THE STUDY INTO THE PROCESSES OF MEAT RAW MATERIAL TREATMENT AT DIETETIC FOODS MANUFACTURE

A.V.Ustinova, E.G.Bobrikova, A.L.Timoshenko, L.V.Nikitina*, V.I.Khlebnikov, A.M.Krylov** and B.P.Philipenko***

*The All-Union Meat Research and Designing Institute, Moscow
**The Moscow Cooperative Institute, Moscow, USSR
***The Moscow Technological Institute of Meat & Dairy Industries, Moscow, USSR

INTRODUCTION

The main requirements for the dietetic and baby foods are as follows: selection of the raw material of a definite chemical composition and biological value and the use of a special type of cooking aiming at lowering percentage of substances which are chemical irritants for the secretory function of the digestive tract (Brentz et al. 1983).

Products containing extractive substances are contra-indicated for people suffering stomach ulcer, duodenal ulcer, gastritis with a high secretory function, kidney and bile passages illnesses, pancreatitis, celiac disease, enterocolitis, atherosclerosis, heart diseases, diabetes, obesity, disturbance of the metabolism of minerals and others (Zikeeva, 1987).

The mostly common and recommended method for nitrous substances extraction is cooking meat in chunks. At this the amount of extractives transiting into broth is determined by their weight, while cooking meat in pieces weighing 100g until ready-to-eat up to 65% of such substances may be extracted (Olle, 1963).

The least losses of extractives in items manufactured from comminuted meat occur during heating at super high frequences, somewhat more - at heating products by an air-steam mix.

Laboratory studies conducted by the authors (Ustinova et al.,1988) have shown that the level of extractive substances removal at cooking influences the meat to water ratio. At changing of the meat-to-water ratio from 1:1 to 1:3 the amount of soluble substances extraction from meat increases by 25%.

Establishment of specialized areas and floors for dietetic and baby food manufacture implies intensification of the extractable substances removal which may be achieved only through the use of pressing (stabilization) process of comminuted and heat-treated meat raw material.

MATERIALS AND METHODS

The aim of the study was to give ground to the technology of raw material pre-treatment and evaluation for dietetic and baby food manufacture. For this beef and pork was studied separately and in a mix.

Trimmed raw material was continuously fed into a contact steamer, where it passed through a plate with the openings of 5.5mm diameter and then was blanched with live steam. According to the initial raw material temperature, rotation speed of the steamer screw, final temperature in the range of 85 ± 5°C was maintained by regulation of the pressure of the heating steam which was introduced into the working camera of the steamer. The steam-treated raw material

was then weighed, separated into fractions by pressing on a continuous screw press with the openings in filter screens 1.0; 1.5; 2.5 mm. Compacting pressure was regulated by changing dimensions of the outlet opening.

The pre-treated raw material should comply with the following requirements for the chemical composition: moisture - 60-65%, fat - 9-12%, protein - 26-28%, extractives - 0.005-0.007 (Ustinova et al.,1987). Separation into solid and liquid fractions was conducted in two ways: by pressing and by using gravitational forces, i.e. dripping method.

RESULTS

One of the characteristics of the stabilization process is the amount (yield) of the separable liquid fraction depending on the level of the raw material hydration, on heating temperature of meat, compacting pressure, rotation speed of the press screw. The amount of the separated liquid fraction determines residual content of extractives in the treated material.

It was established that hydration level of the raw material is influenced by the rotation speed of steamer screw and pressure of the heating steam. With the increase of the rotation speed of the screw from 1.0 to 2.66 s^{-1} the hydration level lowered from 10.3 to 8.5%.

Increase of the heating steam pressure causes rise in the hydration level (Fig.1). Thus at the constant rotation speed of the screw 1.5 s^{-1} and pressure rise of the heating steam from 0.04 to 0.1 MPa the degree of the raw material hydration increased from 6.9 to 9.9%. Steam pressure increase in the same range at the rotation speed of the screw 1.33 s^{-1} gave rise to the hydration degree from 8.6 to 11.4%.

Experimental results confirm the earlier received data (Ustinova et al., 1988), showing that with the temperature rise of the blanched raw material up to 88-90°C the amount of the separable liquid fraction increases. This is connected, firstly, with the consumption rise of the heating steam during the steam-contact blanching and, secondly, with protein denaturation changes leading to moisture loss. Heating above 88-90°C leads to a decrease of the liquid fraction yield (Fig.2), which is explained by the strengthening of collagen deagreggation and as a result the supplementary water ions orientation around its molecules. The amount of separable liquid fraction depends on the separation method, diameter of the filter screen openings, compacting pressurs and rotation speed of the press screw.

The use of the dripping process with further pressing at 0.3MPa ensures the summary yield of the liquid fraction 45-49% from the blanched raw material weight, comprising dripping - 30-37%.

Roration speed of the press screw is a value, defining the time of raw material staying in the operational zone, i.e. the degree of pressure effect on the pressable mass.

Increase in the rotation speed of the screw (at a constant pressure in the operational zone) from 1.0 to 1.5 s^{-1} did not influence the amount of the separable liquid fraction (Fig.3), and the speed above 1.5 s^{-1} causes the lowering of the liquid fraction yield indicating the lack of time needed for the liquid fraction

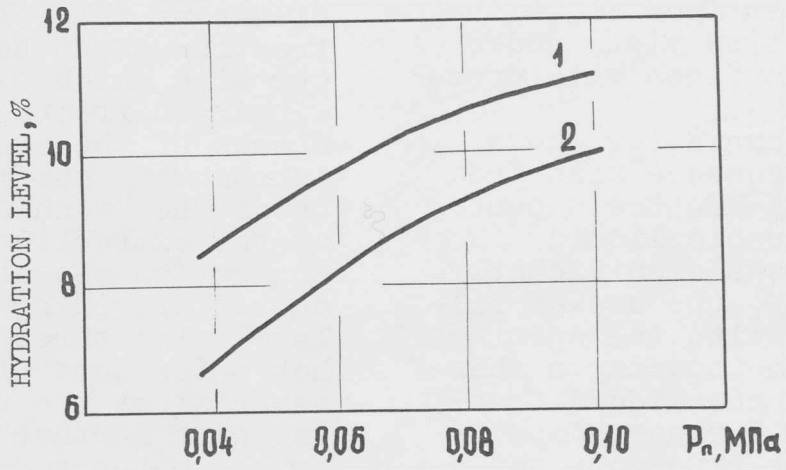

Fig.1. Dependence of hydration degree on the heating steam pressure at the screw rotation speed of $1.33s^{-1}$ (1) and $1.5s^{-1}$ (2)

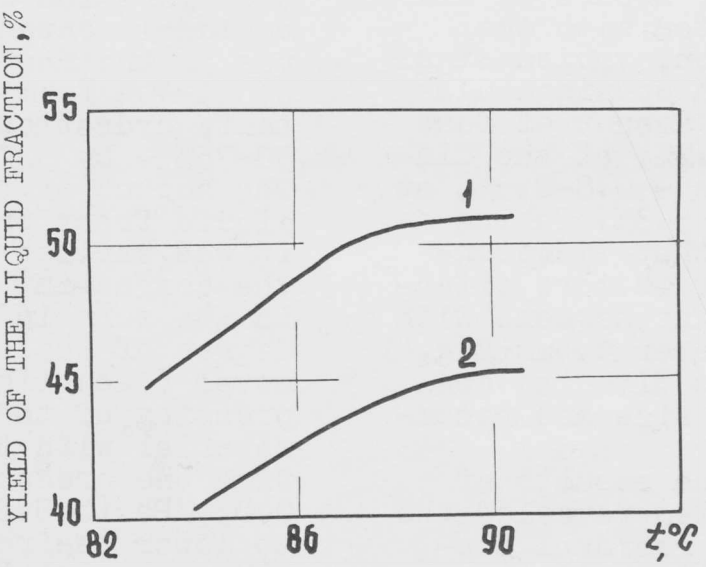

Fig.2. Dependence of the liquid fraction yield on the raw material temperature after blanching at the compacting pressure of 0.3MPa (1) and 0.2MPa(2)

to go through the drainage passages.

As it is seen from Fig.4 the liquid fraction yield under pressing increases with pressure rise.

The curves character shows that with pressure rise from 0.05 to 0.25 MPa the amount of the separable liquid fraction grows significantly up to 46-47%, the use of filter screens with the openings diameter 1mm inducing a sharper rise of the liquid fraction yield. Further compacting pressure rise does not influence the yield of the broth-fat emulsion to noticeably and this permits us to conclude that the processes of fat and weakly bound moisture removal are completed.

The use of filter screens of different opening diameters has shown that at different compacting pressure (from 0.05 to 0.3 MPa) the amount of fuse in the separable mix which penetrated with the liquid fraction, varied significantly. With openings diameter 1mm the amount of fuse reached 0.8-2.2%; at the diameter of 1.5mm - 0.8-2.9%, at 2.5mm - up to 5.3%. Taking into account that differentiation factor is more effective while using screens with openings diameter 1.5mm(Fig.4), filter screens with the openings of this size are recommended.

Analysis of the results of chemical studies revealed the dependence of residual content ofextractives in the stabilized raw material on the hydration degree of blanched meat (Fig.5).

The increase of the hydration degree of the raw material from 7.8 to 11.6% at the expence of the condensed steam lowers the content of extractable substances from 9×10^{-3} to 7.8×10^{-3} g/g of protein.

Such a dependence is stipulated by the fact that during blanching the role of the extracting agent belongs to water with which extractives are withdrawn from meat. The increase of the amount of water introduced into meat strengthens the "washing out" effect of the extractives. In this connection research was conducted providing the hydration level rise through addition of hot water into blanched raw material at the stage of mixing with further stabilization or hot water addition to the pressed meat raw material and its repeated stabilization.

In this way the hydration degree was reached, varying in the wide range, from 8-12%, at the expense of steam condensation, to 75% - at the additional water introduction.

The comparison of chemical analysis data on the extractives content shows that at the hydration degree of 15% the residual content of extractives in the raw material lowers by 25-40% from the initial content, hydration degree above 50-75% - by 30% and more.

The amount of the separated liquid fraction depends, as it was earlier mentioned, from the compacting pressure which in its turn influences the degree of the extractives removal (see fig.5). During pressing of the blanched raw material with the 10% hydration the pressure rise from 0.03 MPa to 0.2 MPa permitted to lower the residual extractives content from 9×10^{-3} to 8×10^{-3} g/g of protein.

CONCLUSIONS

The use of the steam-contact treatment of the comminuted raw material with further pressing makes it possible to obtain a product possessing dietetic properties. Pre-treat-

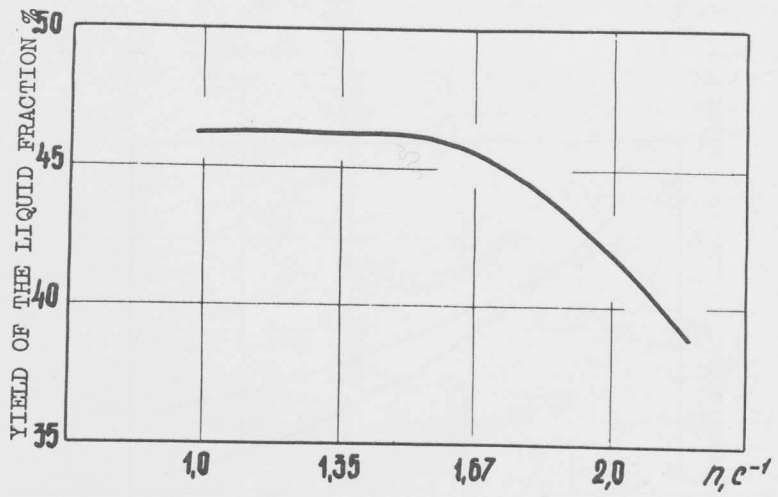

Fig.3. Dependence of the liquid fraction yield on the rotation speed of the press screw at 0.2 MPa

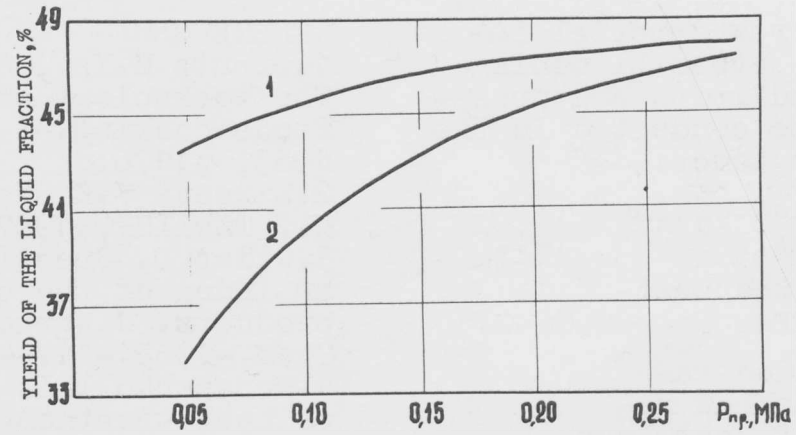

Fig.4. Dependence of the liquid fraction yield on the compacting pressure at the openings diameters of filter screens 1.5mm(1) and 1.0mm(2)

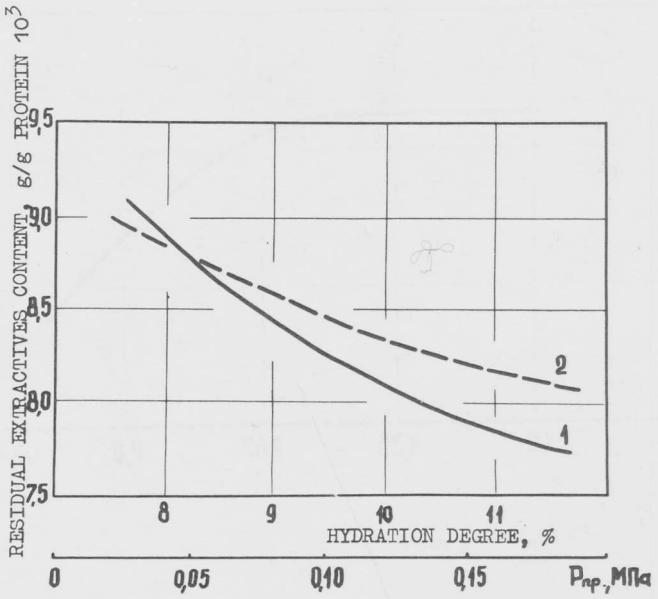

Fig.5. Dependence of the extractives residual content on the hydration level (1) and compacting pressure (2)

ment of the raw material including live steam blanching with water addition and pressing should be conducted in the following regiemes:

roration speed of the steamer screw, s^{-1}	1-1.5
pressure of the heating steam, MPa	0.06-0.1
amount of added water, % to the raw material weight, not less	50
compacting pressure, MPa	0.2-0.3
rotation speed of the stabilizer screw, s^{-1}	1.0-1.5
diameter of the filter screen openings, mm	1.5

The developed regiemes were tested under industrial conditions.

REFERENCES

1.Brentz M.Ya., Sizova N.P. The technology of dietetic foods cooking.-M.,Economics, 1983, p.176.

2.Zikeeva V.K. Health cookery. M., TZNIISP, 1987, p.48.

3.Oller D. Creatine content as an index of the quality of meat products. J.Agric. and Food Chem.-1963.-11.-4.-p.350.

4.Tarasenko I.I. The influence of heat treatment methods on the quality of meat dietetic dishes. Thesis of the candidate of technical sciences.-M., 1984,p.25.

5.Ustinova A.V., Bobrikova E.G, Khlebnikov V.I., Krylov A.M. The influence of the heat treatment method and its parameters on the dietetic properties of foods for baby nutrition.34th International Congress of Meat Science and Technology.-Australia, 1988.

6. Ustinova A.V., Goroshko G.P., Khlebnikov V.I. et al. The composition of a mathematical model of the meat product for dietetic nutrition. 33rd European Congress of the Meat Research Workers.-Finland, 1987, p.233-235.