"TECHNOLOGICAL" SHELF-LIFE OF HEAT TREATED, FROZEN AND STORED MEAT

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SUMMARY: The possibility for longer storage of heat treated meat samples - pigs M. longissimus dorsi and chicken breasts - was investigated. Firstly, the most appropriate method for heat treating was selected, on the basis of instrumental and sensory evaluations of quality characteristics carried out after 7., 30., 90. and 180. day of storage. Secondly, the meat samples were heat treated by stewing and frying up to the center temperatures of the samples up to 40, 60 and 80°C.The samples were frozen at -18°C and stored under the same conditions for 180 days. During the storage period the samples were instrumentally and sensory investigated on the 4., 90., 100. and 180. day. The frozen samples were prepared for estimations applying the same methods as in the first heat treatment, reaching the temperature in the center of the sample of 80°C.

INTRODUCTION: The production of ready dishes for large consumption is based on the processing of various raw materials, whereas the meat is biologically the most valuable. It is well known that heat treatment, conservation, storage and different procedures for serving, i.e. preparing for consumation, determine, among others, the quality characteristics of meat products and products with meat. Technological procedure for ready dishes production requires a double heat treatment, so the first one must be stopped at the right moment, so that the second heat treatment can be carried out without negative consequences to the final product. A great number of papers deals with the shelf-life of ready dishes, but only a small number have the "technological" shelf-life, meaning the period in which sensory characteristics remain acceptable, for subject (Pfaf, 1976, Valles et al. 1978, Cremer et al. 1979, Böhme 1980, Oluški 1983). A large investigations were carried out in the field of heat treatment of meat, but significantly smaller number deals with heat treatment of semi finished dishes (first heat treatment) (Dagerskog et al. 1976, Sato et al., 1973, Popov-Raljić, 1984, Tojagić et al., 1980, 1981).

The characteristics of pigs M. longissimus dorsi and chicken breasts (carcass parts of a lower quality), heat treated by cooking, boiling, stewing, frying and roasting, were instrumentally and sensory evaluated, in order to determine the "technological" shelf-life of products.

MATERIAL AND METHODS: M. longissimus dorsi was separated from carcasses 24 hours after pigs slaughtering applying usual procedure. Separated muscle was kept 4 days after slaughter at temperature of 2-4°C, and after that heat treated. Immediately before heat treatment fat and connecting tissue were separated from the muscle, iced and cutted in parts, 2,5 cm thick.

Chicken breasts were heat treated 2 days after slaughtering. Before heat treatment the fat tissue was separated.After breast splitting in two pieces by cutting of sternum, the deboned two pieces of chicken breasts were taken as one sample for investigations.

In the first part of investigations the meat samples were under laboratory conditions heat treated applying following procedures: COOKING - the samples were cooked in metal net in boiling water, temperature 98-100°C, up to the temperature in the center of the parts of 80°C; BOILING - as by cooking, with medium temperature of 85-90°C; STEWING - meat samples were fried , each side during 3 minutes in oil (3 mm deep). After that water was added (water:oil = 1:1) and additionally heat treated up to the temperature in the center of 80°C; FRYING - the samples in metal net were deep fat fried in corn germ oil, temp. 162°C, up to the temperature in the center of the parts of 80°C; ROASTING - the samples in metal net were heate treated in oven at temperature of 175°C up to the center temperature of 80°C.

A part of heat treated samples (five samples for each meat kind and for each procedure) were investigated immediately after preparing. The rest of samples was frozen at - 18°C in aluminium containers, in which they were heat treated (cooked in bouillon, fried in oil, etc.). After 7, 30, 90 and 180 days of storage the samples were defrosted by the same method by which they were heat treated before freezing. For each type of sample 5 were taken for analysis for the given investigation period.

For temperature measurements thermometer GULTON TESTOTHERM P 200 was used. Tenderness was determined using WARNER-BRATZLER apparatus, by measuring the shearing force required to cut through a cylindrical piece of meat taken from heat treated sample using a borer of a diameter of 1/2 inch.Cylindrical samples were cutted in the direction of the muscle fibers. The results were expressed as mean values for 5-6 individual measurements. Plasticity was determined using consistometer by Höpler, by measuring the change in the altitude of the sample (cutted with borer of a diameter of 1 inch, 1 cm high, by load of 3 kg during 60 sec). Plasticity was expressed in percentage in relation to the start altitude of the sample. Elasticity was measured using the same samples as by plasticity measurements, also during 60 sec., by expressing the values as percentages in relation to the altitude of the sample after finished measurements of plasticity.

Sensory evaluations were made by spezialized panel (5 members) applying following score system:

Estimation	Tenderness	Juiceness	Odour and taste
1	very rough	very dry	very unpleasant
2	rough	dry	unpleasant
3	not enough tender	not enough soft	not enough pleasant
4	tender	soft	pleasant
5	very tender	very soft	very pleasant

The sum of evaluations for each characteristic is total score, which maximally amounts to 20 points.

In the second part of the experiment , for two methods of heat treatment, which showed the best results for both two meat kinds, the investigations were repeated under the same conditions, but in the first part the reached temperatures in the center were 40, 60 and 80°C and in the second part only 80°C. Because of technical reasons, the investigations of samples were carried out on the 4., 90., 100. and 180. day of storage.

RESULTS AND DISCUSSION: From the results of sensory evaluations of quality, which are correlative with the results obtained by instrumental measurements, it is obvious in the first part of investigations, that for pigs M. long. dorsi all applied methods are acceptable up to 90 days of storage, except boiling (Graph.2.).

For chicken breasts following methods are acceptable for storage period up to 90 days : cooking (Graph. 1.), stewing (Graph.3.) and roasting (Graph.5). Up to 180 days frying (Graph.4.)is acceptable and for the storage period up to 30 days boiling can be recommanded (Graph.2.).

In general, stewing and frying are the most suitable methods for heat treating of pigs M. long. dorsi and chicken breasts intended for longer storage, and roasting could be also acceptable (Graph. 3-5). For this reason, in the second part of experiment stewing and frying were selected as two most suitable methods.

From Graph. 6. and 8. it can be seen, that the highest average score is obtained for pigs M. long. dorsi, treated by stewing, in the first treatment up to 40°C, and in the second up to 80°C. With the lowest score were evaluated the samples treated up to 80°C in both two treatments.

Some different results were obtained for heat treated chicken breasts. With highest score were evaluated the samples stewed up to 80°C, and reconstituted by heating up to the same temperature (Graph.7.).Fried samples were evaluated with highest score, if they previously were treated up to the 40°C, and reconstituted at 80°C.

However, it is very interesting to point out that in both two methods and for both two meat kinds a phenomenon was observed, which was not the subject of this investigations. Namely, between 90. and 100. day of storage, a significant, sudden changes in sensory characteristics, desirable and undesirable, were registered. No causality , considering the meat kind, method of heat treatment or applied temperatures was stated, so in this moment only assumtions can be made. It is possible that the ability of proteins to bind water is returned, or the reason should be more deeper--in microstructure of meat.

CONCLUSIONS: From the results of investigations following conclusions can be made:

- the procedures for heat treatment affect differently sensory properties of pigs M. long. dosri and chicken breasts
- sensory characteristics are also influenced by freezing, storage and reconstitution
- stewing and frying are the most suitable methods for heat treatment of pigs M. long. dosri and chicken breasts
- freezing at -18°C of samples, prepared in described way, is possible up to 90 days, without negative consequences
- the period of storage between 90. and 100. day should be further investigated, in order to find the reasons for significant and sudden changes in sensory characteristics of samples.

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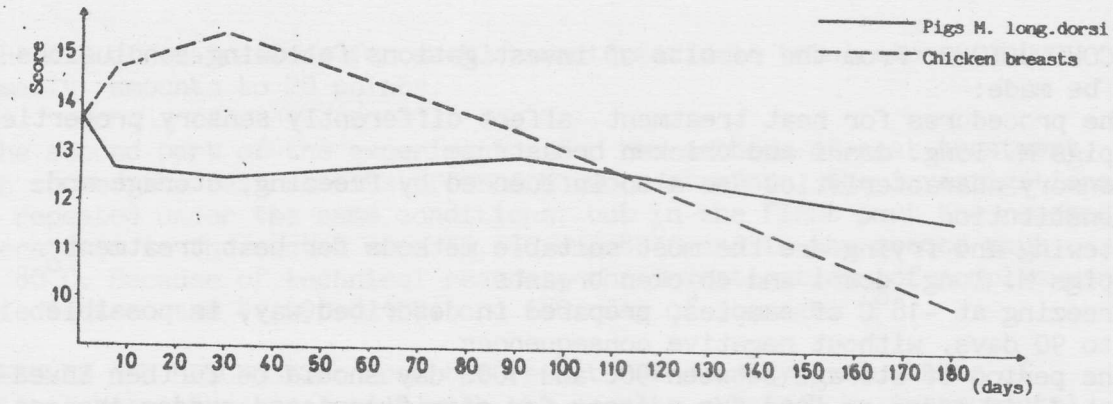
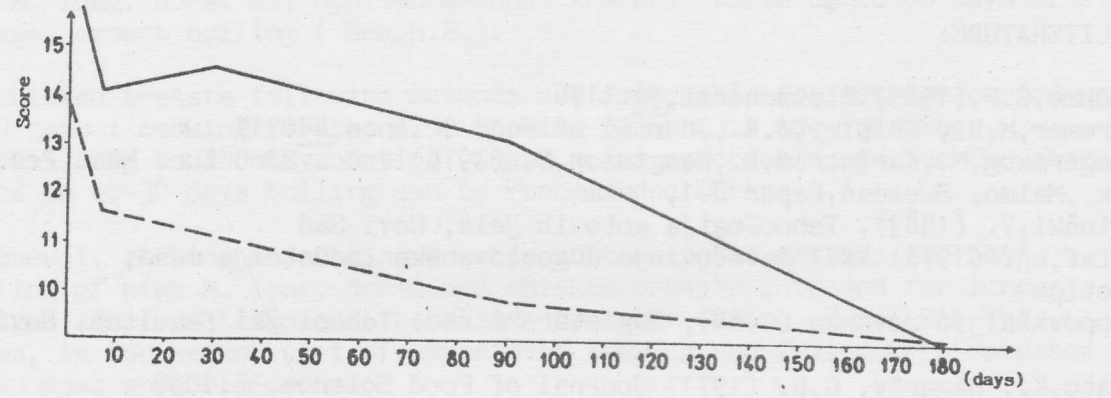
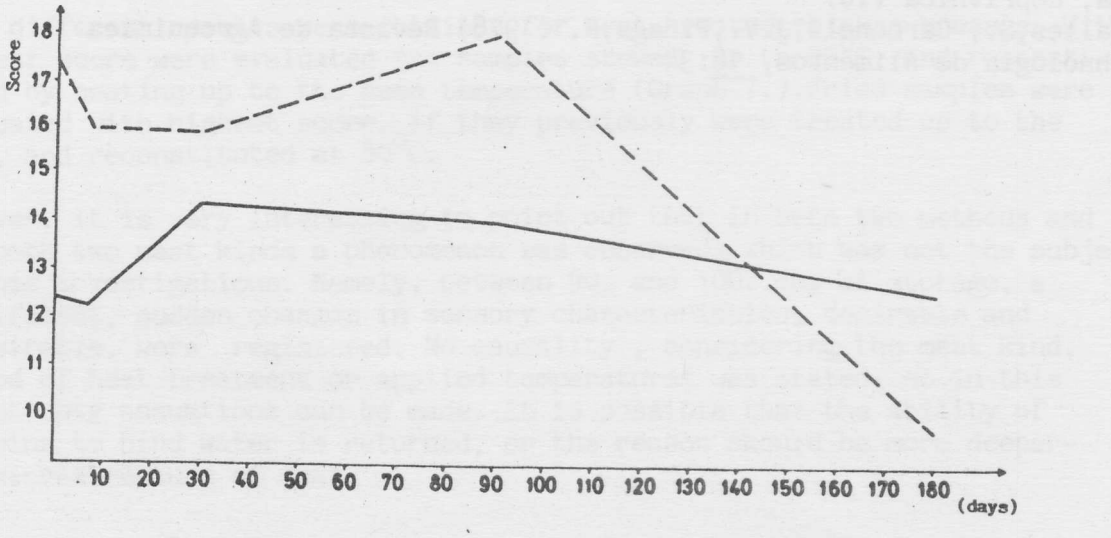


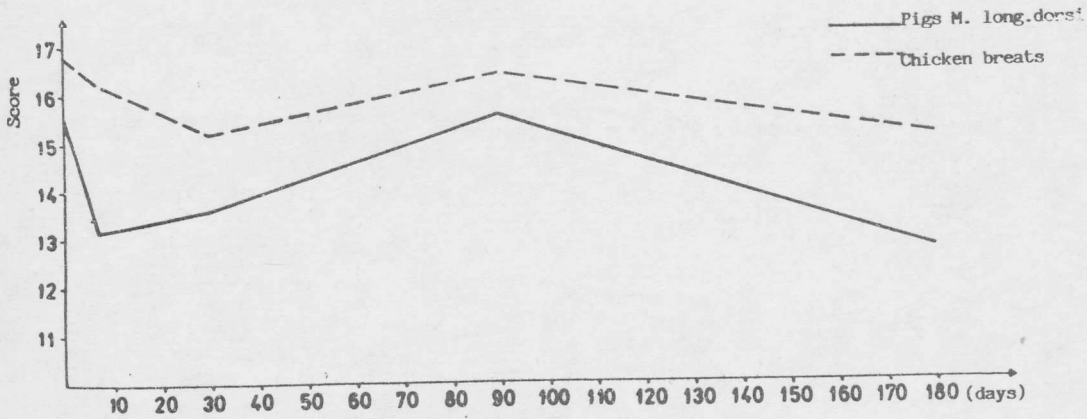
Graph.1. Effect of cooking, freezing and reconstitution on total score for sensory evaluations of pigs M.long. dorsi and chicken breasts



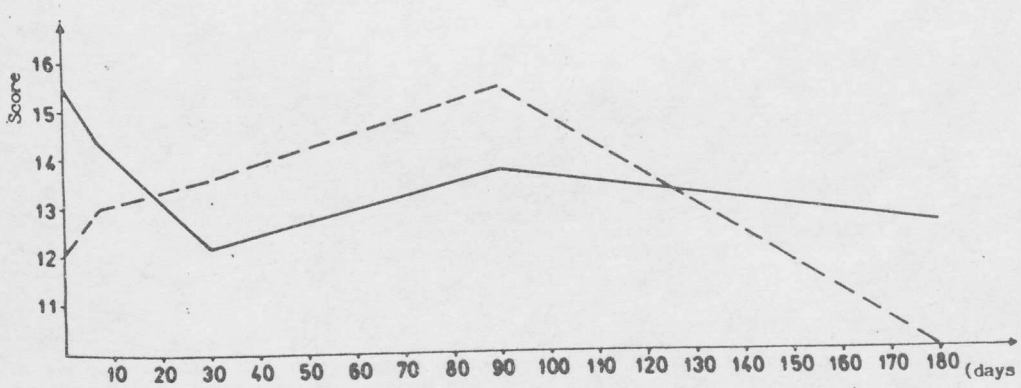
Graph.2. Effect of boiling, freezing and reconstitution on total score for sensory evaluations of pigs M. long. dorsi and chicken breasts



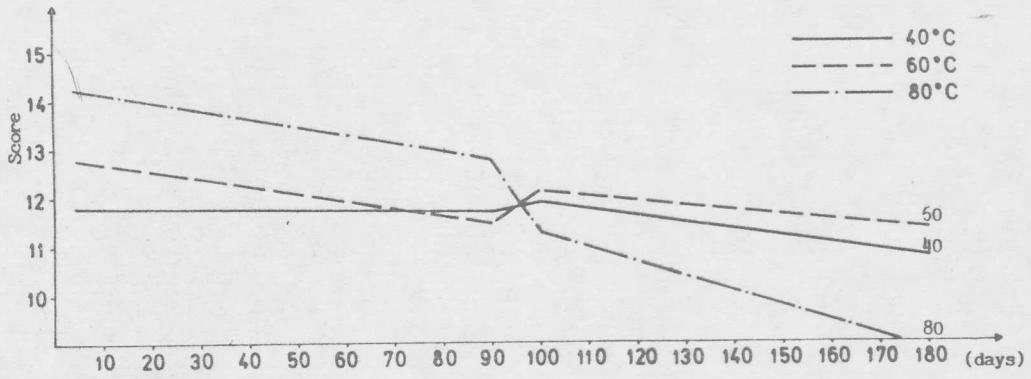
Graph.3. Effect of stweing, freezing and reconstitution on total score for sensory evaluations of pigs M. long. dorsi and chicken breasts



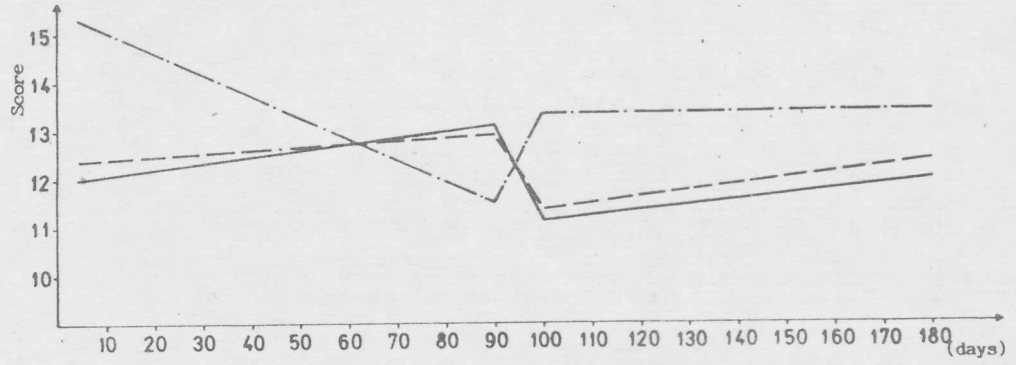
Graph.4. Effect of frying,freezing and reconstitution on total score for sensory evaluations of pigs M. long. dorsi and chicken breasts



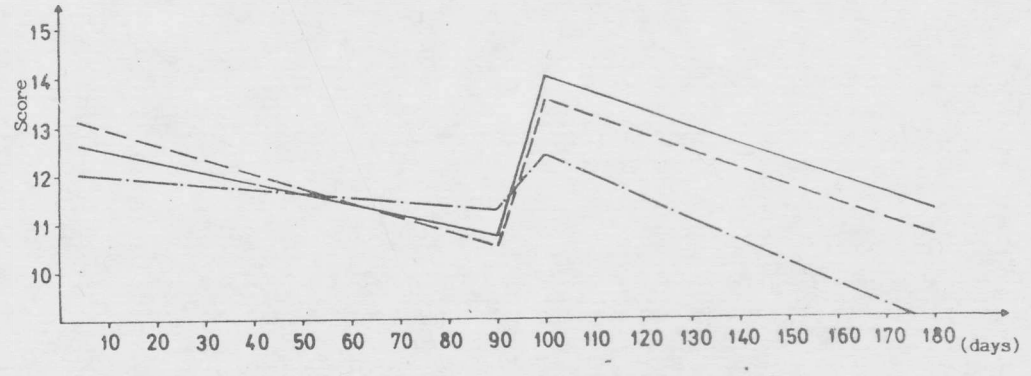
Graph.5. Effect of stweing, freezing and reconstitution on total score for sensory evaluations of pigs M.long. dorsi and chicken breasts



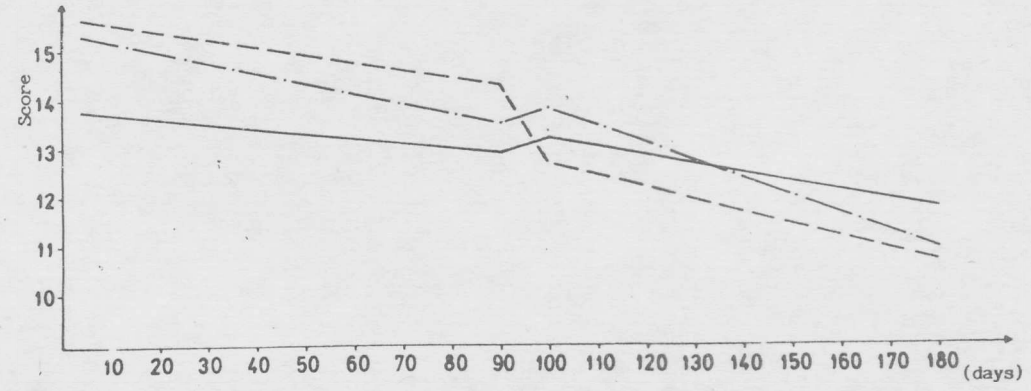
Graph.6. Effect of stweing up to 40, 60 and 80°C , storage and reconstitution on total score for sensory evaluations of pigs M. long.dorsi



Graph.7. Effect of stewing up to 40, 60 and 80°C , storage and reconstitution on total score for sensory evaluations of chicken breasts



Graph.8. Effect of frying up to 40, 60 and 80°C, storage and reconstitution on total score for sensory evaluations of pigs M. long. dorsi



Graph.9. Effect of frying up to 40, 60 and 80°C, storage and reconstitution on total score for sensory evaluations of chicken breasts