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EFFECT OF FREEZING AND STORAGE ON SOME QUALITY PROPERTIES OF HEAT TREATED CHICKEN BREAST

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SUMMARY

The reached level of development of the industrial prepared ready dishes is not yet final.The results of the recent investigations suggest that there is a possibility to produce a new group of semifinished dishes or some ingredients for ready dishes by heating the parts to the temperature in the center of app. 75-80°C, which is lower than usual temperature for ready dishes production.
Culinary half-preparing was followed by freezing,storage and completion of heat preparing immediately before consumption.

INTRODUCTION

The technological operations during meat production and processing cause a series of the decomposition processes. The consequnces are numerous (Solovljev,1966;Briskey et al., 1966;Lawrie,1974;Oluški,1973;Rahelić,1978 and others). One of the unaviodable changes is also the protein denaturation and the most important technological consequences of the protein denaturation, disregarding the reasons, are the loss of protein`s water binding capacity,the changes in the meat texture,odour and taste.Heat treatment is the technological operation which especially accelerate the protein denaturation (Čavlek,1969;Grau,1969;Hamm,1962;Rahelić et al., 1980; Szczesniak and Torgenson,1965;Giles, 1969 and others).
Weight loss is also important characteristic from the economic as well as from the technological standpoint.It exerts influence on the price of product and on its sensory characteristics (tenderness,juiciness,odour and taste).In the same time weight loss is an indicator of the denaturation changes in meat proteins (Szczeniak and Torgenson,1965; Savić,1972;1972;Hamm,1962 and others).
Because of that it is an unaviodable parameter in the scientific investigations of different factors affecting the intensity and the rate of the loss of the protein native character (ripening,freezing,heat tretament, chemical substances etc.).
Weight loss- and in that way also the rate of the protein denaturation- is proportional to the quantity of the heat to which the meat was exposed.
Freezing and storage of frozen meat cause as well as heat treatment the denaturation of

1975;Carlin et al.,1959;Milica Gugušević--Djaković et al.,1974;Hanson et al.,1959; Dagerskog et al.,1976; Sato et al.,1973 and others), so the aim of our research was to investigate this field more comprehensive.
On the bases of the obtained results it was proved that the chicken breast can be stored at - 20°C up to 110 days without significant drop in quality.

tions were based on this fact.

MATERIALS AND METHODS

The breasts of chicken,7 weeks of age,produced on the farm,weighing app. 2oo-25o g 2 days post mortem, were used for investigation. The samples were taken from the same production series.
The chosen and prepared meat parts were allocated to three treatment groups.Each group was fried in a fresh,not preheated maize germ oil,heated to the temperature of app. 170°C. The first group of samples was fried until the temperature in the center reached 40°C. The frying of the second group of samples was broken when the temperature in the center reached 60°C and the third group of samples was fried until the temperature reached 80°C in the center of the parts.
After cooling at room temperature during one hour, the meat parts were weighed,then putted into the aluminium containers,poured with maize germ oil which was used for frying and

stored at - 20°C.After the storage period of 4,60,90,100,110,120 and 180 days the meat parts were defrosted by frying at 170°C in the same oil in which they were prepared until the temperature in the center in all of samples reached 80°C.

The total weight loss during the culinary half-preparing,freezing,storage and defrosting,i.e. completion of culinary preparing by frying was estimeted by weighing of the samples in each phase of the experiment.The results were presented in percents related to the initial weight of raw samples.

Tenderness of the defrosted and heat treated meat was determined using Warner-Bratzler apparatus.The force required to effect a shearing action in the cylindrical sample was measured using the borer of a diameter of 1,27 cm.The cylindrical samples were cutted transverzal realted to the muscle fibers. The results were given inkg as a mean value for three samples.

The plasticity was measured using Höpler consistemoter .The changes of the hights of samples cutted with the borer of a diameter of 2,54 cm and 1 cm high,after 2 kg - loading within 60 sec were measured. The plasticity was presented in percentage related to the initial hight of the sample as a mean value for three samples.

Elasticity was determined with Höpler consistometer using the same samples which were taken for plasticity assements.The changes of the hight of samples within 60 sec after removal of the loading conditions were estimated.The results of the measurement are given in percentage related to the hight of the sample after the plasticity measurements as a mean value for three samples.

Sensory evaluations are very important in quality control of foods.Five trained panelist from the Technological faculty carried out the sensory evaluations in order to make them as objective as possible.Tenderness, juicines,odour and taste and the colour on the surface were estimated using the scoring system presented in the table 1.

The results are presented as mean values of the individual scores.The sample which was graded with the note lower than 2,50 for any of evaluated characteristics was considered as undesirable, because it could not satisfy the requirements of the quality minimum.

The results were statistical analysed by calculating of the arithmetical meat for all of groups during all phases of the investigations.

Table 1. Scoring system used for sensory evaluations

numerical note	description of characteristic			
	tenderness	juiciness	odour and taste	colour on the surface
1,oo	very tough	very dry	very unplea-sant	very undesi-able
2,oo	tough	dry	unplea-sant	undesi-able
3,oo	not enough tender	not enough juicy	not enough plea - sant	not enough desir-able
4,oo	tender	juicy	plea-sant	desir-able
5,oo	very tender	very juicy	very plea-sant	very desir-able

RESULTS AND DISCUSSION

The results of the investigations of total weight loss (in %) are presented in table 2.It is necessery to remark that the meat was not frozen to be already defrosted after the storage of 4 days. More interesting and more important are the subsequent changes after storage for 60,90,100,110,120 and 180 days. The obtained results showed that the freezing and storage for 60 as well for 90 days affect lower total weight losses in relation to the storage period of 4 days.So the assesments were made also on the fouth day of the storage to make comparisons between all parameters at defined storage time.The weight losses measured after storage of 100 and 110 were almost similar or some greater in comparison to them after the storage of 90 days.The proteins acquired again the ability to water binding (partially) during the storage period between the 4th and 90th day. The characteristic of the storage period between the 60th and 90th and even 110th day was the stability of the protein characteristics.The denaturation caused by freezing was not significant.The qualitative changes

occured between the 110th and the 120th day of storage. Because of the denaturation changes caused by freezing the weight loss was increased in relation to the storage time of three months.

A very important characteristic of culinary prepared meat is the tenderness (table 2.). The comparation of the results of instrumental measurements showed that the fried meat of chicken breast with values of 3,03 to 4,28 kg was enough tender. On the bases of the instrumental as well as sensory evaluations it can be concluded that the storage time affect no significant lowering of the meat tenderness. This results are in agreement with that of Goodwinn et al (1962), cited by Paul and Palmer (1972), who reported that there was no significant differences in tenderness of

Table 2. Some properties of chicken breast, fried, frozen, stored and defrosted by frying - instrumental measurements

Investigated characteristic	treatment group	deep fat frying temp. in the center (°C)	defrosting by frying temp. in center (°C)	freezing and storage (days) 4	60	90	100	110	120	180
Total weight loss (%)	1	40	80	37,11	35,22	33,12	34,00	33,80	34,07	34,49
	2	60	80	37,24	35,68	32,86	33,25	34,25	36,30	37,59
	3	80	80	41,46	38,40	37,74	36,20	37,46	38,88	38,80
Tenderness Warner-Bratzler (kg)	1	40	80	3,69	3,64	3,93	3,99	3,37	3,34	4,28
	2	60	80	3,19	4,09	2,65	3,29	3,69	3,36	3,64
	3	80	80	3,03	3,41	4,09	3,70	3,32	3,95	3,49
Plasticity Höpler-cons. (%)	1	40	80	31,34	38,27	37,04	33,94	33,51	32,60	31,10
	2	60	80	31,87	34,24	35,65	30,34	30,10	29,25	28,74
	3	80	80	30,01	31,53	29,41	31,33	28,89	28,80	28,63
Elasticity Höpler-cons. (%)	1	40	80	56,34	53,10	56,56	58,89	58,94	57,06	48,51
	2	60	80	45,64	50,16	47,16	64,08	58,14	60,00	54,85
	3	80	80	51,64	58,74	61,33	53,17	62,06	52,63	37,53

Table 3. Results of sensory evaluations

Evaluated characteric	Treatment group	deep fat frying temp.in the center(°C)	defrosting by frying temp.in the center (°C)	freezing and storage (days) 4	60	90	100	110	120	180
tenderness	1	40	80	4,12	3,50	3,50	3,50	2,62	3,00	3,00
	2	60	80	4,03	2,37	3,87	2,80	3,20	2,80	2,50
	3	80	80	3,92	3,70	3,60	3,40	3,60	3,60	2,80
juiciness	1	40	80	2,85	2,70	2,70	3,00	2,80	2,30	2,70
	2	60	80	3,10	2,80	3,20	2,70	3,10	3,00	2,80
	3	80	80	3,00	2,90	3,00	3,20	3,10	3,00	2,80
odour and taste	1	40	80	3,30	3,00	3,40	3,40	3,20	3,00	2,90
	2	60	80	3,90	3,40	3,60	2,90	2,90	2,70	2,50
	3	80	80	3,80	3,60	3,20	3,30	3,50	3,10	2,70
colour on the surface	1	40	80	3,80	3,70	3,20	3,20	3,20	3,50	3,30
	2	60	80	4,00	3,80	3,70	4,30	3,80	3,70	2,90
	3	80	80	4,10	3,80	3,70	3,90	3,70	3,30	2,80

of poultry breast after frying (until the temperature in the center reached from 55 to 94°C). Contrary to the instrumental measuremens , the sensory evaluations showed statistically very significant differences (table 3.)

It can be concluded that neither the applied method of culinary preparing nor the storage time caused such a changes in meat tenderness which could drop a quality under the limit of acceptability.

Plasticity is the property which indirectly may indicate the degree of the protein denaration in heat treated meat. Such a conclusion may be drawn from the comparative study of the values for the total weight loss and for the plasticity (tab.2.) The agreement of the results is evident.

In the samples with lower weight losses were determined the higher values for the plasticity , or vice versa. The lowest values for

the plasticity were found in meat samples stored for 130 days and which were heated in the both phases of heat tretament to the temperature in the center of 80°C (28,63%). The weght losses showed in this treatment group also the highest values if the control on the 4th day of storage is exepted (38,80%).

In contrast to the plasticity, which in investigation may be used as an indicator of the water binding capa ity and indirectly as an indicator of the degree of the protein denaturation, the value for the elasticity can be a parameter for the detection of any of the changes which may be caused by heat treatment ,freezing and storage (tab.2.).
By comparison of the results for total weight loss (tab.2.) with the results of sensory evaluations (tab.3.) some agreement were noted. The samples with higher weight losses were mostly scored with lower values for the juiciness.After the storage period of 6 months the lower values for juicines were observed for the meat samples which was heated to the temperature in the center of 40°C by first and 80°C by second heat treatment.
During the freezing some processes which may cause the demage effect on the odour and taste (Savić,1970; Oluški,1983)occur in the oil. Keeping this fact in mind the oil which was used for frying was not formerly hetaed. Berger (cited by Tilgner,1974) also reprted that the quality of the odour and taste of the fried products depend on the quality of oil used for frying.
In our investigation were also excluded the effect of the storage temperature on the odour and taste of fried meat.Namely, Hanson et al. (1958) reprted that the changes of the odour and taste are more intensive in samples stored at - 6,6°C than the samples stored at the temperature of - 23,3°C. We used the temperature of - 20°C because it is the usual temperature in our commercial condition for storage.
Dagerskog et al.(1976),Sato et al. (1973) consider the reached temperature in the center of the parts during the firs phase of the heat treatment to be a very important factor affecting the quality of culinary semi-finished and then frozen minced meat steaks. They reportod too that at the higher temperatures the higher quantities of the products of Maillard reaction have an antioxidateve effect. The results of Dagerskog et al.(1876) and Sato et alž.(1973) were not confirmed in our investigations.
The odour and taste were scored as desirable by all treatment group even after the storage of 180 days (2,9o;2,5o;2,7o).It was noted that after the storage of 110 and 120 days the values for the odour and taste decreased, so the fried chicken meat should not be stored for a time longer than 110 days.
On the bases of the obtained results it was proved that half-prepared and culinary prepared meat of chicken breast can be stored at -20° without significant quality changes up to 110 days.

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