I/4 On Thermolysis of Meat Proteins

Vilma Mihályi, E. Zukál and L. Körmendy

Summary

The changes occuring in myofibrillar protein fraction during heat treatment was investigated. It has been found that a portion of the muscle proteins coagulated dissolve when heated to higher temperatures /120°C/. The process of dissolution can be explained by the decomposition and rearagement of the tertiary structure of protein. The investigations confirmed the assumption that some of the muscle proteins suffer thermolysis during heat treatment at 120°C to give free amino acids and peptides of low molecular weight.

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Introduction

The influence of heating on muscle systems is an interesting field of meat research, important for the practice of processing meat and to the determination of nutritive value, flavour- and aroma compounds.

Experiments

Materials

Myofibrils /purified meat protein gel/: Pork semimembranosus muscle was minced twice /mincer disc with 0,8 mm mesh/. One part of meat was mixed with 1,5 parts of cooled destilled water /5°C/ in an ultraturrax for 30 sec and

rubbed through a sieve /1 mm mesh/ to eliminate connective tissue. The gel obtained was centrifuged at 2500 g for 20 minutes, after which 1 part of gel was again mixed with 1,5 parts of 1% NaCl-solution /in water/ and centrifuged as before. The rest was mixed cooled water /1:5/ and centrifuged. This procedure of washing was repeated three times. The protein pellet resulting from the last centrifugation was used for the experiments. The protein part of the gel consisted of the myofibrils and mitochondrion particles from which soluble proteins and the greater part of connective tissue had been removed.

Methods

Heating. Samples were transferred to cans. After closing the cans they were heated in an autoclaves at 120°C. The heating times were: 7,5; 15; 22,5; 30; 37,5; 45 hours.

Determination of amount of water soluble materials

The cans were opened and the samples were suspended in boiling water. The insoluble residue was separated by filtration. This procedure was repeated till the filtrate was free of nitrogen. The insoluble and soluble materials were evaporated on a boiling water bath with the help of absolute ethanol.

Determination of non-protein nitrogen

The extraction was carried out by the following solutions:

1. 10 % trichloro acetic acid
2. 80 % ethylalcohol

The nitrogen content was determined by Kjeldahl-method.

Amino acid analysis

It was made by an automatic amino acid analyser /Biocal/.

Results and discussion

Zukal /1969/1970/ investigating the effect of strong heat treatment /120°C/ purified beef myofibrils experienced, that extensive changes also took place in protein gel without external reaction partner; the changes were in the solubility of the gel in water, those proteins which became insoluble in water between 60 and 100°C dissolved at 120°C. Zukal established, that the dissolution process might be caused by a breakdown either of hydrogen bonds or, perhaps, of disulphide bonds in protein.

In these experiments, pork myofibrils was treated in a similar way. Table 1 shows the composition of protein gels. Table 2 shows the effects of heating on meat protein gel. The results shows the remarkable changes.

It can be seen from the table 2 that the solubility in water similarly to beef myofibrils increased at increasing heat treatment time. The changes taking place in solubility in 10% trichloro acetic acid solution and in 80% ethanol solution can be attributed to the arising of nitrogen's material of low molecular weight, namly to the thermolysis of myofibrillar proteins. Among the destruction's products there were proved to be ammonia, peptides and amino acids /table 2/.

The following amino acids were determined by amino acid analyser: lysine, histidine, arginine, cystine, aspartic acid, threonine, serine, glutamic acid, proline, glycine, alanine, valine, methionine, isoleucine, leucine, tyrosine, and phenylalanine.

Table 1 - Composition of protein gel

component	%
dry substance in % of weight of gel	9,09
total nitrogen in % of dry substance	15,18
Lipid in % of dry substance	1,82
connective tissue nitrogen in % of total nitrogen	0,81
NaCl content in % of dry substance	0,002

Table 2 - Effects of heating on meat protein gel

investigated components	heating time in hours at 120°C						
	0	7,5	15	22,5	30	37,5	45
water soluble material in % of total dry material	0	22,2	30,6	35,3	40,2	43,6	45,7
TCE soluble nitrogen in % of total nitrogen	0,7	1,69	3,12	6,05	7,77	10,17	14,47
ETOH soluble nitrogen in % of total nitrogen	0,23	0,81	1,33	2,08	3,58	5,58	7,69
amino acids in % ETOH soluble material	0	33,92	42,11	60,67	69,48	74,94	75,57
ETOH soluble peptides in % of ETOH soluble material	0	19,20	14,12	21,25	24,80	15,25	15,24

TCE - 10 % trichloroacetic acid solution in water
ETOH - 80 % ethanol solution in water

LITERATURE

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