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ON SELECTION OF THE OPTIMUM REGIEME FOR CANNED MEATS PASTEURIZATION

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SUMMARY

Currently various regiemes of canned meats heating are used in the world for pasteurized canned products manufacturing. Each of them has disadvantages. That is why development of canned meats pasteurization optimum regieme is an actual problem. As the result of studies into physico-chemical, structure-mechanical, biophysical, microbiological, hystological and organoleptical characteristics of beef pasteurized canned meats quality the dynamics of these characteristics change is found and a new stepwise regieme for pasteurization is substantiated; the latter allows to manufacture products of high quality and stable at storage.

INTRODUCTION

During last years there has been widely developed manufacturing of delicious meat products, including pasteurized canned products, of high nutritional value and organoleptical properties that significantly depend on heating regiemes.
Currently different regiemes of heating at temperatures below 100°C are used; they can be divided into 3 groups (1,2,3):

1 - product is heated at constant temperature of heating medium during the whole processing cycle;
2 - heating is started at medium temperature close to 100°C; further processing takes place at 75-80°C;
3 - heating consists of several steps(with gradual increase of medium temperature and product conditioning); this regieme is known as "a selective stepwise".

Each,of the abovementioned, regieme has certain disadvantages that affect quality of the finished product. E.G. use of the regieme at which heating medium temperature is constant during the whole processing and a two-step regieme leads to overheating of product surface layer (≈ 5mm) that constitutes a significant part of product volume. Selective two-step regieme is disadvantageous due to the fact that at the first step of heating (60°C for 40 min.) the central part of a product is for a long time in a non-favourable temperature zone (22-30°C), from microbiological point of view; namely at this temperature range intensive growth of microflora occurs.
It is necessary to point out that canned meats pasteurization is aimed at manufacturing of products with high organoleptical parameters and inhibition of viable microflora being able to cause microbiological deterioration of canned products during storage. These two aims are achieved by contradictory methods. So, if heating temperature and time increase favourably influence microbiological state of a product, than such characteristics of its quality as juiciness and consistency, significantly diminish, liquid phase separation increases.

MATERIALS AND METHODS

Tests were made using Longissimus dorsi (pH 6.3) extracted from beef half-carcass of 2-3 years old animals. Time of chilling and ageing was 48 hours. Raw materials were cured in a massager with brine addition (18% to meat weight). Brine consisted of: salt, pyrophosphates, sodium ascorbinate, glucose, sugar, sodium nitrite. Curin time was 16-18 hours. Cured raw materials were packed into cans (Ø - 99mm, h - 35mm), 250g in each; cans were sealed and heated at 60,65,70,75,80 and 85°C for 90 min. up to the achievement of the desired temperature in the centre of a can being equal to the temperature af a heating medium.
Samples quality was tested according to the following parameters: amount of separated liquid phase - by weighing before and after heating; penetration degree - by the depth of penetrometer, developed by the specialists of The Moscow Technological Institute of Meat and Dairy Industries, neddles penetration; pH-value - using pH-meter 340; conformational changes of proteins - by the method of protein fluorescence; hystological investigation - by Van-Gizone and colouring with hematoxylineeozine; fat and protein content (total nitrogen) - by Soxlet and Kjeldahl methods; content of volatile fatty acids - by the method of steam distillation followed with calculation of propionic acid; lactic acid content - by Friedman test; biological value - by PER; microbiological evaluation of a finished product - by inoculation in Petri dishes; organoleptical assessment - by a 5-point scale.
Pasteurized canned meats from cured beef (13% to meat weight) heated using the industrial regieme, $\frac{100}{15}$ $\frac{100-84-82}{3-5}$ $\frac{82-84}{140}$ $\frac{\text{chilling °C}}{60 \text{ min.}}$, served as the controls.

RESULTS AND DISCUSSION

As it was shown ealier (5) meat heating causes irreversible conformational changes of muscle proteins. Changes of cured beef fluorescence maximum, shown in Fig. 1, testify that the character and degree of muscle protein structural changes depend on temperature and time of heating. Increase of heating temperature up to 70°C is accompanied by a shift of fluorescence maximum to a long-wave area testifying to a denaturational ("loosening") character of meat structure changes. Heating at temperatures higher 70°C is characterized by coagulation changes that is proved by a shift of fluorescence maximum to a sort-wave area. Conditioning of samples during heating influences the character of muscle proteins conformation: at 60 and 70°C - a shift of fluorescence maximum to a long-wave area, at 65 and higher 75°C - to a short-wave area(6).
Structural changes of cured beef muscle proteins also influence other tested parameters (fig. 2 and 3).
Studying the dynamics of liquid phase accumulation at temperature range of 60-85°C

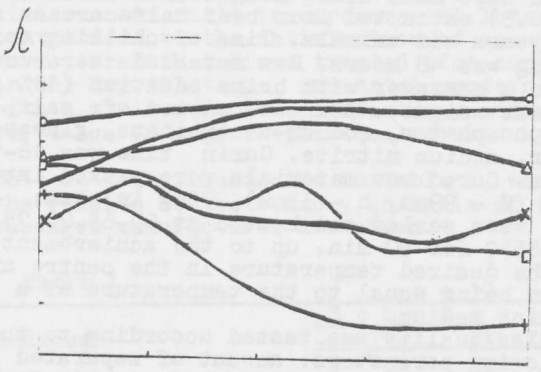


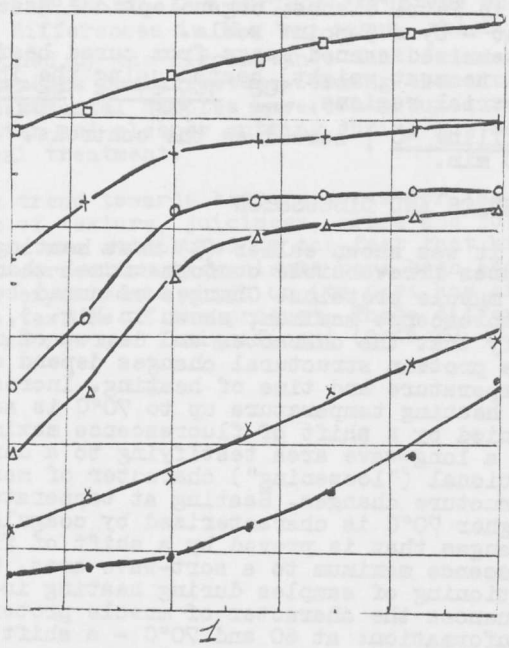
Fig. 1. Position of fluorescence maximum (λ) of cured beef as related to temperature and and time of heating
- ●—●—● – 60°C
- ×—×—× – 65°C
- Δ—Δ—Δ – 70°C
- ○—○—○ – 75°C
- +—+—+ – 80°C
- □—□—□ – 85°C

it is possible to single out 2 sections: 60-75°C and higher 75°C that are characterized by a different rate of liquid phase separation: 0à5 and 1.09%, correspondingly (Fig. 2). At 60°C amount of separated liquid phase is equal to 1.19 and at 75°C - 8.01%. At temperatures higher 75°C liquid phase separation intensifies and reaches 12.0% at 80°C and 17.6% at 85°C.

It should be stressed that amount of aseparated phase depends not only the temperature of heating but also on time (Fig. 2). However the character of its separation during conditioning significantly differs from the character of this process during temperature increase. A higher increase of liquid phase separation takes place at temperatures higher 75°C and samples conditioning for 90 min. at lower temperatures. At temperature increase ratio of liquid phase separation during 90 min. conditioning decreases and constitutes 3.3, 2.5, 1.95, 1.4 and 1.2 at 65,70,75,80 and 85°C, correspondingly.

If at low heating temperature (up to 65°C) the rate of liquid phase separation is practically constant during conditioning than at higher temperatures (up to 85°C) it separates, mainly, during the first 30 min. of conditioning.

Change of pH value as well as liquid phase amount depend on temperature and time of heating. However in contrast to the dynamics of liquid phase accumulation, major changes of pH value take place at temperature increase. At 60°C pH increases to 6.68 and at 85°C - to 6.85(initial pH value being equal to 6.3). Conditioning of samples during heating is accompanied by insignificant increase



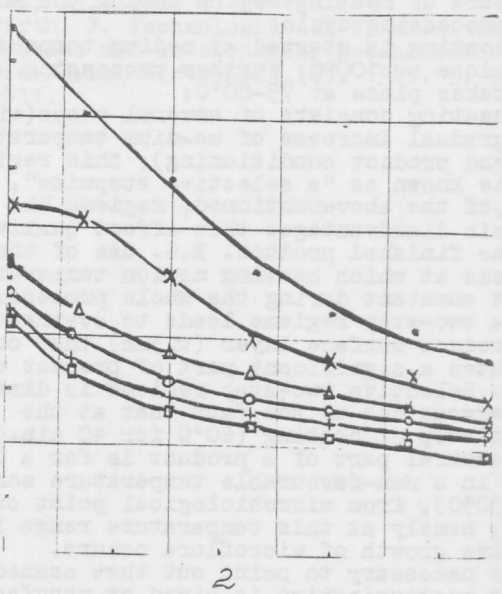


Fig. 2. Change of liquid phase content and penetration degree for cured beef as related to temperature and time of heating(●—●—● 60°C, ×—×—× 65°C, Δ—Δ—Δ 70°C, ○—○—○ 75°C, +—+—+ 80°C, □—□—□ 85°C)

1 - Liquid phase content

2 - Penetration degree

of pH at 60 and 65°C and at higher temperatures conditioning does not,practically, influence pH.
Change of penetration degree coincides, in total, with the character of liquid phase change (Fig. 3). The most significant decrease of penetration degree occurs at temperatures 60-65°C; at further heating temperature increase intensity of penetration degree decrease is lowered.
Hystological investigations during heating to 60°C showed 116% increase of muscle fibre diameter, 35.5% decrease of fibres amount in sight microscope as compared to these parameters for initial sample. Increase of heating temperature and time is accompanied by diameter increase and, correspondingly, increase of fibres per unit of area.
Organoleptical characteristics of cured beef also depend on temperature and time of heating (Fig. 4). So for the product to be acceptable for consumption it should be heated to 70°C in the centre; it can be also acceptable at heating up to 65°C for 30 min. The highest organoleptical evaluation was given to samples conditioned at 70°C for 15 min. Further increase of heating temperature and time negatively effects product quality.
Analysing existing (5,6,7) and obtained data it is possible to conclude that temperature and time of heating influence the character oand degree of changes in cured beef. The same parameters of liquid phase content, pH-value, penetration degree may be obtained at 70°C and conditioning for 15 min; at 65-70°C and 60°C for 60 and 90 min., correspondingly. However organoleptical evaluation of these samples is different that testifies to ambiguity of changes in meat, including change of muscle proteins structure. At low (up to 65°C) and high (above 72°C) temperatures of heating major structural changes of muscle proteins have coagulation character; these changes are more expressive at higher temperatures. Conditioning of samples at all tested temperatures cause the shift of fluorescence maximum to a short-wave are excluding 20 and 40 min. heating at 65 and 60°C. It should be stressed the heating temperature of about 70°C at which for 50 min. structural changes have a denaturational character.
Thus, to obtain high quality and stable during storage pasteurized canned meats their heating process should consist of several steps. At first step heating medium temperature should not exceed 50-50°C, and time of heating is determined by achievement of 20-22°C in the centre of a product; this allow lows to eliminate coagulation changes of muscle proteins and microflora growth. At second step to intensify heating process and to eliminate favourable for microflora growth temperature level it is necessary to increase sharply the heating medium temperature up to 85-100°C and to heat product to its surface layer (≈5mm) temperature being equal to 78-80°C. Then heating medium temperature should be decreased to 68-73°C thus providing elimination of deep post-denaturational changes of muscle proteins; the product should be stored at these temperatures to reach the desired sanitary status and optimum qualititative characteristics. On the basis of obtained data a new regieme

Table. Organoleptical characteritics as related to the heating regieme

Parameters	Traditional regieme (control)	A new regieme
Organoleptical evaluation (total), score	4.5 ± 0.15	4.85 ± 1.3
including		
juiciness	4.5 ± 0.21	4.90 ± 0.12
tenderness	4.4 ± 0.16	4.80 ± 0.15
Jelly content (100% for the control)	100	65
Penetration degree	9.3 ± 1.22	12.6 ± 1.31
Sum of carbonyl compounds, mg%	1.33 ± 0.30	1.35 ±0.41
Volatile fatty acids,mg%	26.31 ± 4.86	25.87 ± 5.01
PER	4.06	3.99

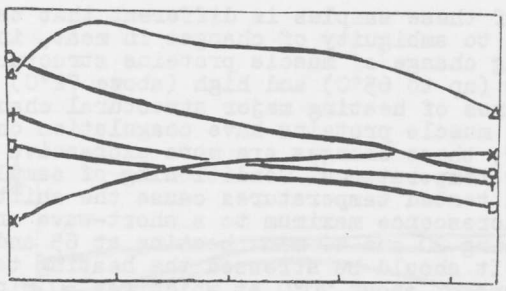


Fig. 3. Change of cured beef organoleptical evaluation as related to temperature and time of heating

x—x—x – 65°C
Δ—Δ—Δ – 70°C
o—o—o – 75°C
+—+—+ – 80°C
□—□—□ – 85°C

for canned meats pasteurization has been developed. Comparative analysis of "Pasteurized Beef" quality, made according to a traditional and a new one regieme of heating, showed that the latter is preferable one.

Microbiological investigations of pasteurized canned products made according to the developed regieme showed their sanitary safety from microbiological point of view.

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