Intensification of the production of raw-dried pork products using starter cultures
I. Changes in the structural and mechanical properties of the meat products

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Introduction

The raw-dried non-comminuted pork products have a high nutritive value and provide a possibility of long storage, therefore the increase in the volume of production is a question of present interest. The production is however attended by important difficulties connected with the prolonged technological cycle on the one hand, and with the influence of the different production conditions characteristic of the enterprises, on the other hand.

One method of intensifying the production cycle of raw-dried meat products consists of accelerating the processes of ageing and mass-exchange at maintaining or improving the quality of the finished products. The use of various bacterial cultures resulted in obtaining important achievements in this field. The long application of bacterial cultures in our country to the production of raw-dried minced meat sausages (3,4,5) and the good results obtained provided a basis for carrying out studies on the possibilities of application to intensifying the production of raw-dried non-comminuted meat products. The objective of the present study was to establish the effect of the starter cultures on the structural and mechanical properties of the products and the dynamics of the drying process.

Material and Methods

The present studies were carried out on pork obtained from swines of the 'White Bulgarian' breed, live weight of 110-115 kg, breeded under the same conditions. Hind quarters were separated from the carcasses and shaped by removing the coxal bone (os coxae) and the metatarsal bones.

The left-hand parts were used as test samples and were subjected to the following salting. The meat was injected with brine containing mixed starter culture, strains 136 and 167 (ratio 1:1) as a 24-hour bouillon suspension in Hotinger yeast bouillon, in an amount ensuring 10^5 - 10^6 microbial cells per gram of meat raw material, 4-6% to the weight of the raw materials. The samples were then placed in a salt solution of concentration of 10^0B for 96 hours followed by dry salting for 48 hours. The entire salting process was completed at a temperature of 13 - 15°C for 6 - 7 days.

The right-hand parts used as control samples were salted in accordance with the conventional dry method at a temperature of 2 - 4°C by repeated rubbing of a dry salting mixture and appropriate kneading for 30 - 35 days.

Drying of the test and the control lots was conducted at a temperature of 10 - 12°C, relative humidity = 85 - 75% and airflow of 1.0 - 0.5 m/s for 100 d.

The samples to be studied were taken from the initial raw material and from the products on the 10th, 20th, 30th, 40th, 50th, 60th, 80th and 100th d of the technological process. The changes in the structural and mechanical properties were followed by determining the values of the indices, such as structural strength, plastic strength and tenderness of muscle tissue after Grau (1,2) for the muscles m. semimembranosus, m. semitendinosus and m. quadriceps femoris individually. The dynamics of the drying process was controlled by determining the dry matter in the samples.

The experimental results obtained were handled by the mathematical and statistical methods (6,7) and presented in tables and diagrams as a confidence interval M ± tm, where M - average arithmetic value from n - 18 studies, m - mean square error of the average result, t - coefficient of Student within the 95% confidence interval adopted.

Results and Discussion

The data given in Table 1 show that the values of the structural strength for the test and the control samples maintained a definite tendency to increase during the entire technological process. In all the muscles the increase was more significant with the control samples.

After the 30th day the differences in the values of the structural strength between the test and the control samples began to increase and and values 35-40% higher were obtained in the samples without starter cultures to the end of the technological process.

The results obtained for the changes in the tenderness of muscle tissue are presented in Fig. 1, 2 and 3. In the samples salted with addition of bacterial strains, the tenderness began to increase just after the initial days of salting which coincided with the process of increasing the number of bacteria injected.

In the process of drying the values of the tenderness decreased definitely which was connected with the process of thickening of the muscle tissue as a result of the product dehydration, the increase in the sodium chloride concentration and the subsequent denaturation changes in the muscle proteins.

In the control lots the increase in the tenderness began considerably later, just after the 20th d, when the action of the enzyme system of the raw materials occurred and the salting mixture diffused in depth of the muscle tissue.

TABLE 1

Moment of study	Type of sample	Structural strength g/cm² Sample	Structural strength g/cm² Control	Plastic strength Sample	Plastic strength Control
		m. semimembranosus			
Initial material		1600±96	1600±93	480±29	480±34
On the 10th day		2400±175	4500±243	960±58	1040±63
On the 20th day		9800±637	12000±804	1420±99	2100±148
On the 30th day		16000±880	20000±1280	2150±150	3400±221
On the 40th day		28800±1699	35600±2250	2800±224	4600±330
On the 60th day		45000±3195	70000±4130	3400±272	5800±453
On the 80th day		63000±3906	82000±5002	4380±306	6700±455
On the 100th day		68300±3551	89700±5200	5110±492	7300±498
On the 120th day		71100±4400	98800±6130	5400±384	7650±502
		m. semitendinosus			
Initial material		1500±95	1500±83	450±30	450±28
On the 10th day		2200±160	2000±112	1100±53	920±81
On the 20th day		7300±467	6800±353	1900±101	1580±113
On the 30th day		15200±927	16300±880	2000±112	2100±224
On the 40th day		25400±1727	28900±2080	2600±208	4200±336
On the 60th day		40000±3040	52000±3484	3200±240	5010±320
On the 80th day		59600±3158	71000±3763	4310±197	6000±420
On the 100th day		64300±3344	87700±5876	4960±382	6500±358
On the 120th day		69800±4258	94400±5664	5300±395	6840±513
		m. quadriceps femoris			
Initial material		1800±122	1800±108	490±29	490±27
On the 10 th day		2500±133	4600±257	970±68	1060±68
On the 20th day		9200±598	11200±694	1500±114	2160±128
On the 30th day		15000±1110	19000±988	2050±136	3390±204
On the 40th day		26000±1872	35100±2598	2790±167	4550±283
On the 60th day		46000±3174	71800±4524	3510±263	5990±408
On the 80th day		62000±3472	80000±5520	4400±225	6700±475
On the 100th day		68700±4396	88900±7023	5220±380	7100±555
On the 120th day		70500±5288	99600±6375	5700±438	7700±500

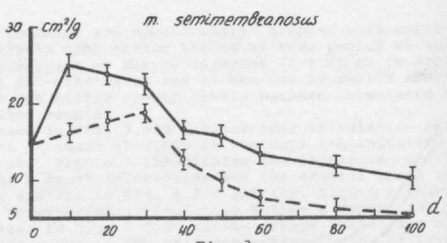

Fig. 1

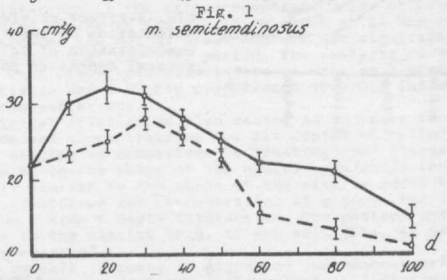

Fig. 2

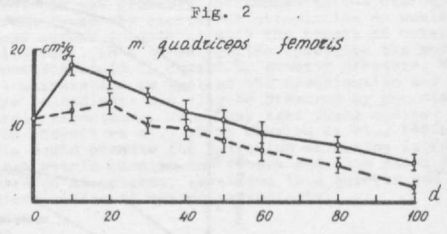

Fig. 3

Fig. 4 shows the results concerning the dynamics of the process of drying. It is seen that in the test samples the process developed considerably more intensively and the differences in the degree of dehydration appeared to the 10-15th day. As a result of this, the process of drying was completed about 45 days earlier when applying the bacterial cultures.

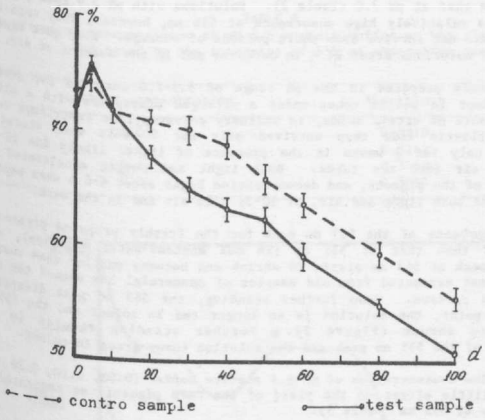

Fig. 4

Based on the experimental data obtained and the analyses made, the following conclusion may be drawn: the application of the bacterial strains 136 and 167(at a ratio of 1:1) to the production of raw-dried pork products provides conditions of intensifying the mass-exchange processes in salting and drying of the products and the processes affecting the improval of the structural and mechanical properties of the finished products.

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