Anatomical Proportions and Chemical and Amino Acid Composition of Common Shrimp Species in Central Vietnam

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ABSTRACT : This investigation was conducted to evaluate the shrimp flesh (SF) and shrimp by-product (SB) of the most abundant shrimp species (Metapenaeus affinis, Penaeus semisulcatus and Penaeus monodon) caught in Central Vietnam, with the emphasis on yield, gross and amino acid (AA) composition and effect of heat treatment. The results showed that the mean edible SF and SB (head and shells with tail) yields of the three shrimp species averaged 56.7 and 43.3%, respectively, of the total wet body weight, with the *M. affinis* generating the highest by-product yield (45.7%) and *P. semisulcatus* (40.6%) the lowest. Significant differences in dry matter (DM), crude protein (CP) and ash content were found between SF and SB. The DM content of SF (21.5%) was lower than of SB (24.9%) and the ash content (on a DM basis) of the SB in all shrimp species was more than three times that of the SF ($p<0.05$), whereas the CP content was almost twice as high in the SF as compared with the SB ($p<0.05$). The SB of the three species contained (on a DM basis) between 44.0 and 49.8% CP ($p<0.05$) and between 13.5 and 18.1% chitin ($p<0.05$). The Ca content of SB differed also between species ($p<0.05$). On average, the sum of AA in SB corresponded to 89.3% of the CP and essential AA accounted for about 50% of the total AA. The most abundant AA were arginine, aspartic and glutamic acids, which accounted for 33% of the total AA. Minor, but significant differences in some AA concentrations of SB between species were observed ($p<0.05$). With the exception of the DM and ether extract content, all other chemical constituents of entire shrimp, SF and SB were not significantly affected by heat treatment ($p>0.05$). *(Asian-Aus. J. Anim. Sci. 2000. Vol. 13, No. 10 : 1422-1428)*

Key Words : Anatomical Proportions, Shrimp By-Product, Heat Treatment, Chemical Composition, Amino Acids

INTRODUCTION

With over 3,000 km of sea coast Vietnam has a high potential in fishery production in general and in shrimp production in particular. It was estimated that over 155 thousand tons of shrimp were caught in 1998, of which about 11% were from the central coastal region (Department of Statistics, 1999). In this region three species of shrimp are the most abundant, namely Pink prawn (*Metapenaeus affinis*), Green Tiger prawn (*Penaeus semisulcatus*) and Giant Tiger prawn (*Penaeus monodon*) (Phu, 1996).

Studies on the most abundant shrimp species have demonstrated that the edible flesh and by-product yield of shrimps, as well as their chemical composition, varies among species (Balogun and Akegbejo-Samsons, 1992). As shrimp production for export is increasing, considerable volumes of shrimp by-product are generated, and these by-products constitute a serious environmental hazard through their decomposition when they are not properly disposed of (Le, 1996). Information on the anatomical fractions of shrimp, the proximate and amino acid (AA) concentration of shrimp by-product, as well as heat treatment effects on chemical composition is scarce in the literature. However, some reports are available on the chemical composition (Evers and Carroll, 1996), and AA composition of Pandalus jordani shrimp by-product (Watkins et al., 1982), and the AA profile in commercial shrimp by-products and changes in the concentration following heat treatment (Mandeville et al., 1992).

In Vietnam, as in other countries with similar conditions, little work has been carried out regarding the output of shrimp by-products and their proximate chemical composition and AA profile, as influenced by shrimp species and treatment. This type of information would lead to improved shrimp by-product utilization.

The present study was aimed therefore at assessing the flesh and by-product yields, and determining the chemical and amino acid composition of shrimp by-products of the most abundant species in Central Vietnam.

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MATERIALS AND METHODS

Sample collection and heat treatment

Samples of fresh Pink prawn (*Metapenaeus affinis*), Green Tiger prawn (*Penaeus semisulcatus*) and Giant Tiger prawn (*Penaeus monodon*) were collected monthly at random between March and November in 1997 from local markets in Thua Thien Hue province in Central Vietnam. Once every month 500 g samples of each shrimp species were collected and brought to the laboratory for preparation. The samples were divided into two parts, of which one was kept as fresh material. The second part was treated following the Hue Seafood Processing Factory procedure (1995). Fresh shrimps were put in a basket and dumped into hot water of 800℃ for five min and cooled at room temperature prior to removal of the head and shell.

Sample preparation and analyses

The fresh shrimp samples were washed and dried on soft tissue paper to remove water. The fresh weight and length of ten randomly chosen individual shrimps at each collection time were recorded immediately. The heads and the shells with tail were carefully removed and the weights of the edible shrimp flesh as well as the proportions of the heads and the shell with tail were recorded and determined on a fresh and dry matter basis. The heated shrimp samples were deheaded, and the shells with tail were carefully removed.

The separated fractions of the fresh as well as heated shrimp samples were dried at 60℃ prior to chemical analysis. The heads and the shells with tail of the fresh as well as the heated samples were considered as the respective shrimp by-product. The proximate analyses were performed on both fresh and heated samples of the flesh and by-product of the three shrimp species. AA analyses were performed on both fresh and heated shrimp by-products. However, due to technical problems only samples from the two last (in September and November) of six sampling occasions could be used for AA analysis.

Chemical analyses

Chemical analyses were performed following the Association of Official Analytical Chemists (AOAC) methods (1984): dry matter (DM) was measured by drying fresh samples at 100℃ for 24 hours; total nitrogen (N) was determined by the Kjeldhal method and crude protein content was calculated (N*6.25); ether extract (EE) was determined by Soxhlet extraction without acid hydrolysis. Ash was the residue after ashing the samples at 550-600℃. Chitin was determined according to Stelmock et al. (1985). Calcium and phosphorus were determined according to AOAC (1985). Amino acids were analysed according to Spackman et al. (1958) on an ion- exchange column using a HPLC. Samples were hydrolyzed for 24 hours at 110℃ with 6 mol/l HCl containing 2 g/l reagent grade phenol and 5000 nmol norleucine (internal standard) in evacuated and sealed ignition tubes. Half-cystine and methionine were determined as cysteic acid and methionine sulphone, respectively, with separate samples hydrolyzed for 24 hours as described above following oxidation with performic acid overnight at 0℃ (Moore, 1963). All samples were analyzed in duplicate.

Statistical analysis

Analysis of variance was performed using the general linear model (GLM) procedure of Minitab version 12 (1998). Data on anatomical fractions were analyzed according to the factorial design (3×3), with shrimp species and anatomical fraction as factors, and data on chemical composition as a 3×2 factorial design (shrimp species, and fresh versus heated; and/or shrimp species and the flesh versus by-product as factors). Results are presented as least squares means, the pooled standard error of the mean and coefficient of variation.

RESULTS

The length and body weight of the shrimps were significantly different between the three species ($p<0.05$) (table 1). The length of the body was highest in *P. monodon*, followed by *P. semisulcatus* and *M. affinis*, and *P. monodon* also had the highest body weight, followed by *P. semisulcatus* and *M. affinis* (60.5 vs. 41.4 and 16.5 g, respectively). On average, the edible flesh of the three shrimp species accounted for 56.7% of the total wet body weight, while their by-product, including heads and shells with tail, was 43.3%. The two Penaeus species had a lower proportion of by-products and a higher proportion of flesh than *M. affinis*, but the by-products of the former species had a higher proportion of heads. Therefore, *M. affinis* generated the highest by-product proportion (45.7%), followed by *P. monodon* (43.7%) and *P. semisulcatus* (40.6%).

There were significant differences in the content of DM, CP and ash between the flesh and by-product of the fresh and heated samples of the three shrimp species (table 2). The content of DM was lower in flesh than in by-products ($p<0.05$). The CP content was almost twice as high in the flesh as compared with the by-product, whereas the ash content of by-product was more than three times that of the flesh of all shrimp species ($p<0.05$). *M. affinis* contained less CP, and more chitin and Ca than the Penaeus species ($p<0.05$).

Significant differences in the chemical composition of fresh and heated shrimps were found between shrimp species, with the highest value in DM for *M. affinis* and slightly lower values for EE as compared with the other species (table 3). There was a tendency for heat treatment to result in slightly higher DM contents compared to the fresh shrimps ($p<0.01$).

Chemical analysis data of the entire shrimps show values which are intermediate between the flesh and the by-products (table 4). Thus the CP content of the

Table 1. Mean body weight and anatomical proportions of the three shrimp species*, (n=60)

	Metapenaeus	*Penaeus*		SEM	p
	affinis	*semisulcatus*	*monodon*		
Body length, cm	10.7^{a}	14.0^{b}	16.2^{c}	0.07	0.001
Body weight, g	16.5^{a}	41.4^{b}	60.5^{c}	1.02	0.001
of which:					
Flesh	8.9^{a}	24.6^{b}	33.8^{c}	0.88	0.001
Head	5.5^{a}	12.7^{b}	21.0^{c}	0.91	0.001
Shell with tail	2.1^{a}	4.1^{b}	5.7^{c}	0.22	0.001
Body proportion (% wet weight basis):					
Flesh	54.3^{a}(19.7)**	59.4^{b}(19.4)	56.3^{b}(16.9)	1.02	0.006
By-product	45.7^{a}(25.5)	40.6^{b}(25.9)	43.7^{b}(26.1)	1.02	0.006
% of by-product:					
Head	72.5^{a}(23.0)	75.5^{b}(23.7)	78.4^{b}(24.2)	0.84	0.001
Shell with tail	27.5^{a}(31.9)	24.5^{b}(32.7)	21.6^{b}(33.0)	0.84	0.001

* Means within rows with differing superscript letters are significantly different (p<0.01).
** Numbers in parentheses are dry matter percentages.

Table 2. Mean values for dry matter (%), and contents of crude protein, ether extract, chitin, ash, Ca and P for the three shrimp species (% of DM)*, (n=12 per treatment)

	Shrimp species							p-values, effect of		
	Metapenaeus affinis		*Penaeus semisulcatus*		*Penaeus monodon*					
	Flesh	By-product	Flesh	By-product	Flesh	By-product	CV, %	Shrimp species	Flesh vs. by-product	Interaction
Dry matter	22.4^{a}	26.5^{b}	21.5^{a}	23.7^{b}	19.9^{c}	24.6^{b}	10.5	0.010	0.001	0.239
Crude protein	82.6^{a}	44.0^{b}	83.4^{a}	49.8^{c}	83.9^{a}	49.6^{c}	4.6	0.001	0.001	0.011
Ether extract	5.6^{a}	7.3^{b}	6.8^{b}	7.4^{b}	7.6^{b}	6.3^{ab}	22.3	0.331	0.351	0.017
Chitin	-	18.1^{a}	-	14.1^{b}	-	13.5^{b}	-	0.001	-	-
Ash	6.3^{a}	22.8^{b}	6.3^{a}	21.6^{b}	5.5^{a}	21.9^{b}	12.3	0.111	0.001	0.243
Ca	-	10.5^{a}	-	8.0^{b}	-	9.0^{c}	-	0.001	-	-
P	-	1.2^{1}	-	1.24	-	1.36	-	0.170	-	-

* Means within rows with differing superscript letters are significantly different (p<0.05).

Table 3. Effect of heat treatment on the content of dry matter, crude protein, ether extract and ash in entire bodies of the three shrimp species (% of DM)*, (n = 12 per treatment)

	Metapenaeus affinis		*Penaeus semisulcatus*		*Penaeus monodon*		CV, %	p-values, effect of		
	Fresh	Heated	Fresh	Heated	Fresh	Heated		Shrimp species	Fresh vs. heated	Interaction
Dry matter	24.1^{a}	24.7^{a}	21.6^{b}	23.6^{ba}	19.8^{b}	24.6^{a}	11.9	0.025	0.001	0.067
Crude protein	62.7^{a}	63.9^{a}	68.2^{b}	66.3^{b}	67.1^{b}	66.4^{b}	18.8	0.043	0.922	0.160
Ether extract	6.9	6.1	7.4	6.7	7.4	6.5	23.5	0.393	0.047	0.980
Ash	14.8	14.8	13.5	13.8	14.2	13.2	6.5	0.929	0.849	0.977

* Means within rows with differing superscripts are significantly different (p<0.05).

fresh entire shrimp averaged 65.9% of DM, versus 83.2 and 47.6% for the flesh and by-products, respectively. Corresponding values for the ash content were 14.1 versus 6.7 and 22.0%, respectively. Heat treatment affected the DM content of the entire shrimps and of the flesh (p<0.001), but not of the by-products. The EE of fresh shrimps tended to be slightly higher than of the heated. The ash content of the flesh was slightly lowered by the heat treatment (p<0.01), whereas CP content was unaffected.

Table 4. Dry matter content (%) and chemical composition (% of DM) of fresh and heated entire shrimps, shrimp flesh and by-product (%)*, (n=12 per treatment)

	Entire shrimp				Shrimp flesh				Shrimp by-product			
	Fresh	Heated	SEM	p-value	Fresh	Heated	SEM	p-value	Fresh	Heated	SEM	p-value
Dry matter	22.1	24.3	0.52	0.003	19.1	23.9	0.48	0.001	25.2	24.7	0.49	0.871
Crude protein	65.9	65.4	3.23	0.910	83.2	83.3	0.90	0.981	47.6	47.6	0.90	0.990
Ether extract	7.2	6.4	0.27	0.041	6.8	6.3	0.39	0.850	7.7	6.5	0.39	0.133
Ash	14.1	13.8	1.44	0.870	6.7	6.4	0.29	0.001	22.0	22.3	0.27	0.912

* Means of the three shrimp species.

The essential amino acids (EAA) of the shrimp by-products accounted for an average of 24.2% of DM or 44.8% of the CP (tables 5 and 6). The most abundant EAA were found to be arginine (Arg), which accounted for 21.4% of the sum of EAA (9.6 vs 44.8, table 6). Minor, but statistically significant differences ($p<0.05$) in the content (g/100 g DM) of some EAA in the by-products were observed between species for Arg, lysine (Lys), methionine (Met) and phenylalanine (Phe) (table 5). P. monodon had a lower content of Arg and Met than the other species, and a higher Phe content ($p<0.05$). However, there was no significant difference in total EAA content (g/100 g DM) between shrimp species, although there was a difference when expressing individual AA as g/16 g N of total EAA ($p<0.05$), *M. affinis* being inferior compared with *P. monodon* and *P. semisulcatus* (table 6). Of the total sum of AA in shrimp by-products about 44.5% were the non-essential (NEAA), of which aspartic acid (Asp) and glutamic acid (Glu) were the most abundant (table 6).

In general, the contents (in g/100 g DM and g/16 g N) of both essential and non-essential amino acids were not significantly affected by heat treatment ($p>0.05$).

DISCUSSION

The data on the length and body weight of the three shrimp species obtained in the present study were in agreement with the results of Le (1996), who reported average lengths of *M. affinis*, *P. semisulcatus* and *P. monodon* of 9.7, 13.0 and 15.2 cm, and body weights of 15.4, 40.4 and 59.1 g, respectively. The mean shrimp by-product yield of 43.3% (ranging from 41 to 46%) for the three species investigated is comparable to the by-product yield of 49% reported for the four most abundant shrimp species in Nigerian waters (Balogun and Akegbejo-Samsons, 1992). However, the shrimp by-product yield in the present study was much lower than the 67% reported by Drolet (1980, cited by Bataille and Bataille, 1983) for two small species (Pandalus borealis and Pandalus montagui). A reason for that could be methodological differences in assessing the yield. Furthermore the differences in the flesh and by-product proportions exist also between small and large shrimp species as noted in our study and which are supported by the finding of Balogun and Akegbejo-Samsons (1992), who reported that *Parapenaeopsis atlantica* (a small shrimp type) generated the highest proportion of by-products compared with bigger shrimp species (*Palaemon serratus*). This difference could possibly be explained by the relatively higher surface area of the small as compared to the big animal when relating it to body mass.

The proximate chemical composition obtained for the three fresh and heated entire shrimp species, flesh and their by-products were comparable to the results of Balogun and Akegbejo-Samsons (1992) and Le (1996). Chau et al. (1997) reported the CP content of the by-products (head and shells with tail) of shrimp species to vary between 23 and 54% CP. For EE, chitin and ash these authors quoted corresponding contents varying between 0.4 and 9%, 11 and 27%, and 23 and 32% (on a DM basis), respectively. The present data fell within these ranges. Watkins et al. (1982) reported chitin contents of shrimp by-product and shrimp by-product meal of 19.3 and 17.6%, respectively, with our results ranging from 13.5 to 18.1%. With respect to differences in the proportion of by-products between shrimp species, one could expect differences found in the chemical composition of by-products, as already has been pointed out. Thus, the by-product of the small shrimp species (*M. affinis*) had a lower CP content, and higher chitin, ash and Ca contents compared with the Penaeus species. The difference in DM content between fresh and heated shrimp flesh probably resulted from the coagulation of the flesh by heating, which has also been reported with meal of warm blooded animals (Sheard et al., 1998). Another explanation could be an evaporation of water during heat processing. The drop in EE content in the entire shrimp might be the result of fat being dissolved when heating the shrimps in 80℃ water. This was supported by our observation, that a scum of fat floated on the water.

For AA analysis only samples from the last two sampling occasions (n=4 per shrimp species) were used. These samples showed higher CP values (mean

Table 5. Amino acid composition of fresh and heated by-products of the three shrimp species (*Metapenaeus affinis*, Ma; *Penaeus semisulcatus*, Ps; and *Penaeus monodon*, Pm), and of the fresh and heated by-products (g/100 g DM)

	Shrimp species					Fresh and heated by-products			
	Ma	Ps	Pm	SEM	p	Fresh	Heated	SEM	p
Crude protein	56.5	52.4	53.8	0.46	0.01	54.3	54.2	0.38	0.87
Corrected protein[1]	48.7	46.3	48.0						
Essential Amino Acids (EAA)									
Arginine	5.4	5.2	4.9	0.10	0.03	5.1	5.2	0.08	0.75
Histidine	1.1	1.1	1.2	0.02	0.15	1.1	1.1	0.02	0.53
Isoleucine	1.8	1.9	1.9	0.04	0.16	1.9	1.8	0.03	0.28
Leucine	3.0	3.0	3.1	0.05	0.18	3.0	3.0	0.04	0.56
Lysine	3.1	2.8	3.1	0.04	0.01	3.0	3.0	0.03	0.95
Methionine	1.0	1.0	0.7	0.04	0.01	0.9	1.0	0.03	0.09
Phenylalanine	2.4	2.4	2.6	0.03	0.02	2.5	2.4	0.02	0.21
Threonine	2.2	2.3	2.4	0.05	0.06	2.3	2.3	0.04	0.42
Tyrosine	1.8	1.8	1.9	0.04	0.06	1.8	1.8	0.03	0.51
Valine	2.5	2.6	2.6	0.03	0.16	2.6	2.5	0.03	0.56
Total EAA	24.2	24.1	24.4	0.36	0.79	24.2	24.1	0.29	0.86
Non Essential Amino Acids (NEAA)									
Alanine	3.8	3.8	4.3	0.05	0.01	4.0	3.9	0.04	0.06
Aspartic acid	4.6	4.8	4.8	0.07	0.19	4.7	4.8	0.06	0.73
Glutamic acid	5.9	6.0	6.4	0.06	0.01	6.1	6.1	0.05	0.56
Glycine	3.6	3.4	3.6	0.07	0.34	3.5	3.6	0.06	0.08
Proline	3.7	3.2	3.6	0.07	0.01	3.4	3.5	0.06	0.29
Serine	2.2	2.1	2.3	0.04	0.03	2.2	2.3	0.03	0.24
Total NEAA	23.8	23.3	25.0	0.15	0.01	23.9	24.2	0.12	0.20
Total AA	48.0	47.4	49.4	0.45	0.02	48.2	48.4	0.45	0.75

[1] Calculated corrected protein for chitin N based on analyzed chitin content in table 2.

54.2%) than for the background material (47.6%) reported in table 4. By correcting for the content of N derived from chitin, using a factor of 14.5% (Stephens et al., 1976), we arrive at CP values in the by-products of M. *affinis*, *P. semisulcatus* and *P. monodon* of 48.7, 46.3 and 48.0% of DM, respectively, which can be compared with the sum of AA given in table 5. The sums shown in table 6 correspond to 85.2, 90.6 and 92.1% of the corrected contents of CP. The difference up to 100% can be explained by the fact that not all AA were analyzed. The N in the chitin ranged from 11 to 14% of the total N content in the by-product samples in the present investigation and should therefore be considered as an important non-protein nitrogen component in shrimp by-products. In an earlier investigation on a dry shrimp by-product, Watkins et al. (1982) pointed out the relative high contents of Arg, Asp and Glu. The low content of Met of 1.0 g/100 g DM (or 1.7 g/16 g N) reported by us is critical for growing pigs, which has already been pointed out by Watkins et al. (1982) and Bataille and Bataille (1983), who report values of 1.0 and 0.35 g/100 g DM, respectively. As shown in table 7, a number of EAA concentrations in shrimp by-products fulfil the requirements of the ideal protein for growing pigs (ARC, 1981), with the clear exception of Met. However, from a nutritional point of view, one has also to consider the availability of AA. The finding by Konosu (1979) that Glu and Gly were the main contributors to improving the palatability for pigs of an aqueous extract of dried shrimp, could be of interest when evaluating the potential of shrimp by-products for pigs.

IMPLICATIONS

The obtained results show that shrimp by-product has the nutritional properties of a protein-rich feed resource to be potentially useful in animal feeding. However, although the AA profile is reasonably balanced for most AA, the low methionine content could limit its use for monogastric animals (i.e. pigs and poultry).

The high content of chitin in shrimp by-product should be noted, as this could be a limiting factor for the nutrient utilization. In addition, the content of Ca is high and could possibly restrict the dietary

Table 6. Amino acid composition of fresh and heated by-products of the three shrimp species (*Metapenaeus affinis*, Ma; *Penaeus semisulcatus*, Ps; and *Penaeus monodon*, Pm), and of the fresh and heated by-products (g/16 g N)

	Shrimp species					Fresh and heated by-products			
	Ma	Ps	Pm	SEM	p	Fresh	Heated	SEM	p
Essential Amino Acids (EAA)									
Arginine	9.5	10.0	9.1	0.19	0.03	9.5	9.6	0.16	0.71
Histidine	2.0	2.1	2.2	0.04	0.02	2.1	2.1	0.03	0.60
Isoleucine	3.2	3.6	3.6	0.07	0.01	3.5	3.4	0.06	0.33
Leucine	5.3	5.7	5.8	0.09	0.01	5.6	5.6	0.08	0.65
Lysine	5.5	5.3	5.7	0.08	0.01	5.5	5.5	0.06	0.97
Methionine	1.8	1.9	1.4	0.07	0.01	1.6	1.8	0.06	0.11
Phenylalanine	4.3	4.6	4.8	0.06	0.01	4.6	4.5	0.05	0.33
Threonine	4.0	4.4	4.5	0.09	0.02	4.3	4.2	0.08	0.47
Tyrosine	3.1	3.5	3.5	0.07	0.02	3.4	3.4	0.06	0.49
Valine	4.4	4.9	4.8	0.06	0.01	4.7	4.7	0.05	0.70
Total EAA	43.1	46.0	45.4	0.70	0.03	44.8	44.8	0.57	0.95
Non Essential Amino Acids (NEAA)									
Alanine	6.7	7.3	8.1	0.11	0.01	7.4	7.2	0.09	0.12
Aspartic acid	8.2	9.1	9.0	0.13	0.01	8.7	8.8	0.11	0.68
Glutamic acid	10.4	11.4	11.9	0.14	0.01	11.2	11.3	0.11	0.57
Glycine	6.3	6.6	6.7	0.14	0.23	6.4	6.7	0.12	0.11
Proline	6.5	6.1	6.6	0.15	0.08	6.3	6.5	0.13	0.37
Serine	4.0	4.1	4.4	0.08	0.01	4.1	4.2	0.07	0.28
Total NEAA	42.1	44.6	46.7	0.47	0.01	44.1	44.7	0.38	0.37
Total AA	85.2	90.6	92.1	1.02	0.01	88.9	89.4	0.83	0.71

inclusion.

Finally, shrimp by-product has a high content of water and needs to be preserved in a suitable way in order increase its availability over time.

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Table 7. Comparison of the EAA contents of fresh and heated shrimp by-product with the ideal protein for pigs (g per 16 g N)

Amino acids	Ideal protein*	By-product	
		Fresh	Heated
Histidine	2.3	2.1	2.1
Threonine	4.2	4.3	4.2
Valine	4.9	4.7	4.7
Methionine+Cystine	3.5	1.6	1.8
Phenylalanine+Tyrosine	6.7	8.0	7.9
Isoleucine	3.8	3.5	3.4
Leucine	7.0	5.6	5.6
Lysine	7.0	5.5	5.5
Tryptophan	1.0	**	**
Non-essential amino acids	59.6	44.1	44.7

* ARC, 1981.

** Not analyzed.

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