Pakistan J. Sci. Ind. Res., Vol. 31, No. 3, March 1988

AMINO ACID COMPOSITION OF TISSUE PROTEIN FROM FIVE SPECIES OF OYSTERS

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(Received January 26, 1988)

The amino acid composition of tissue protein was studied in five species of oysters, namely, *Crassostrea rivularis, C. madrasensis, C. glomerata, C. tuberculata* and *C. gryphoides* from the coast of Pakistan. Protein hydrolysate of dried whole animal was prepared and component amino acids were determined by amino acid auto analyser. A total of fourteen amino acids were identified in the species studied. Almost all essential amino acids were present except methionine and arginine which could not be detected. Among the species, *C. madrasensis* exhibited higher concentrations of the essential amino acids, lysine, phenylalanine and threonine. Seasonal variation in the bound amino acid content were studied for *C. madrasensis* and *C. rivularis.*

Keywords : Amino acids, Biochemical composition, Oysters.

INTRODUCTION

Nutritional studies on oyster meat are well documented from temperate waters but very little is known about oysters from tropical regions. Recently, data was published on the biochemical composition of some edible oyster species from Karachi coast [1,2]. Reports on the amino acid composition of oyster tissue protein are few; data is available on the American [3,4] and Pacific oyster [5] but none on Pakistani oysters, this is the first report on the subject.

The importance of essential amino acids in human nutrition is well known. Considering the fact that the nutritive quality of meat protein can only be assessed by determining its amino acid profile in the present study. The evaluations of the quality of meat of five species of oysters was done by estimating the amino acid composition of whole body protein hydrolysate. Seasonal studies were carried out on two species.

MATERIALS AND METHODS

Specimens of five species of oysters were collected from different areas of Karachi coast; Sandspit backwaters (*Crassostrea rivularis, C. glomerata* and *C. madrasensis*), Sonari (*C. gryphoides*) and Gadiani (*C. tuberculata*). In the laboratory, oysters were shucked and tissues were dried in an electric hot air oven at 70°. Total protein was determined by Micro-Kjeldahl procedure. For component amino acids, a known amount of dried tissue was hydrolysed with 6N HCl in a sealed glass ampoule at 110° for 24 hours. The hydrolysate was filtered and desalted with Amberlite and individual amino acids were estimated by using Biotronik LC 6001 amino acid auto analyser. The column was capable of resolving sixteen amino acids. The chromatograms of the protein hydrolysate were compared with that of a standard amino acid mixture.

RESULTS AND DISCUSSION

The results of the amino acid composition of oyster tissue protein hydrolysates are summarised in (Tables 1-3).

A total of fourteen amino acids could be quantized

Table 1. Seasonal variation in the proetin and amino acid composition of tissue protein hydrolysate of *C. rivularis*. (values in % protein)

Component	February	May	August	November	Average
Protein % d.w.	40.56	41.25	52.50	55.00	47.33
Alanine	6.04	6.91	9.00	9.67	7.90
Aspartic acid	6.78	9.83	12.56	6.58	8.94
Glutamic acid	6.30	7.98	11.26	5.08	7.65
Glycine	13.27	11.88	6.55	9.10	12.10
Histidine	2.07	1.87	2.72	1.91	2.14
Isoleucine	2.38	1.80	3.12	2.08	2.32
Leucine	3.98	2.89	5.34	3.63	3.96
Lysine	1.59	1.74	1.44	1.28	1.51
Phenylalanine	1.75	1.30	1.94	1.55	1.63
Proline	0.46	2.05	0.79	2.40	1.43
Serine	4.07	6.01	7.82	3.51	5.35
Threonine	3.85	5.74	6.92	3.24	4.93
Tyrosine	0.85	0.60	0.91	0.79	0.79
Valine	3.64	3.75	5.55	2.98	3.98

Table 2. Seasonal variation in protein and amino acid composition of tissue protein hydrlysate of *C. madrasensis* (Values in % protein)

Component	February	May	August	November	Average
Protein %d.w.	40.00	45.31	56.25	46.30	46.97
Alanine	6.99	5.69	7.12	13.25	8.26
Aspartic acid	7.00	11.46	10.45	12.21	10.28
Glutamic acid	5.99	5.18	8.27	13.38	8.21
Glycine	10.46	16.17	16.11	12.98	13.93
Histidine	1.30	1.09	2.51	2.60	1.87
Isoleucine	1.42	1.32	2.40	3.60	2.19
Leucine	3.86	4.21	4.19	6.40	4.67
Lysine	4.15	6.76	3.37	3.76	4.51
Phenylalanine	2.58	1.67	2.39	3.64	2.57
Proline	2.02	1.05	2.39	2.38	1.96
Serine	2.65	2.46	4.45	4.98	3.64
Threonine	4.80	4.41	4.13	5.47	4.70
Tyrosine	0.84	0.82	1.56	2.11	1.33
Valine	2.04	1.79	3.69	5.41	3.23

Table 3. Protein and amino acid composition of tissue protein hydrolysate of three species of oysters. (Value in % protein)

Component	*C. glomerata*	*C. tuberculata*	*C. gryphoides*
Protein %d.w.	39.40	40.00	38.75
Alanine	7.53	6.24	5.78
Aspartic acid	7.06	12.40	2.70
Glutamic acid	7.03	7.89	3.97
Glycine	11.23	10.40	13.03
Histidine	2.39	1.50	0.92
Isoleucine	2.66	2.84	2.67
Leucine	4.44	2.70	4.40
Lysine	2.46	2.02	1.85
Phenylalanine	1.23	1.13	1.72
Proline	2.05	4.93	0.91
Serine	3.27	4.53	1.31
Threonine	3.19	8.38	1.99
Tyrosine	1.22	1.13	1.37
Valine	2.50	1.93	2.37

with almost all essential amino acids. The predominant amino acids in all the species studied were glycine, alanine, aspartic and glutamic acids while histidine and tyrosine were present in low amounts. Among the species, *C. madrasensis* exhibited higher concentrations of the essential amino acids, lysine, phenylalanine and threonine. Seasonal variation in bound amino acid content were studied for *C. madrasensis* and *C. rivularis* because of their high nutritive value as inferred from their biochemical content and calorific value [2, unpublished data]. It was interesting to note that during the months of study, the amino acid composition of tissue protein did not vary in both species; with glycine, alanine, aspartic and glutamic acids were high and tyrosine and phenylalanine were low in amount.

Limited data is available on oyster tissue protein composition. Pottinger and Baldwin [3] determined the amount of only four amino acids i.e. lysine, arginine, histidine and tryptophan in *O. virginica*. Riley [4] working on *C. gigas* determined eleven amino acids and observed a good correlation between free amino acids of extracellular body fluid and bound amino acids of whole body hydrolysate with increase in the length of starvation time. He suggested that this correlation indicates the importance of protein catabolism during starvation.

Sidwell *et al* [5] estimated amino acid composition of tissue protein of *C. virginica* from two sites (Maryland and Alabama) in the United States. They found that aspartic and glutamic acids were high while histidine and methionine were low in amount. The same was true in the present case.

Table 4 summarizes the results of Riley [4] and

Table 4. Amino acid profiles of the protein in oysters.

Amino acid	*C. gigas* (4) Relative conc. %	*C. virginica* (5) % of total protein	
		Alabama	Maryland
Alanine	7.2	5.5	5.1
Arginine	–	6.4	6.3
Aspartic acid	13.3	9.8	10.4
Glutamic acid	23.3	14.0	12.8
Glycine	7.3	5.1	5.2
Histidine	–	2.1	2.4
Isoleucine	–	3.7	3.8
Leucine	8.7	6.6	6.3
Lysine	11.0	8.4	7.6
Methionine	–	2.0	2.0
Phenylalanine	–	3.4	3.4
Proline	6.3	4.4	4.1
Serine	7.3	4.8	4.7
Threonine	6.0	4.1	4.2
Tyrosine	4.3	3.3	3.2
Valine	5.2	4.6	4.2

Figures in parentheses indicate the reference.

Sidwell *et al* [5]. A predominance of aspartate and glutamate can be noted in both species, *C. gigas* and *C. virginica* while in the present study glycine and alanine were in maximum amounts in all the species. According to Sidwell *et al* [5], on the basis of yearly averages, the amino acid profiles of protein was similar in *C. virginica* from both sites suggesting that the pattern is species-oriented unlike protein content which is affected by external factors such as the availability of food and other environmental conditions.

In Table 5, data from various sources is presented showing the amino acid composition of protein from fish crab, mussel and chicken. Although on a dry weight basis, this data is comparable to the result obtained in the present study since on an average the protein content of oysters is 50 percent dry weight. In addition, the essential amino acid content of oyster protein is apparently as good as that of other meats.

Table 5. Amino acid composition of protein from some meats. Values in percent dry weight)

Amino acid	Fish(6) (range)	Crab(7)	Mussel(8)	Chicken(9)
Alanine	5.2 – 7.5	4.36	2.92	–
Arginine	2.6 – 9.6	7.14	8.28	–
Aspartic acid	6.2 – 11.8	6.60	0.15	–
Glutamic acid	5.9 – 16.6	9.17	0.40	–
Glycine	1.0 – 5.6	4.13	3.79	–
Histidine	1.2 – 5.7	3.02	0.77	–
Isoleucine	2.6 – 7.7	3.25	2.51	7.7
Leucine	3.9 – 18.0	5.68	4.24	6.3
Lysine	4.1 – 14.4	4.95	5.01	8.1
Methionine	1.5 – 3.7	4.39	0.51	3.3
Phenylalanine	1.9 – 14.8	2.9	2.34	4.9
Proline	3.0 – 7.1	2.64	1.01	–
Serine	2.5 – 5.4	3.35	1.56	–
Threonine	0.6 – 6.2	3.47	2.08	4.6
Tryptophan	0.4 – 1.4	1.04	–	–
Tyrosine	1.3 – 5.0	2.39	1.53	1.3
Valine	0.6 – 9.4	3.42	3.83	5.8

Figures in parentheses indicate the reference.

The present investigation thus shows the importance of oyster meat protein which could supply the required protein and essential amino acid in the diet of protein malnourished people. The work further suggests the necessity for the commercial exploitation of the oyster species available along our coast.

Acknowledgement. The author wishes to thank Prof. Dr. Z.H. Zaidi for the use of the amino acid auto analyser.

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