on f values.



CONCLUSIONS: The obtained results lead to the following conclusions:

- Higher amount of added water in homogenates with low fat contents increases the heating rate, that is, dicreases the f values.
- If the phosphate preparation is incorporated in homogenates, the above mentioned conclusion is valid. However, these homogenates are conducting heat more slowly than corresponding homogenates without this addition.

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