MANUFACTURE OF HYDROLYZATES FROM SECONDARY ANIMAL RAW MATERIAL

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Nowadays food protein deficiency may be satisfied by means of additional usage of inedible protein waste obtained after cattle and meat processing [1, 2]. The muscular tissue contains in average 15-20 % of protein and sometimes this value is even higher. High level of protein contained in raw materials, due to its keratine origin, is assimilated with difficulty. Such kind of raw materials contains protein in bound state. Its partial or complete hydrolytic decomposition to amino acids and polypeptides allows to obtain hydrolyzates which may be used as nutritional additives in food and microbiological industries, as well as in medicine and manufacture of mixed feed.

PURPOSE

Purpose of this study is to analyze the chemical and enzymatic processing of cattle and meat protein waste and to receive hydrolyzates with optimal amino acid composition.

MATERIALS AND METHODS

In the study, dispersed waste of cattle and meat processing (hooves, horns, and blood of cattle, pig bristle and meat and bone ground pork and beef) as well as down-feather waste were used. Acid hydrolysis was carried out by the ratio of raw material: 2-6 n.mineral acid from 1:1 to 1:4 at 120 ^{0}C during 6-24 hours, as indicated in [3]. Amino acid composition of products was analyzed on the "BIOTRONIC" amino acid analyzer LC-3000 (Germany) according to the standard program [4]. Protein content was determined according to Kjeldal or data of amino acid analyses.

RESULTS AND DISCUSSION

Data summarized in the Table showed that all keratin-containing raw material is practically the best protein source compared to meat and bone material. Meat and bone material contains about 20 % of protein and 25 % of fat. It requires a stage of compulsory fat removal before hydrolysis. Keratin-containing material has 80-90 % of protein and is almost fatless.
Amino acid composition of this raw material is characterized by a great quantity of essential amino acids in optimal ratio to standard protein. In contrast to meat and bone material, keratin-containing material has optimal quantity of treonine (essential amino acid) and cystine (semiessential amino acid) which substitutes 50 % of methionine (essential sulphur-containing amino acid).
However keratin-containing material is hydrolyzed with animal enzymes (pancreatin in particular) with difficulty. In this connection acid hydrolysis may be used for processing of keratin-containing materials.
The blood of slaughter animals may be used for obtaining secondary animal protein (see Table), because of its potential degradation. It is known that the total protein of slaughter animals blood is in soluble state and may be processed in "mild" conditions in the presence of hydrolases. Completed study showed that the fermented hydrolyzate may be easily obtained from diluted blood (1:2) in 3-6 hours at 50 ^{0}C after processing the mixture by 1-5 % mass pancreatin or yeast enzymes [5]. It is evident that by the processing of the meat and bone material for obtaining hydrolyzate with optimal amino acid composition at the stage of acid hydrolysis, keratin-containing material is to be added to remains of the raw material after fermentative hydrolysis and mixed acid hydrolysis is to be carried out.
Comparative hydrolysis of difficultly hydrolyzed down-feather waste by means of acids (2M hydrochloric acid, 20 % sulphuric acid, and concentrated phosphoric acid) at 120 ^{0}C during 5 hours in autoclave (raw material: acid ratio was equal to 4) showed that 20 % sulphuric acid was the weakest hydrolysing reagent. It hydrolyzed poorly bonds formed by methionine, isoleucine, leucine, lisine (10-15 % of summary yield after hydrolysis), as well as treonine and glutamine (20-25 % of yield). The phosphoric acid did not practically favour the release of hystidine, lisine, treonine, and serine; their yields being not higher than 10 % .
Acid hydrolyzate obtained from the protein of blood residuum had the following amino acid composition in g/100 g of protein: aspargine - 5.54; treonine – 3.81; serine – 11.45; glutamine - 8.75; proline – 13.59; glicine – 6.72; alanine – 3.95; cystine – 4.52; valine – 3.78; methionine – 0.28; isoleucine – 2.74; leucine – 5.68; tyrosine – 2.12; phenylalanine – 4.15; histidine – 4.18; lisine – 0.91; arginine – 4.65 (total: 86.90).
As a result, the acid hydrolysis gave yield of protein hydrolyzates with the following characteristics: $N_{am.}$, mg %: 250-350; N_{tot}, mg %: 450-550; dry residium: 10-20 %; pH: 5-6,5. Analysis of physico-chemical characteristics of hydrolyzates showed that fermentative hydrolyzates obtained in the process of fermentative or chemical processing had more balanced composition and greater number of unhydrolyzed peptides (1-15 kD molecular mass) fractions. The acid hydrolysis allowed to carry out deep degradation of proteins in almost insoluble keratin-containing waste. At the same time, optimal conditions and the usage of various materials allowed to obtain hydrolyzates enriched by essential amino acids with optimally balanced composition.

CONCLUSION

Thus, the waste remained after the processing of cattle and meat may be used for obtaining hydrolyzates with valuable amino acid composition for food and microbiological purpose as well as for the production of mixed feeds.

Amino acid composition of the protein raw material

Amino acid	Composition (g/100 g of protein) in:								
	cattle hooves*	cattle horns*	pig bristle*	down-feather wastes*	cattle blood	meat-bone ground beef (30 % of bone)*	meat-bone ground pork (30 % of bone, 35 % of fat)*	egg albumin (standard)	beef flesh
Aspargine	7.26 66.63	7.28 64.48	6.60 53.93	7.02 59.67	6.0	6.52 15.42	7.28 11.64	9.3	9.0
Treonine	4.57 42.01	3.21 33.07	5.03 41.06	4.64 39.44	4.7	2.40 5.67	3.21 5.14	7.0	3.3
Serine	6.89 63.30	3.27 75.60	6.72 54.90	6.13 52.10	7.3	3.21 7.60	3.27 5.22	5.9	1.8
Glutamine	14.36 131.75	13.08 130.80	15.58 127.10	13.25 112.62	10.2	10.44 24.70	13.08 20.89	16.5	18.5
Proline	6.84 62.76	6.28 14.18	7.06 57.68	4.40 37.47	4.7	9.63 22.80	6.28 10.03	5.1	3.5
Glicine	3.51 32.25	9.47 55.23	3.41 27.91	6.36 54.06	5.3	15.81 37.42	9.47 15.13	3.1	2.5
Alanine	3.63 33.38	6.08 28.42	3.63 29.65	5.31 45.13	8.9	7.90 18.70	6.08 9.71	6.7	4.1
Cystine	6.49 59.60	0.11 9.89	7.24 59.14	2.38 20.23	1.6	0.11 0.26	0.11 0.17	1.9	1.1
Valine	6.08 55.86	3.84 41.47	4.59 37.49	6.09 51.76	7.8	3.70 8.66	3.84 6.13	4.9	4.4
Methionine	0.89 8.24	0.43 13.11	0.44 3.64	1.98 16.83	2.2	0.30 0.66	0.43 0.68	4.5	3.0
Isoleucine	4.70 43.13	3.03 5.14	3.59 29.31	4.02 34.17	4.3	1.85 4.37	3.03 4.84	7.0	4.9
Leucine	10.02 91.99	5.64 74.28	8.22 67.14	9.14 77.69	12.0	4.20 9.90	5.64 9.01	8.2	7.8
Tyrosine	5.53 50.76	2.25 31.24	2.76 22.55	1.15 9.77	4.6	1.30 3.01	2.25 3.59	5.8	3.6
Phenylalanine	1.95 17.97	3.20 21.90	1.70 13.93	3.71 31.53	4.7	2.60 6.10	3.20 5.11	4.8	5.3
Histidine	1.11 10.25	3.10 15.42	1.12 9.15	6.47 54.99	2.0	2.57 6.09	3.10 4.95	2.4	3.9
Lisine	4.26 39.11	6.48 45.28	3.97 32.41	3.20 27.28	4.1	4.28 10.13	6.48 10.35	7.6	8.7
Arginine	8.72 80.00	6.61 79.07	10.83 88.38	3.91 33.23	5.5	6.66 15.76	6.61 10.55	5.7	8.8
Triptophane	1.14 10.43	1.08 9.01	1.12 9.14	1.02 8.67	1.3	- -	1.14 1.72	2.0	1.0
Total	97.95 899.42	84.44 777.59	93.61 764.51	90.18 766.64	97.2	83.48 197.25	84.50 134.86	108.4	95.2
Protein content in raw mater., %	91.50	83.40	81.58	85.00	18.0	22.70	16.00	12.8	19.5

*denominator - g/kg of raw material

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