萃取物成分組成之影響要因：

1. 成長、飢餓
2. 季節性變動
3. 餌料
4. 組織部位別
5. 雄雌性
6. 養殖魚介類
7. 種類

成長(growth)與飢餓(starvation)

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Effect of Growth on the Levels of Free Histidine and Amino Acids in White Muscle of Milkfish (*Chanos chanos*)

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Accumulation patterns of free amino acids (FAAs) in white muscle of milkfish (*Chanos chanos*) during the period of 8-month growth were investigated. Histidine, taurine, and glycine were the predominant FAAs. An increase in histidine was observed during growth. The level present in the 1-month-reared fish (mean weight = 58 g) was about 5 times higher than that in the initial fish (1.4 g). After 8 months of growth, milkfish contained 59 μmol/g, which was responsible for 72% of the total FAAs. There was a positive correlation between the histidine content and fish body weight. In contrast, taurine decreased with increasing rearing time. The glycine level was not correlated well with fish size. The total relative amounts of histidine, taurine, and glycine remained about the same, although the individual contributions varied considerably in the FAA pool during the period of cultivation.

Table 1. Body Weight (Grams),[a] Body Length (Centimeters),[a] and Proximate Composition (Percent)[b] in White Muscle of Milkfish during the Period of 8-Month Growth

month	weight	length	moisture	crude fat	crude protein	ash
0	1.39 ± 0.24	4.72 ± 0.37	80.78 ± 1.49^{a}	1.56 ± 0.10^{c}	16.31 ± 0.91^{b}	1.29 ± 0.07^{a}
1.0	57.53 ± 4.66	14.60 ± 0.58	75.03 ± 1.09^{b}	2.45 ± 0.18^{b}	20.89 ± 0.67^{a}	1.28 ± 0.08^{a}
2.5	194.44 ± 37.14	22.72 ± 1.18	74.99 ± 0.72^{b}	2.83 ± 0.27^{ab}	19.81 ± 1.53^{a}	1.25 ± 0.09^{a}
4.5	422.36 ± 50.69	28.58 ± 1.20	74.38 ± 0.78^{b}	3.21 ± 0.33^{a}	20.98 ± 0.71^{a}	1.22 ± 0.11^{b}
6.5	477.82 ± 70.62	30.32 ± 1.21	74.10 ± 0.64^{b}	3.40 ± 0.24^{a}	19.94 ± 0.87^{a}	1.25 ± 0.07^{ab}
8.0	587.32 ± 85.26	32.38 ± 0.37	74.63 ± 0.66^{b}	3.43 ± 0.14^{a}	21.04 ± 0.66^{a}	1.21 ± 0.08^{b}

[a] Expressed as mean ± standard deviation ($n = 12$). [b] Expressed as mean ± standard deviation ($n = 6$). Means followed by the same letter within each column are not significantly different at $P = 0.05$.

Table 2. Free Amino Acids (Micromoles per Gram of Wet Weight)[a] in White Muscle of Milkfish during the Period of 8-Month Growth

	month					
	0	1.0	2.5	4.5	6.5	8.0
phosphoserine	0.25 ± 0.01^{a}	0.08 ± 0.01^{b}	0.07 ± 0.02^{b}	0.07 ± 0.01^{b}	0.05 ± 0.00^{c}	0.05 ± 0.01^{c}
taurine	8.45 ± 1.99^{bc}	15.81 ± 1.10^{a}	12.84 ± 1.60^{b}	7.54 ± 1.93^{c}	6.37 ± 2.75^{c}	2.80 ± 0.83^{d}
aspartic acid	1.81 ± 0.23^{a}	0.19 ± 0.07^{b}	0.19 ± 0.06^{b}	0.23 ± 0.08^{b}	0.20 ± 0.22^{b}	0.06 ± 0.02^{b}
threonine	1.72 ± 0.17^{a}	0.74 ± 0.09^{c}	0.56 ± 0.07^{cd}	0.49 ± 0.11^{d}	0.60 ± 0.28^{cd}	0.98 ± 0.24^{b}
serine	2.64 ± 0.25^{a}	1.61 ± 0.29^{b}	0.94 ± 0.15^{cd}	1.09 ± 0.31^{c}	0.63 ± 0.13^{e}	0.74 ± 0.16^{de}
asparagine	0.82 ± 0.08^{a}	0.35 ± 0.05^{bc}	0.44 ± 0.15^{b}	0.40 ± 0.09^{bc}	0.27 ± 0.18^{c}	0.36 ± 0.03^{bc}
glutamic acid	6.27 ± 1.05^{a}	2.88 ± 0.64^{b}	1.63 ± 0.10^{c}	1.07 ± 0.15^{c}	1.10 ± 0.40^{c}	1.41 ± 0.82^{c}
glutamine	0.92 ± 0.06^{a}	0.98 ± 0.11^{a}	0.42 ± 0.10^{b}	0.39 ± 0.10^{b}	0.51 ± 0.11^{b}	0.48 ± 0.21^{b}
proline	3.46 ± 0.96^{a}	3.00 ± 0.67^{ab}	2.18 ± 2.03^{bc}	1.24 ± 0.41^{cd}	1.18 ± 0.29^{cd}	0.83 ± 0.14^{d}
glycine	6.92 ± 1.80^{a}	4.16 ± 1.08^{b}	2.95 ± 0.75^{b}	3.52 ± 1.44^{b}	8.39 ± 2.27^{a}	7.88 ± 1.91^{a}
alanine	6.53 ± 0.90^{a}	1.83 ± 0.09^{c}	2.11 ± 0.50^{c}	1.64 ± 0.13^{c}	1.58 ± 0.50^{c}	3.77 ± 1.54^{b}
valine	1.69 ± 0.60^{a}	0.76 ± 0.18^{b}	0.65 ± 0.10^{bc}	0.40 ± 0.15^{cd}	0.46 ± 0.06^{bcd}	0.27 ± 0.13^{d}
methionine	0.84 ± 0.13^{a}	0.19 ± 0.11^{b}	0.12 ± 0.07^{bc}	0.08 ± 0.04^{c}	0.10 ± 0.03^{c}	0.09 ± 0.02^{c}
isoleucine	1.49 ± 0.10^{a}	0.36 ± 0.07^{b}	0.28 ± 0.08^{c}	0.17 ± 0.03^{d}	0.17 ± 0.03^{d}	0.13 ± 0.03^{d}
leucine	2.84 ± 0.21^{a}	0.71 ± 0.08^{b}	0.48 ± 0.13^{c}	0.31 ± 0.09^{d}	0.27 ± 0.04^{d}	0.21 ± 0.03^{d}
tyrosine	1.10 ± 0.17^{a}	0.27 ± 0.02^{b}	0.22 ± 0.06^{bc}	0.17 ± 0.03^{c}	0.13 ± 0.05^{c}	0.12 ± 0.02^{c}
phenylalanine	1.20 ± 0.15^{a}	0.30 ± 0.03^{b}	0.19 ± 0.06^{c}	0.13 ± 0.04^{cd}	0.10 ± 0.03^{d}	0.06 ± 0.03^{d}
β-alanine	0.24 ± 0.05^{a}	0.05 ± 0.06^{c}	0.13 ± 0.05^{b}	0.06 ± 0.02^{c}	0.06 ± 0.01^{c}	0.02 ± 0.02^{c}
ornithine	0.32 ± 0.02^{b}	1.16 ± 0.12^{a}	0.40 ± 0.13^{b}	0.21 ± 0.07^{c}	0.12 ± 0.01^{cd}	0.09 ± 0.05^{d}
lysine	5.13 ± 0.29^{a}	1.87 ± 0.16^{cd}	1.78 ± 0.45^{cd}	1.41 ± 0.41^{d}	2.76 ± 1.82^{bc}	3.09 ± 0.66^{b}
histidine	7.16 ± 1.54^{e}	37.38 ± 3.15^{d}	40.41 ± 6.15^{cd}	46.17 ± 3.76^{bc}	47.90 ± 2.68^{b}	59.19 ± 8.73^{a}
arginine	2.12 ± 0.29^{a}	2.25 ± 0.14^{a}	0.75 ± 0.30^{b}	0.94 ± 0.38^{b}	0.30 ± 0.08^{c}	0.23 ± 0.05^{c}
total	63.23 ± 7.49^{d}	76.76 ± 4.38^{ab}	69.74 ± 4.38^{bcd}	67.74 ± 3.79^{cd}	73.24 ± 4.39^{bc}	82.68 ± 9.42^{a}

[a] Expressed as mean ± standard deviation ($n = 6$). Means followed by the same letter within each row are not significantly different at $P = 0.05$.

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Effect of starvation on free histidine and amino acids in white muscle of milkfish *Chanos chanos*

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Table 1
Changes in body weight, body length, condition factor and hepatosomatic index of milkfish during 60 days of starvation*

Day	Weight (g)	Length (cm)	Condition factor	HSI (%)
0	46.7 ± 3.2^{b}	14.6 ± 0.3^{b}	15.0 ± 0.2^{a}	1.9 ± 0.1^{a}
10	42.9 ± 1.4^{bc}	14.3 ± 0.4^{b}	14.5 ± 1.2^{ab}	1.2 ± 0.1^{c}
25	40.2 ± 1.9^{cd}	14.3 ± 0.3^{b}	13.7 ± 0.9^{c}	1.0 ± 0.2^{d}
40	35.1 ± 2.2^{d}	14.2 ± 0.2^{b}	12.2 ± 0.8^{d}	0.8 ± 0.1^{e}
60	27.6 ± 4.1^{e}	14.2 ± 0.2^{b}	9.5 ± 1.2^{e}	0.7 ± 0.1^{e}
Control	198.4 ± 25.2^{a}	24.0 ± 1.2^{a}	14.4 ± 1.0^{b}	1.6 ± 0.5^{b}

*Data are means ± S.D. ($n = 12$). Means followed by the same letter within each column are not significantly different at $P > 0.05$. Condition factor = weight/length^3 × 10^3, HSI, hepatosomatic index = liver weight/body weight × 100%; Control, fish fed on a diet for 60 days.

Table 2
Changes in proximate composition (%) in white muscle of milkfish during 60 days of starvation*

Day	Moisture	Protein	Crude fat	Ash
0	76.0 ± 0.8^{b}	20.1 ± 0.5^{a}	2.6 ± 0.2^{b}	1.2 ± 0.1
10	77.0 ± 0.6^{b}	20.0 ± 0.6^{a}	2.4 ± 0.1^{b}	1.2 ± 0.1
25	77.6 ± 0.9^{b}	19.3 ± 0.4^{ab}	1.8 ± 0.1^{c}	1.3 ± 0.0
40	79.5 ± 0.7^{a}	18.7 ± 0.6^{bc}	1.7 ± 0.2^{c}	1.2 ± 0.1
60	79.8 ± 0.6^{a}	18.0 ± 0.6^{c}	1.2 ± 0.1^{d}	1.2 ± 0.1
Control	74.6 ± 0.7^{c}	20.1 ± 0.6^{a}	3.2 ± 0.3^{a}	1.2 ± 0.1

*Data are means ± S.D. ($n = 6$). Means followed by the same letter within each column are not significantly different at $P > 0.05$. Control, refers to Table 1.

Table 3
Changes in free amino acids (μmole/g of wet weight) in white muscle of milkfish during 60-days of starvation*

	Day					Control
	0	10	25	40	60	
Phosphoserine	0.1 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	0.1 ± 0.0
Taurine	22.7 ± 1.1^{a}	21.7 ± 0.4^{a}	22.8 ± 2.5^{a}	24.1 ± 4.8^{a}	23.9 ± 4.6^{a}	12.8 ± 2.8^{b}
Aspartic acid	0.3 ± 0.1^{bc}	0.2 ± 0.1^{c}	0.3 ± 0.1^{bc}	0.4 ± 0.1^{ab}	0.4 ± 0.1^{a}	0.2 ± 0.1^{cd}
Threonine	0.5 ± 0.2^{bc}	0.6 ± 0.2^{b}	0.8 ± 0.1^{a}	0.8 ± 0.2^{a}	0.9 ± 0.2^{a}	0.3 ± 0.1^{c}
Serine	0.6 ± 0.1^{bc}	0.5 ± 0.1^{c}	0.6 ± 0.2^{bc}	0.6 ± 0.2^{ab}	0.7 ± 0.3^{a}	0.5 ± 0.1^{bc}
Asparagine	1.3 ± 0.4^{a}	0.8 ± 0.4^{b}	0.7 ± 0.3^{b}	0.6 ± 0.1^{b}	0.5 ± 0.2^{b}	0.1 ± 0.2^{c}
Glutamic acid	1.0 ± 0.2^{bc}	0.8 ± 0.1^{c}	1.0 ± 0.3^{bc}	0.8 ± 0.5^{c}	1.3 ± 0.4^{a}	1.1 ± 0.4^{bc}
Glutamine	1.2 ± 0.2^{a}	1.0 ± 0.1^{b}	0.9 ± 0.1^{cd}	0.7 ± 0.1^{de}	0.6 ± 0.1^{e}	1.0 ± 0.1^{bc}
Proline	1.8 ± 1.5^{ab}	1.6 ± 1.1^{abc}	0.7 ± 0.0	0.6 ± 0.1^{c}	0.8 ± 0.1^{bc}	2.6 ± 1.0^{a}
Glycine	6.8 ± 0.9^{b}	6.7 ± 1.6^{b}	7.3 ± 0.9^{b}	7.5 ± 1.5^{b}	7.8 ± 1.3^{b}	12.0 ± 1.6^{a}
Alanine	2.3 ± 0.8^{a}	1.9 ± 0.5^{ab}	2.5 ± 0.7^{a}	2.6 ± 0.6^{a}	2.3 ± 0.7^{a}	1.4 ± 0.4^{b}
Valine	0.5 ± 0.1^{ab}	0.6 ± 0.0^{a}	0.6 ± 0.1^{a}	0.6 ± 0.1^{a}	0.6 ± 0.2^{a}	0.4 ± 0.1^{b}
Methionine	0.1 ± 0.0^{ab}	0.1 ± 0.0^{ab}	0.1 ± 0.1^{a}	0.1 ± 0.0^{a}	0.1 ± 0.1^{a}	0.0 ± 0.0^{b}
Isoleucine	0.1 ± 0.1^{ab}	0.2 ± 0.1^{ab}	0.3 ± 0.1^{a}	0.2 ± 0.1^{ab}	0.3 ± 0.1^{a}	0.1 ± 0.0^{c}
Leucine	0.2 ± 0.1^{bc}	0.3 ± 0.1^{ab}	0.4 ± 0.2^{ab}	0.4 ± 0.1^{ab}	0.4 ± 0.3^{a}	0.1 ± 0.0^{c}
Tyrosine	0.2 ± 0.1	0.2 ± 0.1	0.1 ± 0.1	0.1 ± 0.1	0.2 ± 0.1	0.1 ± 0.1
Phenylalanine	0.1 ± 0.0^{bc}	0.1 ± 0.1^{ab}	0.1 ± 0.1^{bc}	0.1 ± 0.1^{bc}	0.1 ± 0.1	0.0 ± 0.0
β-Alanine	0.1 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	0.1 ± 0.0	0.1 ± 0.0
Ornithine	0.4 ± 0.4^{a}	0.3 ± 0.3^{ab}	0.1 ± 0.0^{b}	0.1 ± 0.0^{b}	0.1 ± 0.0^{b}	0.5 ± 0.3^{a}
Lysine	2.1 ± 0.7^{b}	2.5 ± 0.8^{ab}	2.5 ± 0.4^{ab}	2.4 ± 0.8^{ab}	2.0 ± 0.7^{b}	3.5 ± 1.4^{a}
Histidine	31.1 ± 3.1^{ab}	30.1 ± 3.3^{b}	26.6 ± 2.9^{bc}	16.8 ± 6.6^{c}	16.3 ± 4.9^{c}	35.5 ± 3.0^{a}
Arginine	0.6 ± 0.4^{b}	0.6 ± 0.3^{b}	0.5 ± 0.1^{b}	0.4 ± 0.1^{b}	0.5 ± 0.2^{b}	1.1 ± 1.7^{a}
Total	74.0 ± 3.5^{a}	70.7 ± 7.0^{a}	68.8 ± 3.6^{a}	60.2 ± 10.4^{b}	60.1 ± 6.1^{b}	72.3 ± 4.6^{a}

*Data are means ± S.D. ($n = 6$). Means followed by the same letter within each row are not significantly different at $P > 0.05$. Control refers to Table 1.

餌料、季節性變動

魚介類的體成分在不同季節，尤其產卵期的前後，常有相當明顯的變動。

- 生理狀態：授精、產卵等
- 棲息環境：水溫、餌料來源等

當令期、時令期、盛產期、『旬』

風味、美味性

FISHERIES SCIENCE 2002; **68**: 388–394

Original Article

Comparison of taste components in cooked meats of small abalone fed different diets

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ABSTRACT: Differences in taste preference and the levels of extractive components and glycogen were compared between cooked meats of small abalone *Haliotis diversicolor* fed either gracilar (G-small abalone) or an artificial diet (A-small abalone). Using sensory tests, taste preference of cooked meats was significantly higher for A-small abalone than for G-small abalone. Results of clustering analysis and principal component analysis of chemical data also revealed that the two cooked meats differed from each other in terms of their measured constituent compositions irrespective of sampling periods. Compared with G-small abalone, A-small abalone meats were lower in taurine and arginine, but higher in glycine (Gly), glutamic acid (Glu), alanine, serine, proline, adenosine monophosphate (AMP), and glycogen. It is concluded that the discrepancy in the levels of taste-active components of abalone, such as Gly, Glu, and AMP, is likely to be responsible for the differences in taste preference between G- and A-small abalone cooked meats.

KEY WORDS: **abalone, amino acid, artificial diet, extractive component, *Haliotis diversicolor*, taste.**

Table 2 Results of paired comparison test for taste of the cooked meats of G- and A-small abalone

Date of sampling	No. panelists (G)	(A)	Level of significance
Sep. 10 1997	14	26	$P < 0.10$
Jan. 13 1998	12	28	$P < 0.05$
Mar. 18 1998	11	29	$P < 0.01$
May 8 1998	4	36	$P < 0.001$
July 21 1998	11	29	$P < 0.01$
Sep. 9 1998	11	29	$P < 0.01$

Table 4 Levels of chemical constituents (mg/100 g) in the cooked meats of G- and A-small abalone

Compound	Sep. 10 1997 (G)	Sep. 10 1997 (A)	Jan. 13 1998 (G)	Jan. 13 1998 (A)	Mar. 18 1998 (G)	Mar. 18 1998 (A)	May 8 1998 (G)	May 8 1998 (A)	Jul. 21 1998 (G)	Jul. 21 1998 (A)	Sep. 9 1998 (G)	Sep. 9 1998 (A)
Phosphoserine	12^{a}	12^{a}	9^{a}	7^{a}	6^{a}	6^{a}	5^{a}	8^{a}	6^{a}	7^{a}	5^{a}	6^{a}
Taurine	1578^{a}	1148^{b}	1333^{a}	963^{b}	1351^{a}	1213^{a}	1322^{a}	1074^{b}	1531^{a}	1152^{b}	1263^{a}	1211^{a}
Aspartic acid	4^{b}	27^{a}	9^{b}	13^{a}	8^{b}	22^{a}	7^{b}	15^{a}	13^{b}	28^{a}	13^{a}	13^{a}
Threonine	14^{a}	12^{a}	17^{a}	12^{b}	18^{a}	12^{b}	25^{a}	13^{b}	15^{a}	16^{a}	13^{a}	19^{a}
Serine	36^{b}	53^{a}	33^{b}	53^{a}	40^{b}	55^{a}	36^{b}	58^{a}	27^{b}	57^{a}	28^{b}	40^{a}
Glutamic acid	96^{b}	125^{a}	50^{b}	75^{a}	33^{b}	59^{a}	25^{b}	73^{a}	56^{b}	100^{a}	49^{a}	60^{a}
Glutamine	6^{b}	11^{a}	22^{b}	35^{a}	16^{b}	30^{a}	18^{b}	63^{a}	30^{a}	26^{a}	19^{b}	35^{a}
α-AAA	5^{a}	8^{a}	9^{a}	6^{b}	10^{a}	3^{b}	8^{a}	7^{a}	9^{a}	8^{a}	5^{a}	8^{a}
Proline	29^{b}	61^{a}	29^{b}	83^{a}	38^{b}	111^{a}	25^{b}	94^{a}	21^{b}	55^{a}	18^{a}	23^{a}
Glycine	129^{b}	294^{a}	370^{b}	455^{a}	334^{b}	393^{a}	266^{b}	403^{a}	187^{b}	358^{a}	186^{b}	307^{a}
Alanine	48^{b}	76^{a}	40^{b}	58^{a}	21^{b}	45^{a}	17^{b}	72^{a}	50^{b}	98^{a}	41^{a}	49^{a}
Citrulline	7^{a}	1^{b}	5^{a}	1^{b}	6^{a}	0^{b}	3^{a}	0^{b}	3^{a}	0^{b}	2^{a}	4^{a}
α-ABA	1^{a}	3^{a}	2^{a}	3^{a}	2^{a}	2^{a}	2^{a}	4^{a}	3^{b}	5^{a}	2^{a}	3^{a}
Valine	11^{a}	12^{a}	11^{b}	20^{a}	10^{a}	13^{a}	11^{b}	17^{a}	11^{b}	16^{a}	7^{b}	14^{a}
Methionine	4^{a}	5^{a}	6^{a}	4^{a}	4^{a}	4^{a}	4^{a}	2^{a}	5^{a}	4^{a}	3^{a}	4^{a}
Cystathionine	2^{a}	4^{a}	7^{a}	6^{a}	9^{a}	5^{a}	5^{a}	2^{a}	2^{a}	2^{a}	3^{a}	3^{a}
Isoleucine	10^{a}	11^{a}	8^{b}	12^{a}	8^{a}	9^{a}	6^{b}	11^{a}	8^{a}	10^{a}	5^{a}	8^{a}
Leucine	15^{b}	19^{a}	10^{b}	22^{a}	11^{b}	15^{a}	11^{b}	23^{a}	14^{b}	21^{a}	8^{b}	12^{a}
Tyrosine	10^{b}	22^{a}	15^{b}	34^{a}	14^{b}	30^{a}	11^{b}	27^{a}	10^{b}	21^{a}	8^{a}	9^{a}
Phenylalanine	5^{b}	13^{a}	9^{b}	18^{a}	10^{b}	15^{a}	6^{b}	19^{a}	7^{b}	16^{a}	5^{a}	7^{a}
β-Alanine	4^{b}	9^{a}	1^{a}	2^{a}	1^{a}	2^{a}	1^{b}	4^{a}	3^{b}	15^{a}	1^{a}	2^{a}
β-AiBA	2^{a}	2^{a}	2^{a}	2^{a}	3^{a}	3^{a}	4^{a}	2^{a}	3^{b}	7^{a}	3^{a}	4^{a}
γ-ABA	0^{a}	1^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}
Tryptophan	6^{a}	3^{b}	5^{a}	7^{a}	8^{a}	8^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}
Ethanolamine	2^{a}	2^{a}	0^{a}	0^{a}	0^{a}	0^{a}	2^{a}	2^{a}	1^{a}	1^{a}	0^{a}	0^{a}
Ornithine	3^{a}	2^{a}	14^{a}	3^{b}	4^{a}	4^{a}	3^{a}	4^{a}	3^{a}	6^{a}	2^{a}	0^{b}
Lysine	11^{a}	23^{a}	14^{b}	22^{a}	12^{b}	26^{a}	16^{b}	28^{a}	15^{b}	26^{a}	18^{a}	22^{a}
Histidine	12^{a}	17^{a}	18^{b}	26^{a}	22^{a}	23^{a}	18^{b}	28^{a}	15^{b}	23^{a}	18^{a}	23^{a}
Arginine	585^{a}	506^{b}	446^{a}	376^{b}	549^{a}	469^{b}	511^{a}	493^{a}	605^{a}	480^{b}	467^{a}	501^{a}
Subtotal	2649^{a}	2481^{a}	2485^{a}	2319^{a}	2547^{a}	2575^{a}	2367^{a}	2550^{a}	2653^{a}	2560^{a}	2192^{a}	2392^{a}
ATP	2^{a}	9^{a}	0^{a}	0^{a}	1^{a}	1^{a}	2^{a}	4^{a}	2^{a}	2^{a}	7^{a}	8^{a}
ADP	27^{b}	53^{a}	45^{a}	39^{a}	29^{a}	33^{a}	43^{b}	62^{a}	99^{a}	96^{a}	43^{a}	46^{a}
AMP	90^{b}	126^{a}	100^{a}	118^{a}	160^{a}	177^{a}	122^{b}	162^{a}	111^{a}	131^{a}	68^{a}	73^{a}
IMP	0^{b}	1^{a}	0^{a}	0^{a}	0^{a}	0^{a}	1^{a}	0^{b}	1^{b}	4^{a}	0^{a}	0^{a}
Inosine	2^{a}	1^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	0^{a}	1^{a}	0^{a}	0^{a}
Adenosine	2^{a}	2^{a}	1^{a}	1^{a}	2^{a}	1^{a}	1^{a}	1^{a}	1^{a}	1^{a}	1^{a}	1^{a}
Hypoxanthine	1^{a}	1^{a}	4^{a}	3^{a}	4^{a}	3^{a}	2^{a}	2^{a}	3^{a}	2^{a}	2^{a}	2^{a}
Subtotal	124^{b}	193^{a}	150^{a}	162^{a}	197^{a}	216^{a}	171^{b}	231^{a}	217^{a}	236^{a}	122^{a}	130^{a}
Glycinebetaine	426^{a}	422^{a}	413^{a}	380^{a}	388^{b}	476^{a}	353^{a}	383^{a}	429^{a}	460^{a}	382^{a}	428^{a}
Glycogen	571^{b}	4167^{a}	2066^{b}	5638^{a}	2121^{b}	7818^{a}	1408^{b}	7313^{a}	2173^{b}	7028^{a}	1993^{b}	5125^{a}
Total	3769^{b}	7264^{a}	5114^{b}	8499^{a}	5253^{b}	11085^{a}	4299^{b}	10473^{a}	5471^{b}	10280^{a}	4689^{b}	8075^{a}

^{a,b}Means in a row from the same sampling date with different superscripts are significantly different ($P < 0.05$).
α-AAA, α-amino adipic acid; α-ABA, α-amino-*n*-butyric acid; β-AiBA, β-amino-isobutyric acid; γ-ABA, γ-amino-*n*-butyric acid.

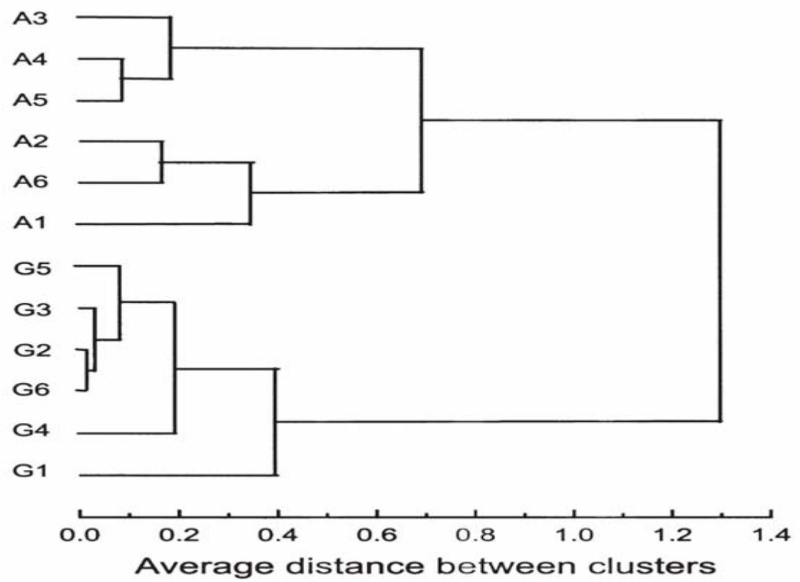

Fig. 1 Cluster analysis of all chemical data of the G- and A-small abalone meat samples. G, G-small abalone; A, A-small abalone; 1–6, sampling dates from September 1997 to September 1998.

Levels of chemical constituents (mg/100 g) in the cooked meats of (G) G- and (A) A-small abalone

	1997 Sep. 10		1998 Jan. 13		Mar. 18		May 8		Jul. 21		Sep. 9	
	(G)	(A)	(G)	(A)	(G)	(A)	(G)	(A)	(G)	(A)	(G)	(A)
Taurine	1578[a]	1148[b]	1333[a]	963[b]	1351[a]	1213[a]	1322[a]	1074[b]	1531[a]	1152[b]	1263[a]	1211[a]
Serine	36[b]	53[a]	33[b]	53[a]	40[b]	55[a]	36[b]	58[a]	27[b]	57[a]	28[b]	40[a]
Glutamic acid	96[b]	125[a]	50[b]	75[a]	33[b]	59[a]	25[b]	73[a]	56[b]	100[a]	49[a]	60[a]
Proline	29[b]	61[a]	29[b]	83[a]	38[b]	111[a]	25[b]	94[a]	21[b]	55[a]	18[a]	23[a]
Glycine	129[b]	294[a]	370[b]	455[a]	334[b]	393[a]	266[b]	403[a]	187[b]	358[a]	186[b]	307[a]
Alanine	48[b]	76[a]	40[b]	58[a]	21[b]	45[a]	17[b]	72[a]	50[b]	98[a]	41[a]	49[a]
Arginine	585[a]	506[b]	446[a]	376[b]	549[a]	469[b]	511[a]	493[a]	605[a]	480[b]	467[a]	501[a]
Total FAA	2649[a]	2481[a]	2485[a]	2319[a]	2547[a]	2575[a]	2367[a]	2550[a]	2653[a]	2560[a]	2192[a]	2392[a]
ADP	27[b]	53[a]	45[a]	39[a]	29[a]	33[a]	43[b]	62[a]	99[a]	96[a]	43[a]	46[a]
AMP	90[b]	126[a]	100[a]	118[a]	160[a]	177[a]	122[b]	162[a]	111[a]	131[a]	68[a]	73[a]
Total ARC	124[b]	193[a]	150[a]	162[a]	197[a]	216[a]	171[b]	231[a]	217[a]	236[a]	122[a]	130[a]
Glycinebetaine	426[a]	422[a]	413[a]	380[a]	388[b]	476[a]	353[a]	383[a]	429[a]	460[a]	382[a]	428[a]
Glycogen	571[b]	4167[a]	2066[b]	5638[a]	2121[b]	7818[a]	1408[b]	7313[a]	2173[b]	7028[a]	1993[b]	5125[a]
Total	3769[b]	7264[a]	5114[b]	8499[a]	5253[b]	11085[a]	4299[b]	10473[a]	5471[b]	10280[a]	4689[b]	8075[a]

[a,b] Means in the rows from the same sampling date with different superscript differ significantly ($p < 0.05$).

養殖虱目魚普通肉含氮萃取物成分之季節變化

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摘 要

為瞭解本省養殖虱目魚含氮萃取物成分含量之季節變化，自民國 81 年 6 月至 82 年 4 月間每二個月採樣，取其普通肉分析。一般成分組成之季節變動小，但主要含氮萃取物成分包括組胺酸、牛磺酸、麩胺酸、離胺酸、甘胺酸及丙胺酸等游離胺基酸（FAA）、肌苷酸（inosinic acid）與肌酸（creatine）之季節性變化則有顯著差異（$p<0.05$）。游離胺基酸總量（878～1,129 mg/100 g）以 12 月份為最高，各主要胺基酸則分別在 12 至 4 月份間較高。核苷酸及相關化合物總量（10～12 μmole/g）在 10 及 8 月份最高，2 月份最低；肌酸含量（345～494 mg/100 g）則以 2～6 月份最高而 10 月份最低。虱目魚呈味成分之組成特徵與青甘鰺等紅肉魚類似，肌苷酸雖因季節而有所變動，但含量比一般魚肉高，推測多季生產虱目魚之 FAA 含量較豐富而呈味性較佳。

關鍵詞：虱目魚，萃取物成分，呈味成分，游離胺基酸，核苷酸，肌酸，季節變化。

邱思魁、游昭玲、蕭泉源，1995，養殖虱目魚普通肉含氮萃取物成分之季節變化。食品科學，22(4): 387-394。

表一 虱目魚之體重、體長及其普通肉之一般成分

Table 1. Body weight, body length and proximate composition* of milkfish

Date of sampling	No. of sample	Body weight (g)	Body length (cm)	Proximate composition(%)			
				Moisture	Proiten	Fat	Ash
'92 Jun. 16	12	497.2±51.7	30.2±0.7	73.0	24.1	2.3	1.3
Aug. 22	12	524.5±28.0	30.7±0.7	74.3	22.0	1.0	1.4
Oct. 27	8	473.2±34.6	29.4±0.8	74.4	22.3	0.7	1.3
Dec. 2	12	470.4±41.3	29.4±1.3	73.3	22.7	1.2	1.4
'93 Feb. 28	12	453.0±41.8	29.0±1.5	74.8	22.6	1.6	1.3
Apr. 26	12	364.4±16.5	27.1±1.2	73.8	22.9	1.7	1.9

* Ordinary muscles.

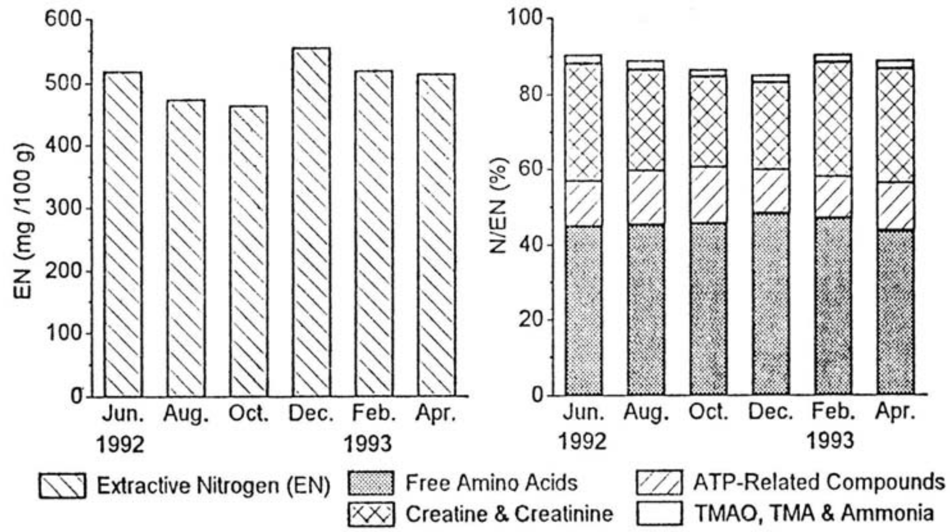
表三 虱目魚普通肉核苷酸相關化合物及其餘成分含量之季節變化

Table 3. Seasonal variation of the contents of ATP-related compounds and other constituents in the muscle extracts of milkfish

	'92 Jun.	Aug.	Oct.	Dec.	'93 Feb.	Apr.
ATP-Related Compounds (μmole/g)						
ATP	0.12±0.01*	0.07±0004	0.06±0.01	0.06±0.01	0.10±0.01	0.12±0.02
ADP	0.20±0.04	0.16±0.01	0.13±0.02	0.17±0.03	0.08±0.02	0.12±0.02
AMP	0.09±0.02	0.17±0.06	0.16±0.01	0.10±0.04	0.14±0.01	0.28±0.10
IMP	9.33±0.37	10.43±0.53	11.17±0.73	10.33±0.52	8.79±0.22	9.80+0.28
Inosine	1.19±0.10	1.04±0.33	0.51±0.07	0.66±0.04	0.81±0.05	0.78±0.08
Hypoxanthine	0.16±0.04	0.15±0.04	0.25±0.07	0.8±0.01	0.17±0.04	0.20±0.03
Total	11.07±0.49[b]	12.02±0.27[a]	12.29+074[a]	11.38±0.49[b]	10.08±0.22[c]	11.30±0.21[b]
Other Constituents (mg/100 g)						
Creatine	494.4±18.9[a]	389.3±12.2[b]	344.8±16.9[c]	392.7±12.1[b]	486.1±31.3[a]	483.4±23.4[a]
Creatinine	8.4±1.2	6.3±0.8	3.4±1.7	8.2±3.5	4.3±1.3	3.7±0.3
TMAO	5.5±0.8	5.0±0.3	2.3±1.7	9.6±2.1	5.9±2.1	7.7±0.9
TMA	1.5±0.2	1.3±0.1	1.0±0.4	2.0±0.2	1.6±0.1	1.2±0.2

* Mean±standard deviation of four determinaions.

[a-c] Means with the same superscript letterin a row did not vary significantly from each other ($p>0.05$).



圖一 虱目魚普通肉萃取物氮之季節變化及其中氮的分佈

Fig. 1. Seasonal variation of extractive nitrogen (EN) and the distribution of nitrogen in the muscle extracts of milkfish.

表二　虱目魚普通肉游離胺基酸含量之季節變化

Table 2. Seasonal variation of the content of free amino acids in the muscle extracts of milkfish

(mg/100 g)

Amino acid	'92 Jun.	Aug.	Oct.	Dec.	'93 Feb.	Apr.
Phosphoserine	1.0±0.1*	0.8±0.5	0.4±0.1	0.7±0.1	0.6±0.2	0.6±0.1
Taurine	104.5±16.7^{b}	97.1±18.5^{b}	67.6±13.1^{c}	77.8±9.1^{c}	96.4±35.9^{bc}	142.1±18.9^{a}
Aspartic acid	2.9±1.0	0.9±0.6	2.2±0.9	1.3±0.6	2.0±1.3	0.6±0.3
Hydroxylproline	10.5±2.3	12.0±6.2	7.4±1.2	2.3±0.7	0.9±0.2	0.5±0.1
Threonine	6.7±0.3	4.1±1.2	4.8±0.8	12.7±0.8	7.0±0.4	5.1±1.5
Serine	11.7±2.9	5.8±1.5	5.8±1.2	5.6±0.5	11.7±6.5	4.9±1.0
Glutamic acid	28.1±3.6^{b}	23.8±6.4^{b}	7.2±2.1^{c}	23.5±5.0^{b}	27.5±3.8^{b}	35.6±4.4^{a}
Glutamine	11.2±1.8	5.8±2.7	18.9±8.9	10.6±6.8	5.2±2.4	15.2±7.4
Proline	9.9±1.4	10.7±1.3	7.8±1.3	8.2±1.0	8.4±3.1	5.7±1.9
Glycine	20.1±3.7^{c}	26.4±2.3^{bc}	27.9±6.4^{bc}	59.8±11.7^{a}	52.2±6.9^{a}	31.1±6.5^{b}
Alanine	18.8±2.6^{bc}	10.9±2.7^{c}	24.5±5.3^{b}	39.2±1.4^{a}	24.4±10.8^{b}	22.7±2.2^{b}
Valine	4.4±0.4	2.0±0.6	1.7±0.3	6.2±1.0	6.8±0.6	3.0±0.4
Methionine	2.6±0.2	1.5±0.4	1.2±0.2	2.2±0.1	2.4±0.5	2.1±0.3
Isoleucine	3.0±0.2	0.8±0.4	1.3±0.3	3.1±0.8	2.8±0.4	2.6±1.2
Leucine	4.5±0.5	1.8±0.6	2.1±0.6	5.1±1.2	5.2±0.8	3.1±0.5
Tyrosine	4.4±1.0	3.2±0.4	2.8±0.6	3.5±0.4	3.6±0.8	1.8±0.6
Phenylalanine	1.6±0.2	1.0±0.4	0.4±0.1	1.8±0.5	2.3±0.8	1.1±0.3
β-Alanine	1.1±0.3	1.0±0.1	0.1±0.1	0.7±0.2	0.9±0.2	0.6±0.1
Ornithine	3.0±0.7	4.0±1.3	3.0±1.9	1.0±0.3	7.7±8.1	1.3±0.4
Lysine	22.8±3.4^{b}	16.4±5.6^{c}	15.8±3.0^{c}	27.5±6.9^{b}	36.0±5.4^{a}	35.8±7.6^{a}
Histidine	710.7±55.7^{b}	669.1±62.9^{b}	670.7±61.5^{b}	829.4±90.3^{a}	734.2±63.3^{b}	665.1±36.6^{b}
3-Methylhistidine	2.5±0.6	3.5±0.7	2.2±0.6	2.5±0.8	1.7±0.3	2.5±0.5
Arginine	11.6±2.9	9.8±1.0	3.3±0.4	4.3±0.4	6.0±1.0	3.4±0.8
Total	997.4±61.7^{b}	912.0±90.0^{c}	878.5±83.5^{c}	1,128.5±78.9^{a}	1,046.0±46.4^{ab}	986.4±24.7^{bc}
Ammonia	11.7±2.8	11.8±1.6	9.3±0.8	11.0±0.6	10.7±0.6	10.3±0.5

* Mean±standard deviation of four determinations.

a–c Means with the same superscript letter in a row did not vary significantly from each other ($p>0.05$).

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養殖台灣蜆化學成分之季節變化

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摘　　要

本研究探討本省養殖台灣蜆 (*Corbicula fluminea* Muller) 可食部位化學成分之季節變化，民國 84 年 8 月至 85 年 8 月間每二個月自花蓮壽豐養殖區採樣與分析。一般成分的季節變化大，水分含量以 12 至 4 月份明顯較高，但此期間之粗脂肪量較低 ($p<0.05$)，粗蛋白及灰分量則變動不大，採肉率 (11.8 ～ 21.0 %) 及肝醣含量 (1,171 ～ 4,216 mg/100 g) 同樣呈現夏、秋季高而冬、春季低之趨勢。游離胺基酸 (FAA) 總量在 87.8 ～ 147.9 mg/100 g 間，麩胺酸、麩胺醯胺、丙胺酸、鳥胺酸、離胺酸及精胺酸等爲主要胺基酸， FAA 總量與多數 FAA 的含量均以 8 及 10 月份較高，而 12 及 2 月份之 FAA 總量最低 ($p<0.05$)。ATP 相關化合物總量 (2.43 ～ 3.75 μmole/g) 以 2 及 4 月份最高， 12 月份則爲最低值 ($p<0.05$)。萃取物氮量 (151 ～ 187 mg/100 g) 大抵以 2 及 4 月份較高。從以上結果，採肉率、粗脂肪、呈味胺基酸、核苷酸、肝醣等含量以夏秋兩季之蜆明顯較高，推測此季節間生產蜆之風味較佳。

表一　採樣蜆之體重、殼長及採肉率

Table 1. Body weight, shell length and meat yield of freshwater clam

Date of sampling	Body weight (g) (n = 60)	Shell length (cm) (n = 60)	Meat yield (%) (n = 3)
1995 Aug. 29	2.4±0.3	2.0±0.1	19.0±0.7^{b}
1995 Oct. 27	2.5±0.5	2.1±0.2	18.5±0.3^{b}
1995 Dec. 30	3.0±0.4	2.1±0.1	12.0±0.4^{d}
1996 Feb. 28	2.8±0.4	2.2±0.1	15.7±0.1^{c}
1996 Apr. 30	2.6±0.5	2.1±0.1	11.8±0.2^{d}
1996 Jun. 25	2.7±0.5	2.1±0.2	21.0±0.1^{a}
1996 Aug. 26	3.0±0.5	2.3±0.2	21.0±0.4^{a}

a-d Mean with the same superscript letter in a column did not significantly differ from each other ($p>0.05$).

表二　蜆一般成分及肝醣含量之季節變動

Table 2. Seasonal variation in proximate composition and glycogen of freshwater clam

Date of sampling	Proximate composition (%)				Glycogen
	Moisture	Protein	Fat	Ash	(mg/100g)
1995 Aug. 29	82.2±0.1^{d}	10.5±0.4^{ab}	1.7±0.3^{b}	0.8±0.1^{c}	4,216±182^{a}
1995 Oct. 27	82.7±0.4^{d}	11.1±0.4^{a}	1.6±0.1^{b}	1.1±0.1^{a}	2,533±254^{c}
1995 Dec. 30	88.3±0.2^{a}	8.7±0.1^{c}	0.5±0.0^{d}	1.1±0.1^{ab}	1,171±38^{d}
1996 Feb. 28	85.2±0.1^{b}	10.7±0.6^{ab}	0.9±0.0^{cd}	1.0±0.1^{ab}	2,303±114^{c}
1996 Apr. 30	85.4±0.3^{b}	10.2±0.6^{b}	0.7±0.0^{c}	0.9±0.1^{bc}	2,309±254^{c}
1996 Jun. 25	83.6±0.3^{c}	10.6±0.3^{ab}	1.8±0.1^{b}	1.0±0.1^{ab}	3,284±160^{b}
1996 Aug. 26	82.1±0.8^{d}	10.5±0.3^{ab}	2.4±0.1^{a}	1.0±0.1^{c}	3,588±336^{b}

Mean ± standard deviation (n = 3).

a-d Mean with the same superscript letter in a column did not significantly differ from each other ($p>0.05$).

表三 蜆游離胺基酸含量 (mg/100 g) 之季節變動

Table 3. Seasonal variation in free amino acids (mg/100 g) in the extract of freshwater clam

Amino acids	1995 Aug.	1995 Oct.	1995 Dec.	1996 Feb.	1996 Apr.	1996 Jun.	1996 Aug.
Phosphoserine	2.9 ± 0.3^{b}	2.4 ± 0.1^{b}	3.0 ± 0.1^{b}	3.0 ± 0.5^{b}	4.3 ± 0.7^{a}	2.9 ± 0.5^{b}	2.8 ± 0.3^{b}
Taurine	2.4 ± 0.7^{c}	2.7 ± 0.0^{bc}	2.4 ± 0.1^{c}	3.1 ± 0.5^{b}	5.3 ± 0.2^{a}	3.1 ± 0.5^{bc}	2.6 ± 0.2^{bc}
Aspartic acid	3.4 ± 0.1^{a}	2.6 ± 0.3^{b}	1.7 ± 0.2^{d}	1.9 ± 0.1^{cd}	2.1 ± 0.3^{b}	2.8 ± 0.2^{b}	3.6 ± 0.3^{a}
Threonine	2.9 ± 0.1^{c}	3.6 ± 0.3^{b}	1.9 ± 0.3^{d}	1.9 ± 0.2^{d}	2.7 ± 0.3^{c}	3.4 ± 0.5^{b}	4.5 ± 0.3^{a}
Serine	4.2 ± 0.1^{a}	3.7 ± 0.3^{ab}	4.3 ± 0.5^{a}	3.6 ± 0.3^{b}	1.8 ± 0.3^{c}	3.2 ± 0.4^{b}	3.8 ± 0.3^{ab}
Asparagine	1.5 ± 0.2^{ab}	0.9 ± 0.3^{d}	1.0 ± 0.2^{bcd}	1.0 ± 0.2^{cd}	1.5 ± 0.3^{a}	1.4 ± 0.2^{abc}	1.6 ± 0.3^{a}
Glutamic acid	13.5 ± 0.1^{b}	12.9 ± 0.7^{bc}	8.8 ± 1.2^{ef}	7.9 ± 0.8^{f}	10.3 ± 1.0^{de}	11.5 ± 1.3^{cd}	17.1 ± 1.5^{a}
Glutamine	17.4 ± 0.5^{a}	17.9 ± 0.5^{a}	7.0 ± 1.0^{d}	9.4 ± 0.1^{c}	15.6 ± 0.5^{b}	3.8 ± 0.4^{e}	4.2 ± 0.3^{e}
a-AAA	1.0 ± 0.3^{b}	0.5 ± 0.2^{c}	0.5 ± 0.1^{c}	0.2 ± 0.0^{d}	0.4 ± 0.1^{cd}	0.8 ± 0.1^{b}	1.4 ± 0.2^{a}
Proline	3.0 ± 0.1^{c}	4.5 ± 0.1^{b}	2.2 ± 0.2^{d}	2.3 ± 0.2^{d}	3.0 ± 0.3^{c}	3.6 ± 0.4^{c}	5.5 ± 0.5^{a}
Glycine	2.8 ± 0.2^{b}	3.6 ± 0.4^{a}	2.3 ± 0.4^{b}	2.3 ± 0.4^{b}	2.9 ± 0.5^{b}	2.4 ± 0.2^{b}	3.8 ± 0.2^{a}
Alanine	15.1 ± 0.1^{c}	20.4 ± 0.4^{b}	7.5 ± 1.0^{e}	11.4 ± 0.4^{d}	12.7 ± 1.3^{d}	15.8 ± 1.7^{c}	26.5 ± 0.7^{a}
a-ABA	0.2 ± 0.0^{d}	1.3 ± 0.1^{b}	0.7 ± 0.3^{c}	1.2 ± 0.1^{b}	1.7 ± 0.1^{a}	0.6 ± 0.2^{c}	1.7 ± 0.1^{a}
Valine	3.4 ± 0.1^{de}	5.0 ± 0.2^{b}	2.9 ± 0.3^{f}	3.1 ± 0.2^{ef}	3.7 ± 0.3^{cd}	4.0 ± 0.3^{c}	5.6 ± 0.2^{a}
Cystine	0.2 ± 0.0^{d}	1.3 ± 0.1^{abc}	1.4 ± 0.1^{abc}	1.1 ± 0.1^{c}	1.9 ± 0.3^{a}	1.2 ± 0.1^{bc}	1.6 ± 0.1^{ab}
Methionine	1.2 ± 0.0^{d}	2.0 ± 0.1^{b}	1.7 ± 0.2^{c}	1.6 ± 0.1^{c}	0.5 ± 0.2^{e}	1.8 ± 0.1^{c}	2.7 ± 0.1^{a}
Isoleucine	2.3 ± 0.1^{cd}	3.1 ± 0.2^{b}	1.6 ± 0.2^{f}	1.8 ± 0.2^{ef}	2.1 ± 0.2^{de}	2.5 ± 0.2^{c}	4.6 ± 0.2^{a}
Leucine	3.3 ± 0.1^{c}	4.6 ± 0.3^{b}	2.1 ± 0.3^{e}	2.5 ± 0.2^{de}	2.7 ± 0.2^{d}	3.4 ± 0.3^{c}	6.2 ± 0.4^{a}
Tyrosine	2.4 ± 0.1^{bc}	2.9 ± 0.2^{b}	1.7 ± 0.3^{e}	1.7 ± 0.2^{de}	2.4 ± 0.7^{bcd}	2.2 ± 0.2^{cde}	3.9 ± 0.3^{a}
Phenylalanine	1.6 ± 0.0^{bcd}	2.1 ± 0.1^{b}	1.1 ± 0.2^{d}	1.3 ± 0.2^{cd}	1.7 ± 0.6^{bc}	1.8 ± 0.1^{bc}	3.3 ± 0.6^{a}
b-Alanine	1.8 ± 0.3^{bc}	2.5 ± 0.4^{ab}	1.4 ± 0.5^{c}	1.3 ± 0.5^{c}	2.0 ± 0.9^{bc}	1.4 ± 0.1^{c}	3.2 ± 0.2^{a}
b-AiBA	0.2 ± 0.0^{d}	0.4 ± 0.0^{b}	0.3 ± 0.0^{bc}	0.2 ± 0.0^{d}	0.3 ± 0.1^{cd}	0.3 ± 0.1^{bc}	0.9 ± 0.1^{a}
γ-ABA	0.2 ± 0.1^{c}	0.5 ± 0.1^{ab}	0.4 ± 0.1^{bc}	0.4 ± 0.1^{bc}	0.3 ± 0.1^{c}	0.3 ± 0.1^{c}	0.6 ± 0.1^{a}
Tryptophan	1.6 ± 0.0^{a}	1.4 ± 0.1^{b}	1.0 ± 0.1^{c}	0.6 ± 0.2^{de}	0.7 ± 0.1^{d}	0.5 ± 0.1^{de}	0.5 ± 0.2^{e}
Ethanolamine	4.5 ± 0.8^{b}	3.4 ± 0.2^{c}	6.3 ± 0.8^{a}	4.6 ± 0.4^{b}	3.2 ± 0.4^{c}	2.6 ± 0.2^{c}	3.0 ± 0.5^{c}
Ornithine	9.4 ± 2.1^{ab}	11.7 ± 3.5^{ab}	8.9 ± 3.4^{ab}	7.3 ± 2.9^{b}	15.3 ± 6.4^{a}	5.6 ± 0.3^{b}	10.1 ± 0.4^{ab}
Lysine	7.2 ± 0.1^{bc}	7.6 ± 0.4^{b}	4.3 ± 0.7^{e}	4.2 ± 0.3^{e}	5.3 ± 0.7^{d}	6.5 ± 0.7^{c}	8.7 ± 0.3^{a}
Histidine	1.8 ± 0.3^{a}	1.7 ± 0.1^{ab}	0.9 ± 0.1^{c}	0.9 ± 0.1^{c}	1.4 ± 0.1^{b}	1.0 ± 0.2^{c}	1.9 ± 0.1^{a}
Arginine	11.4 ± 0.1^{ab}	10.5 ± 0.3^{abc}	8.7 ± 0.8^{c}	10.2 ± 0.8^{bc}	10.5 ± 0.5^{abc}	12.1 ± 2.2^{a}	11.6 ± 0.6^{ab}
Total	122.9 ± 3.4^{bc}	137.8 ± 7.1^{ab}	87.8 ± 12.5^{e}	92.0 ± 8.9^{e}	118.6 ± 12.8^{cd}	102.2 ± 10.0^{de}	147.9 ± 7.8^{a}
Ammonia	3.4 ± 0.2^{cd}	4.0 ± 0.1^{ab}	3.2 ± 0.2^{d}	3.2 ± 0.2^{cd}	3.7 ± 0.3^{bc}	3.1 ± 0.3^{d}	4.5 ± 0.6^{a}

a-AAA, a-Aminoadipic acid; a-ABA, a-aminobutric acid; a-AiBA, b-amino-isobutyric acid; γ-ABA, γ-aminobutric acid.

Mean ± standard deviation (n = 3).

[a-f] Means with the same superscript letter in a row did not significantly differ from each other (p>0.05).

國立台灣海洋大學食品科學系：水產化學授課資料(二)- 萃取物成分組成之影響- 邱思魁1060503

表四 蜆 ATP 相關化合物含量 (μmole/g) 之季節變動

Table 4. Seasonal variation in ATP-related compounds (μmole/g) in the extract of freshwater clam

	1995 Aug.	1995 Oct.	1995 Dec.	1996 Feb.	1996 Apr.	1996 Jun.	1996 Aug.
ATP	0.44 ± 0.14^{ab}	0.27 ± 0.09^{c}	0.28 ± 0.09^{bc}	0.44 ± 0.05^{ab}	0.46 ± 0.06^{a}	0.34 ± 0.05^{abc}	0.38 ± 0.14^{abc}
ADP	0.69 ± 0.09^{bc}	0.56 ± 0.08^{cd}	0.56 ± 0.08^{d}	0.58 ± 0.08^{cd}	0.70 ± 0.05^{bc}	0.91 ± 0.19^{a}	0.83 ± 0.08^{ab}
AMP	0.58 ± 0.05^{c}	0.45 ± 0.12^{d}	0.33 ± 0.01^{d}	0.41 ± 0.07^{d}	0.60 ± 0.05^{c}	0.73 ± 0.10^{b}	0.95 ± 0.02^{a}
IMP	0.48 ± 0.10^{bc}	0.81 ± 0.08^{a}	0.49 ± 0.02^{bc}	0.54 ± 0.06^{b}	0.43 ± 0.01^{c}	0.20 ± 0.02^{e}	0.30 ± 0.06^{d}
Adenosine	0.03 ± 0.01^{a}	0.04 ± 0.01^{a}	0.02 ± 0.00^{b}	0.03 ± 0.01^{a}	0.04 ± 0.01^{a}	0.04 ± 0.00^{a}	0.05 ± 0.01^{a}
Inosine	0.10 ± 0.02^{c}	0.16 ± 0.06^{b}	0.10 ± 0.02^{c}	0.18 ± 0.05^{b}	0.24 ± 0.02^{a}	0.07 ± 0.02^{c}	0.06 ± 0.01^{c}
Hypoxanthine	0.59 ± 0.04^{cd}	0.49 ± 0.06^{d}	0.63 ± 0.02^{cd}	1.41 ± 0.20^{a}	1.14 ± 0.09^{b}	0.75 ± 0.13^{c}	0.48 ± 0.06^{d}
Xanthine	0.05 ± 0.00^{d}	0.06 ± 0.01^{d}	0.13 ± 0.02^{c}	0.13 ± 0.01^{c}	0.14 ± 0.01^{c}	0.28 ± 0.00^{b}	0.31 ± 0.01^{a}
Total	2.97 ± 0.02^{c}	2.83 ± 0.07^{c}	2.43 ± 0.03^{d}	3.72 ± 0.15^{a}	3.75 ± 0.21^{a}	3.31 ± 0.19^{b}	3.36 ± 0.04^{b}

Mean ± standard deviation (n = 3).

[a-e] Means with the same superscript letter in a row did not significantly differ from each other (p>0.05).

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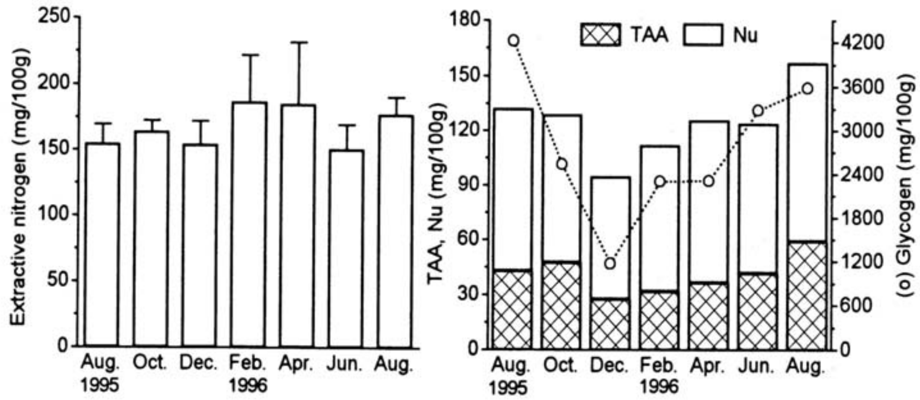

圖一 蜆萃取物氮與呈味成分含量之季節變動

Fig. 1. Seasonal variation in extractive nitrogen and taste components of freshwater clam. TAA, taste amino acids (glutamic acid + alanine + glycine + arginine); Nu, nucleotides (ATP + ADP + AMP + IMP).

國立台灣海洋大學食品科學系：水產化學授課資料(二)- 萃取物成分組成之影響- 邱思魁1060503

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養殖文蛤化學成分之季節變化

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摘要

為瞭解本省不同季節生產養殖文蛤之化學成分，民國 82 年 11 月至 83 年 11 月間每二個月自雲林臺西養殖戶採樣與分析。一般成分之變動小，採肉率 (11.3～16.7%) 以 5 及 7 月份較高，肝醣含量 (1,103～1,432 mg/100 g) 以 7 月份較高。游離胺基酸 (FAA) 總量在 913～1,299 mg/100 g 間，以牛磺酸含量最多，另包括丙胺酸、麩胺酸、精胺酸及甘胺酸等五種主要 FAA 即佔總量之 84～91%，且和 FAA 總量均以 7 及 9 月份高於其他月份。核苷酸及相關化合物總量 (3.74～4.57 μmole/g) 在 5 及 7 月份較高，有機酸 (234～504 mg/100 g) 中以琥珀酸量較多，蘋果酸及檸檬酸其次，在夏及秋季生產之文蛤有機酸總量及琥珀酸較高。萃取物氮量大抵呈現由春季往冬季逐漸上升之趨勢，從以上結果顯示夏、秋季生產文蛤之肝醣、呈味胺基酸、琥珀酸等含量較豐富，推測此季節生產之文蛤風味可能較佳。

關鍵詞：文蛤，萃取物成分，肝醣，游離胺基酸，核苷酸，有機酸，季節變化。

表一 採樣文蛤之體重、殼長及採肉率

Table 1. Body weight, shell length and meat yield of the examined hard clam

Date of sampling	Body weight (g)	Shell length (cm)	Meat yield (%)
1993 Nov. 26	17.2±4.0	4.1±0.4	12.2
1994 Jan. 27	15.0±2.6	4.0±0.2	11.8
1994 Mar. 26	15.6±2.8	4.2±0.3	13.9
1994 May 27	14.2±3.3	4.2±0.3	16.7
1994 Jul. 26	14.0±2.8	4.1±0.4	15.0
1994 Sep. 29	12.9±2.5	3.9±0.3	11.3
1994 Nov. 11	12.5±2.2	3.9±0.2	13.0

表二 文蛤之一般成分及肝醣含量之季節變動

Table 2. Seasonal variation in proximate composition and glycogen content of hard clam

Date of sampling	Proximate composition (%)				Glycogen (mg/100 g)
	Moisture	Protein	Fat	Ash	
1993 Nov. 26	83.0	12.6	0.3	2.0	1,103
1994 Jan. 27	80.3	11.1	0.7	2.4	1,275
1994 Mar. 26	82.0	11.3	0.2	2.5	1.192
1994 May 27	81.4	11.0	0.2	2.2	1,145
1994 Jul. 26	81.3	10.5	0.5	2.3	1,432
1994 Sep. 29	81.4	10.5	3.9	2.4	1,222
1994 Nov. 11	81.6	12.3	0.7	2.5	1,132

表三 文蛤游離胺基酸含量之季節變動

Table 3. Seasonal variation in the content of free amino acids in the meat extract of hard clam (mg/100 g)

Amino acids	1993	1994					
	Nov.	Jan.	Mar.	May	Jul.	Sep.	Nov.
Phosphoserine	7	7	7	8	8	9	9
Taurine	512	533	638	395	460	652	469
Aspartic acid	19	23	29	30	32	22	19
Threonine	6	9	8	4	6	7	9
Serine	4	7	4	4	6	5	7
Glutamic acid	108	131	132	138	159	150	105
Glutamine	3	5	4	4	4	5	3
Sarcosine	2	3	2	0	0	5	2
α-Amino adipic acid	9	9	5	4	8	11	13
Proline	5	6	7	6	6	7	9
Glycine	22	37	26	59	87	60	52
Alanine	85	121	106	136	274	206	205
α-Amino-n-butyric acid	2	4	3	2	3	4	3
Valine	8	14	9	8	8	10	13
Cystine	4	6	1	0	0	1	1
Methionine	0	6	3	4	1	4	4
Cystathionine	1	3	2	0	0	1	1
Isoleucine	5	8	4	4	4	5	8
Leucine	6	11	6	7	6	7	12
Tyrosine	5	8	6	6	6	6	9
Phenylalanine	3	5	5	5	4	4	7
β-Alanine	2	2	3	3	3	3	4
β-Amino-n-butyric acid	0	0	1	0	3	1	1
Ornithine	6	6	8	7	4	6	5
Lysine	13	19	18	18	20	12	15
Histidine	3	5	5	4	4	4	2
Arginine	74	89	94	80	74	89	71
Total	913	1,069	1,132	936	1,189	1,299	1,059
Ammonia	6	6	4	6	7	7	8

表四 文蛤核苷酸及相關化合物含量之季節變動

Table 4. Seasonal variation in the content of nucleotides and related compounds in the meat extract of hard clam (μmole/g)

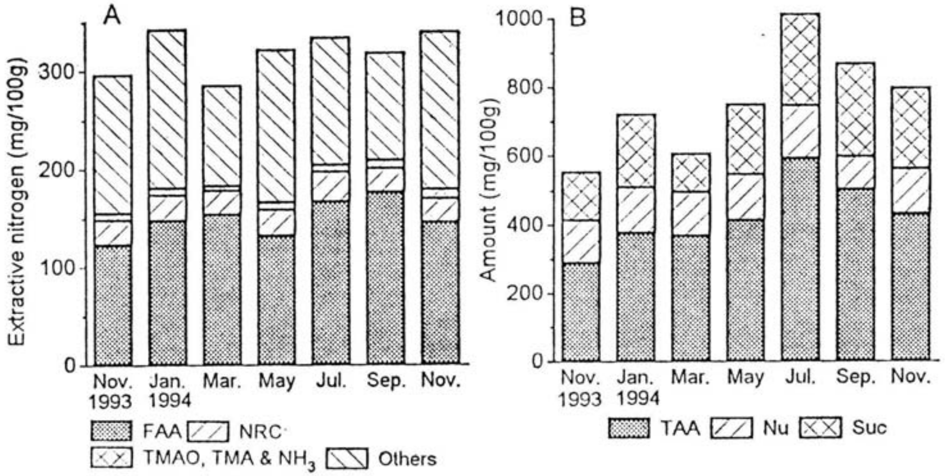
	1993	1994					
	Nov.	Jan.	Mar.	May	Jul.	Sep.	Nov.
ATP	1.05	1.12	1.23	0.99	0.90	0.05	1.14
ADP	0.80	0.97	0.79	0.96	0.59	0.39	1.06
AMP	0.87	0.77	0.85	0.97	2.01	1.74	0.70
IMP	0.17	0.13	0.05	0.17	0.21	0.17	0.03
GMP	0.07	0.08	0.04	0.09	0.16	0.23	0.05
CMP	0.27	0.34	0.34	0.29	0.16	0.29	0.38
UMP	0.12	0.13	0.13	0.29	0.05	0.12	0.13
Adenosine	0.03	0.02	0.05	0.04	0.03	0.05	0.02
Inosine	0.16	0.20	0.10	0.10	0.11	0.14	0.06
Guanosine	0.03	0.03	0.01	0.03	0.03	0.30	0.02
Uridine	0.04	0.05	0.04	0.06	0.10	0.13	0.02
Hypoxanthine	0.29	0.23	0.09	0.25	0.20	0.16	0.17
Xanthine	0.03	0.03	0.02	0.02	0.02	0.10	0.02
Total	3.94	4.08	3.74	4.26	4.57	3.87	3.80

表五 文蛤有機酸、氧化三甲基胺及三甲基胺含量之季節變動

Table 5. Seasonal variation in the content of organic acids, trimethylamine oxide (TMAO) and trimethylamine (TMA) in the meat extract of hard clam (mg/100 g)

	1993	1994					
	Nov.	Jan.	Mar.	May	Jul.	Sep.	Nov.
α-Ketoglutaric acid	4	3	4	10	10	8	5
Citric acid	53	48	64	44	28	63	38
Succinic acid	140	212	109	204	265	271	235
Lactic acid	8	7	1	3	10	2	9
Malic acid	70	79	56	83	72	149	110
Pyroglutamic acid	—	—	—	—	—	11	2
Total	275	349	234	344	385	504	399
TMAO	6	3	1	9	7	6	5
TMA	2	11	7	5	2	7	12

—, not detected.



圖一 文蛤萃取物氮（A）及呈味成分含量（B）之季節變動

Fig. 1. Seasonal variation in the contents of extractive nitrogen (A) and taste components (B) of hard clam meat.
FAA, free amino acids; NRC, nucleotides and related compounds; Others, unidentified compounds; TAA, taste amino acids (alanine+glutamic acid+arginine+glycine); Nu, nucleotides (ATP+ADP+AMP+IMP+GMP); Suc, succinic acid.

- 養殖虱目魚普通肉含氮萃取物成分之季節變化：虱目魚呈味成分之組成特徵與青甘參等紅肉魚類似，肌苷酸雖因季節而有所變動，但含量比一般魚肉高，推測冬季生產虱目魚之FAA含量較豐富而呈味性較佳。
- 養殖台灣蜆化學成分之季節變化：採肉率、粗脂肪、呈味胺基酸、核苷酸、肝醣等含量以夏秋兩季明顯較高，推測此季節間生產蜆之風味較佳。
- 養殖文蛤化學成分之季節變化：夏、秋季生產文蛤之肝醣、呈味胺基酸、琥珀酸等含量較豐富，推測此季節生產之文蛤風味可能較佳。

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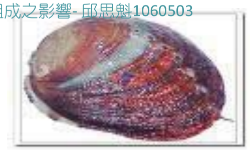

Original Article

Seasonal variations of chemical constituents in the muscle and viscera of small abalone fed different diets

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SUMMARY: The seasonal changes in levels of chemical constituents in the muscle and viscera of small abalone *Haliotis diversicolor* fed gracilar and an artificial diet were investigated. Muscle yields were higher in winter and spring. In October specimens, total adenosine 5′-triphosphate (ATP)-related compounds (ARC), total free amino acids (FAA), and glycogen in both muscle and viscera decreased markedly. The artificial diet fed to small abalone had much higher glycogen in the muscle than those fed on gracilar, and showed a great seasonal change. Total amounts of ARC in the muscles were higher through March to July, while those in the viscera were maximal in January. Taurine, arginine, glycine, glutamic acid, and alanine were the major FAA in both tissues, accounting for 81–94% of the total FAA. Total amounts of FAA in the muscles were higher in the samples collected from winter and early spring than in other seasons. Glycine, glutamic acid, and adenosine monophosphate might be the most important taste components related to the palatability of small abalone. Their total amounts in the muscles of the two specimens were considerably high in December to March. This finding suggested that small abalone produced in winter and early spring might be more palatable.

KEY WORDS: **diet, extractive component, *Haliotis diversicolor*, seasonal variation, small abalone.**

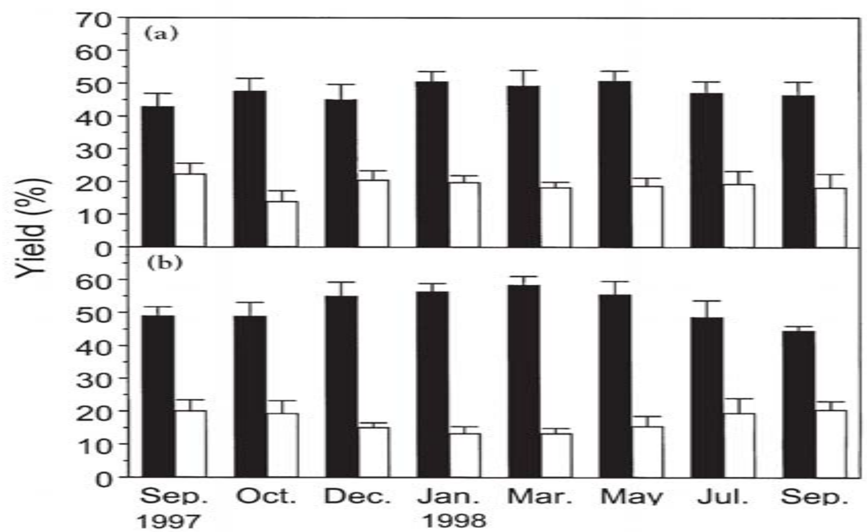

Fig. 1 Seasonal changes in muscle and viscera yields of (a) G-small abalone and (b) A-small abalone. Data are mean and SD of six specimens. (■) muscle; (□) viscera.

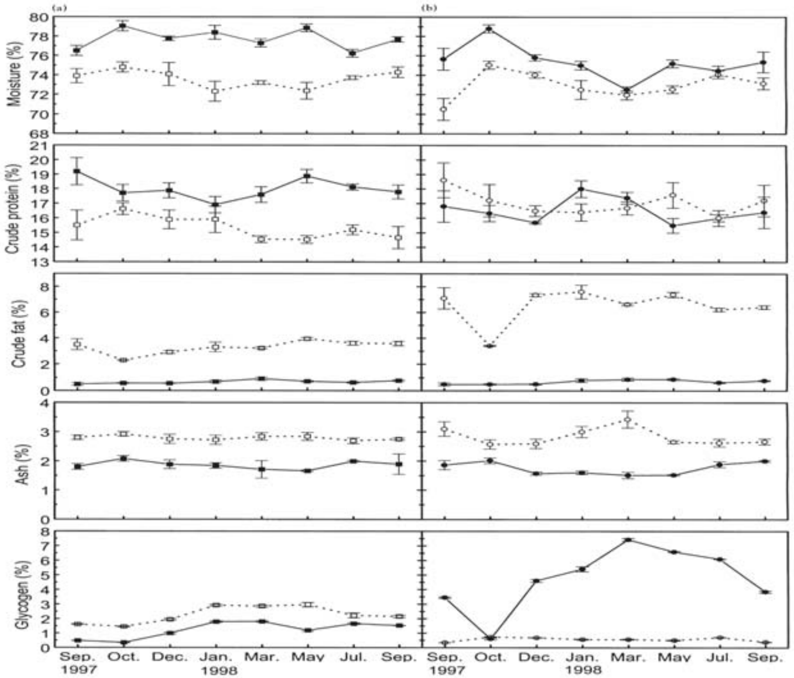

Fig. 2 Seasonal variations of proximate composition and glycogen in the muscle (—) and viscera (·····) of (a) G-small abalone and (b) A-small abalone. Data are mean and SD of two determinations.

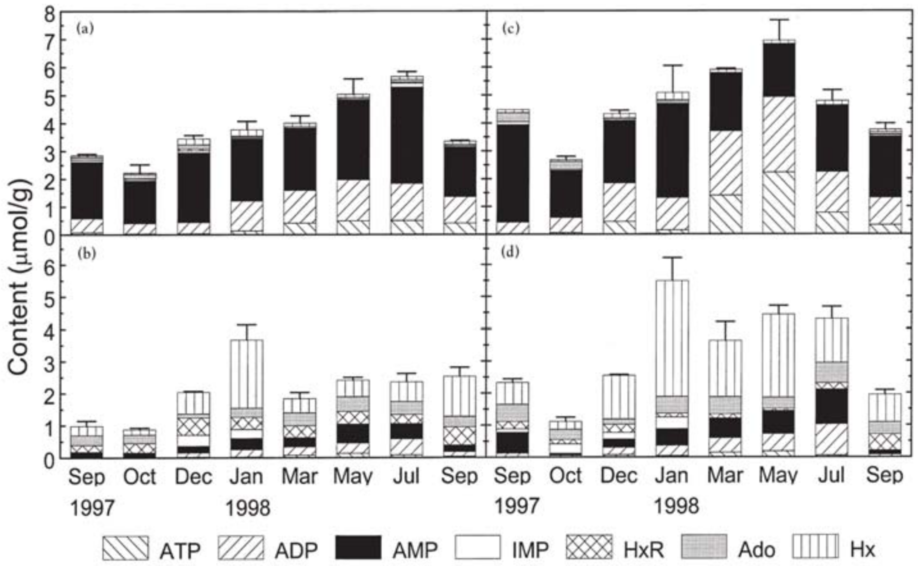

Fig. 3 Seasonal changes in levels of ATP-related compounds in the muscle and viscera of G-small abalone and A-small abalone. Data are mean and SD of two determinations. G-small abalone (a) muscle and (b) viscera. A-small abalone (c) muscle and (d) viscera.

Table 1 Seasonal changes in levels of free amino acids (mg/100 g) in the muscle of G-small abalone

Amino acids	Date of sampling 1997 Sep. 10	Oct. 1	Dec. 20	1998 Jan. 13	Mar. 18	May 8	Jul. 21	Sep. 9
Phosphoserine	11 (0)	9 (0)*	9 (0)	6 (0)	6 (0)	6 (0)	8 (0)	6 (1)
Taurine	1313 (16)	1425 (43)	1351 (49)	1214 (42)	1218 (111)	1339 (57)	1300 (35)	1321 (96)
Aspartic acid	5 (2)	8 (2)	5 (2)	7 (0)	7 (1)	7 (0)	7 (2)	9 (0)
Threonine	10 (0)	11 (1)	18 (0)	20 (0)	17 (3)	24 (2)	15 (2)	17 (1)
Serine	26 (0)	21 (1)	35 (1)	34 (1)	42 (11)	36 (6)	23 (6)	39 (6)
Glutamic acid	70 (1)	47 (2)	34 (2)	30 (0)	54 (20)	39 (2)	47 (6)	66 (6)
Glutamine	15 (0)	14 (0)	37 (3)	22 (1)	42 (23)	18 (3)	25 (2)	32 (1)
α-AAA	2 (3)	5 (2)	6 (2)	7 (1)	10 (4)	6 (0)	10 (0)	8 (2)
Proline	19 (2)	15 (2)	24 (2)	29 (1)	39 (2)	21 (1)	16 (2)	21 (4)
Glycine	74 (1)	131 (7)	350 (3)	399 (14)	438 (61)	238 (35)	162 (79)	195 (20)
Alanine	45 (0)	41 (1)	37 (1)	31 (0)	50 (22)	23 (1)	41 (3)	47 (4)
Citrulline	6 (1)	8 (0)	6 (1)	5 (0)	6 (0)	1 (0)	1 (1)	0 (0)
α-ABA	3 (2)	0 (0)	3 (1)	2 (0)	2 (1)	4 (2)	2 (0)	6 (0)
Valine	8 (1)	7 (1)	11 (1)	10 (0)	14 (2)	11 (1)	9 (2)	10 (1)
Cystine	0 (0)	1 (1)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Methionine	4 (1)	5 (0)	5 (1)	4 (1)	4 (2)	4 (1)	5 (2)	4 (0)
Cystathionine	3 (3)	1 (1)	5 (0)	8 (0)	7 (1)	5 (0)	1 (0)	4 (1)
Isoleucine	8 (3)	6 (2)	10 (0)	7 (0)	10 (1)	6 (0)	6 (2)	7 (0)
Leucine	11 (2)	10 (1)	12 (0)	9 (0)	15 (4)	11 (0)	12 (1)	11 (2)
Tyrosine	10 (6)	12 (0)	20 (2)	16 (1)	22 (10)	10 (1)	10 (2)	10 (2)
Phenylalanine	4 (0)	4 (1)	7 (1)	8 (0)	13 (5)	6 (1)	6 (1)	7 (0)
β-Alanine	4 (3)	3 (2)	3 (3)	1 (0)	2 (1)	1 (0)	3 (0)	1 (0)
β-AiBA	2 (3)	1 (2)	2 (2)	2 (0)	2 (0)	2 (1)	2 (0)	2 (0)
γ-ABA	0 (0)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Tryptophan	6 (2)	7 (8)	8 (6)	3 (0)	9 (0)	0 (0)	0 (0)	0 (0)
Ethanol amine	0 (1)	0 (1)	0 (0)	1 (0)	0 (0)	1 (0)	1 (0)	0 (0)
Ornithine	2 (0)	4 (0)	6 (0)	11 (0)	4 (0)	2 (0)	3 (1)	2 (1)
Lysine	9 (0)	9 (0)	18 (0)	16 (0)	21 (3)	17 (1)	14 (3)	18 (2)
Histidine	8 (0)	9 (1)	12 (0)	15 (1)	24 (6)	16 (1)	13 (4)	17 (2)
Arginine	458 (10)	421 (8)	405 (17)	431 (11)	498 (27)	488 (11)	525 (20)	471 (31)
Total	2133 (10)	2236 (67)	2443 (78)	2351 (70)	2576 (22)	2342 (16)	2266 (165)	2332 (122)

α-AAA, α-amino adipic acid; α-ABA, α-amino-*n*-butyric acid; β-AiBA, β-amino-isobutyric acid; γ-ABA, γ-amino-*n*-butyric acid.
*Data are mean and SD (in parentheses) of two determinations.

Table 2 Seasonal changes in levels of free amino acids (mg/100 g) in the muscle of A-small abalone

Amino acids	Date of sampling 1997 Sep. 10	Oct. 1	Dec. 20	1998 Jan. 13	Mar. 18	May 8	Jul. 21	Sep. 9
Phosphoserine	9 (0)*	7 (0)	7 (0)	9 (1)	6 (0)	7 (1)	7 (0)	6 (0)
Taurine	897 (5)	1045 (5)	1020 (107)	1105 (73)	1150 (114)	986 (35)	1082 (31)	1257 (73)
Aspartic acid	5 (1)	6 (0)	11 (2)	7 (1)	5 (1)	11 (0)	12 (1)	8 (0)
Threonine	10 (0)	16 (1)	11 (1)	15 (1)	15 (4)	11 (1)	18 (1)	15 (1)
Serine	46 (1)	26 (2)	54 (6)	58 (3)	37 (2)	50 (1)	54 (1)	33 (2)
Glutamic acid	110 (2)	46 (1)	59 (8)	79 (2)	50 (5)	67 (1)	109 (0)	71 (4)
Glutamine	23 (1)	29 (1)	75 (13)	66 (1)	35 (10)	55 (3)	52 (3)	43 (0)
α-AAA	3 (2)	6 (2)	7 (1)	4 (2)	6 (0)	7 (0)	10 (0)	7 (3)
Proline	57 (6)	18 (4)	111 (14)	101 (4)	61 (4)	66 (1)	55 (0)	22 (1)
Glycine	224 (5)	278 (7)	484 (41)	448 (24)	362 (28)	335 (41)	329 (32)	257 (14)
Alanine	82 (1)	50 (0)	60 (7)	72 (4)	43 (12)	61 (0)	111 (10)	52 (3)
Citrulline	3 (1)	6 (3)	1 (1)	1 (1)	10 (4)	0 (0)	1 (1)	9 (1)
α-ABA	4 (0)	2 (3)	6 (1)	2 (1)	3 (1)	5 (0)	3 (0)	0 (0)
Valine	9 (1)	11 (1)	20 (1)	23 (2)	11 (1)	15 (0)	15 (0)	15 (1)
Cystine	0 (0)	1 (0)	1 (1)	0 (1)	0 (0)	0 (0)	0 (0)	2 (2)
Methionine	3 (2)	5 (1)	3 (0)	2 (0)	4 (0)	2 (0)	2 (1)	3 (1)
Cystathionine	4 (2)	3 (2)	4 (0)	3 (1)	5 (3)	2 (1)	1 (0)	2 (0)
Isoleucine	8 (2)	9 (1)	14 (4)	14 (0)	8 (0)	10 (0)	10 (0)	3 (0)
Leucine	15 (0)	12 (0)	25 (5)	23 (0)	13 (3)	21 (1)	21 (1)	7 (1)
Tyrosine	21 (1)	15 (0)	48 (8)	31 (1)	19 (3)	22 (0)	19 (1)	8 (0)
Phenylalanine	11 (1)	5 (0)	18 (1)	19 (0)	11 (1)	16 (1)	14 (1)	6 (0)
β-Alanine	9 (1)	4 (2)	4 (1)	2 (0)	1 (1)	3 (0)	10 (1)	2 (0)
β-AiBA	5 (0)	2 (2)	4 (0)	2 (1)	2 (0)	2 (1)	4 (0)	2 (0)
γ-ABA	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Tryptophan	4 (2)	3 (4)	11 (0)	4 (5)	4 (6)	0 (0)	0 (0)	0 (0)
Ethanol amine	1 (2)	0 (1)	0 (0)	0 (0)	0 (1)	1 (0)	1 (0)	0 (0)
Ornithine	2 (0)	7 (0)	3 (1)	4 (0)	14 (0)	4 (0)	7 (2)	7 (0)
Lysine	17 (0)	15 (0)	18 (2)	24 (2)	17 (8)	28 (1)	23 (2)	20 (2)
Histidine	14 (0)	9 (0)	12 (2)	25 (2)	20 (2)	19 (1)	16 (0)	17 (1)
Arginine	412 (9)	395 (10)	387 (50)	375 (17)	454 (27)	405 (20)	432 (2)	449 (19)
Total	2010 (13)	2032 (13)	2476 (278)	2517 (125)	2370 (104)	2212 (108)	2422 (68)	2323 (100)

α-AAA, α-amino adipic acid; α-ABA, α-amino-*n*-butyric acid; β-AiBA, β-amino-isobutyric acid; γ-ABA, γ-amino-*n*-butyric acid.
*Data are mean and SD (in parentheses) of two determinations.

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Chemical constituents in the abdominal muscle of cultured mud crab *Scylla serrata* in relation to seasonal variation and maturation

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ABSTRACT: Seasonal changes in levels of chemical constituents in the abdominal muscle of male and female mud crab *Scylla serrata* were investigated. The gonadosomatic index in the female crab was higher in October and August, of which the muscle yield, glycogen, and total amount of adenosine 5′-triphosphate (ATP)-related compounds (ARC) in the October sample were the highest throughout the year, but the total amount of free amino acids (FAA) was the lowest. The total FAA and individual FAA such as glycine, alanine, and arginine increased in the August and November female samples, while that in the male specimens was higher in January, March, and August. The total ARC in both crabs was lower in the samples collected from winter than in other seasons whereas glycinebetaine was higher in winter and early spring. Glutamic acid, glycine, alanine, arginine, glycinebetaine, and adenosine monophosphate might be responsible for the taste of mud crab. Their level together was relatively higher in the August and January male samples, and in the August and November female specimens. However, the correlation between the taste component content and degree of gonad maturation was low.

KEY WORDS: **crab, extractive component, gonad maturation, *Scylla serrata*, seasonal variation.**

Table 1 Seasonal variations of proximate composition and glycogen in the abdominal muscle of male and female mud crabs

Date of sampling	Body weight† (g)	Carapace width† (cm)	Proximate composition‡ (%) Moisture	Protein	Fat	Ash	Glycogen‡ (mg/100 g)
Male crab							
19 March 1999	280 ± 57	10.4 ± 0.8	80.8 ± 1.0^{abc}	17.1 ± 0.2^{bcd}	0.3 ± 0.1^{a}	1.7 ± 0.2^{b}	122 ± 19^{e}
6 May 1999	302 ± 49	11.0 ± 0.9	82.0 ± 0.9^{ab}	16.4 ± 0.9^{cd}	0.3 ± 0.0^{ab}	1.7 ± 0.1^{b}	90 ± 34^{e}
12 August 1999	295 ± 59	11.1 ± 0.3	80.7 ± 1.2^{abc}	16.5 ± 1.1^{cd}	0.2 ± 0.0^{c}	2.2 ± 0.2^{a}	194 ± 49^{cd}
25 October 1999	250 ± 53	10.9 ± 0.6	78.8 ± 0.8^{c}	19.1 ± 1.2^{ab}	0.2 ± 0.1^{c}	1.5 ± 0.0^{b}	391 ± 11^{a}
22 November 1999	228 ± 41	10.3 ± 0.3	82.5 ± 1.7^{a}	15.8 ± 1.5^{d}	0.2 ± 0.1^{abc}	1.6 ± 0.2^{b}	247 ± 73^{bc}
7 January 7, 2000	348 ± 45	11.5 ± 0.8	79.8 ± 1.2^{bc}	18.1 ± 0.9^{abc}	0.2 ± 0.0^{bc}	1.6 ± 0.1^{b}	288 ± 33^{b}
6 March 2000	286 ± 50	10.9 ± 0.4	78.6 ± 2.2^{c}	19.2 ± 1.0^{a}	0.2 ± 0.0^{bc}	1.6 ± 0.0^{b}	145 ± 8^{de}
Female crab							
19 March 1999	260 ± 15	10.6 ± 0.3	77.6 ± 1.7^{cd}	19.5 ± 0.6^{ab}	0.5 ± 0.1^{a}	1.8 ± 0.0^{b}	297 ± 111^{c}
6 May 1999	242 ± 20	10.8 ± 0.4	81.3 ± 1.2^{a}	16.4 ± 0.7^{d}	0.3 ± 0.1^{b}	1.8 ± 0.3^{b}	181 ± 63^{c}
12 August 1999	260 ± 36	11.0 ± 0.7	75.8 ± 0.5^{d}	20.9 ± 0.7^{a}	0.4 ± 0.1^{bcd}	1.9 ± 0.0^{a}	485 ± 94^{b}
25October 1999	413 ± 56	12.9 ± 0.6	77.9 ± 1.1^{bc}	18.8 ± 1.0^{bc}	0.4 ± 0.1^{b}	1.5 ± 0.1^{c}	882 ± 122^{a}
22 November 1999	353 ± 43	11.8 ± 0.5	79.6 ± 0.9^{abc}	17.9 ± 0.8^{bcd}	0.3 ± 0.1^{d}	1.5 ± 0.0^{c}	274 ± 83^{c}
7 January 2000	265 ± 37	11.1 ± 0.5	80.2 ± 1.7^{ab}	17.4 ± 1.2^{d}	0.4 ± 0.0^{bc}	1.4 ± 0.1^{c}	302 ± 51^{c}
6 March 2000	307 ± 49	11.3 ± 0.4	78.4 ± 2.1^{bc}	18.9 ± 2.0^{abc}	0.4 ± 0.1^{b}	1.4 ± 0.0^{c}	324 ± 64^{c}

†Mean ± SD ($n = 9$).
‡Mean ± SD ($n = 3$). Means in the same column not sharing the same superscripts are significantly different ($P < 0.05$) among different sampling times.

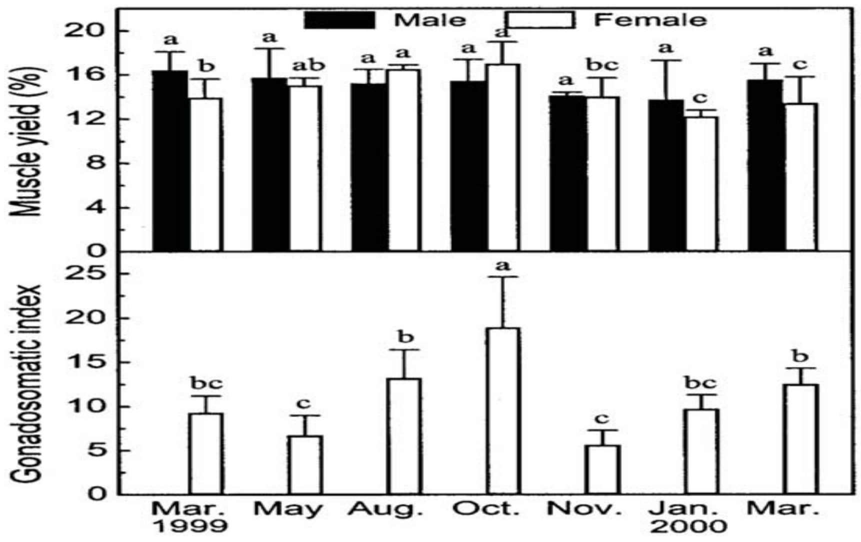


Fig. 1 Seasonal changes in muscle yield and gonadosomatic index of (■) male and (□) female mud crabs. Data are mean and SD ($n = 3$). Different letters indicate significant difference ($P < 0.05$) among different sampling times.

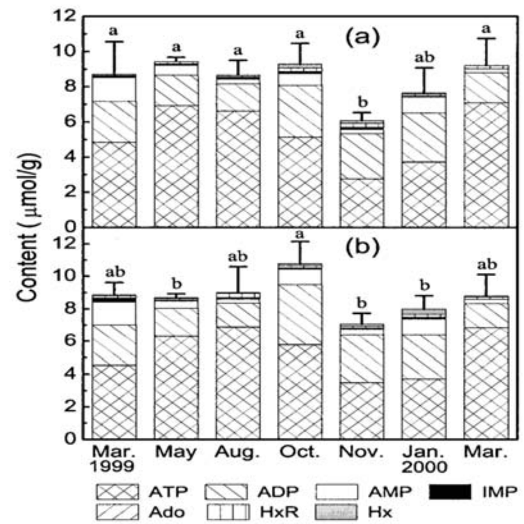


Fig. 2 Seasonal changes in levels of adenosine triphosphate (ATP) and its related compounds in the abdominal muscle of (a) male and (b) female mud crabs. Data are mean and SD ($n = 3$). Bars at the top of each column indicate the SD of the total content. Different letters indicate significant difference ($P < 0.05$) among different sampling times. ADP, adenosine diphosphate; AMP, adenosine monophosphate; IMP, inosine monophosphate; Ado, adenosine; HxR, inosine; Hx, hypoxanthine.

Table 2 Seasonal variations of the major and total free amino acids (mg/100 g) in the abdominal muscle of male and female mud crabs

Amino acids	Date of sampling: 1999 19 March	1999 6 May	1999 12 August	1999 25 October	1999 22 November	2000 7 January	2000 6 March
Male crab							
Taurine	97 ± 29[a]	99 ± 25[a]	83 ± 5[a]	97 ± 32[a]	85 ± 14[a]	85 ± 13[a]	88 ± 30[a]
Glutamic acid	71 ± 4[ab]	57 ± 10[bc]	77 ± 7[a]	74 ± 4[a]	50 ± 6[c]	80 ± 22[a]	52 ± 7[c]
Glutamine	275 ± 76[a]	305 ± 7[a]	244 ± 126[a]	248 ± 21[a]	190 ± 47[a]	291 ± 8[a]	214 ± 15[a]
Proline	296 ± 18[bc]	227 ± 124[c]	169 ± 33[c]	345 ± 84[bc]	327 ± 115[bc]	472 ± 90[ab]	542 ± 169[a]
Glycine	780 ± 44[b]	742 ± 158[b]	986 ± 82[a]	697 ± 10[b]	726 ± 131[b]	825 ± 47[ab]	791 ± 128[b]
Alanine	237 ± 42[ab]	191 ± 8[bc]	259 ± 28[a]	171 ± 26[c]	182 ± 32[b]	273 ± 19[a]	189 ± 20[bc]
Arginine	598 ± 73[a]	615 ± 106[a]	590 ± 35[a]	539 ± 24[a]	547 ± 56[a]	612 ± 64[a]	604 ± 53[a]
Others	328 ± 50[a]	221 ± 68[a]	340 ± 138[a]	231 ± 37[a]	367 ± 56[a]	333 ± 55[a]	320 ± 103[a]
Total	2682 ± 79[abc]	2458 ± 221[bc]	2747 ± 285[abc]	2401 ± 122[c]	2474 ± 273[bc]	2971 ± 92[a]	2800 ± 179[ab]
Female crab							
Taurine	165 ± 20[a]	122 ± 13[bc]	107 ± 13[c]	108 ± 9[c]	116 ± 13[c]	126 ± 9[bc]	151 ± 27[ab]
Glutamic acid	46 ± 1[b]	73 ± 10[a]	45 ± 2[b]	67 ± 8[ab]	61 ± 12[ab]	74 ± 10[a]	63 ± 10[ab]
Glutamine	289 ± 29[abc]	367 ± 74[a]	376 ± 73[a]	203 ± 39[c]	312 ± 33[ab]	256 ± 24[bc]	256 ± 46[bc]
Proline	519 ± 134[abc]	329 ± 37[d]	361 ± 37[cd]	418 ± 97[bcd]	525 ± 47[abc]	572 ± 138[ab]	600 ± 119[a]
Glycine	568 ± 148[b]	484 ± 26[b]	862 ± 79[a]	487 ± 69[b]	554 ± 46[b]	571 ± 158[b]	511 ± 120[b]
Alanine	226 ± 10[abc]	183 ± 26[cd]	278 ± 28[a]	155 ± 35[d]	197 ± 28[bcd]	245 ± 51[ab]	180 ± 10[cd]
Arginine	572 ± 30[b]	534 ± 8[bc]	658 ± 17[a]	463 ± 54[c]	575 ± 23[b]	477 ± 54[c]	527 ± 54[bc]
Others	298 ± 67[b]	374 ± 93[ab]	337 ± 23[b]	234 ± 13[b]	473 ± 150[a]	321 ± 56[b]	270 ± 42[b]
Total	2683 ± 86[bc]	2466 ± 68[c]	3023 ± 203[a]	2134 ± 246[d]	2812 ± 203[ab]	2642 ± 119[bc]	2560 ± 173[bc]

Data are mean and SD ($n = 3$). Means in the same row not sharing the same superscripts are significantly different ($P < 0.05$) among different sampling times.

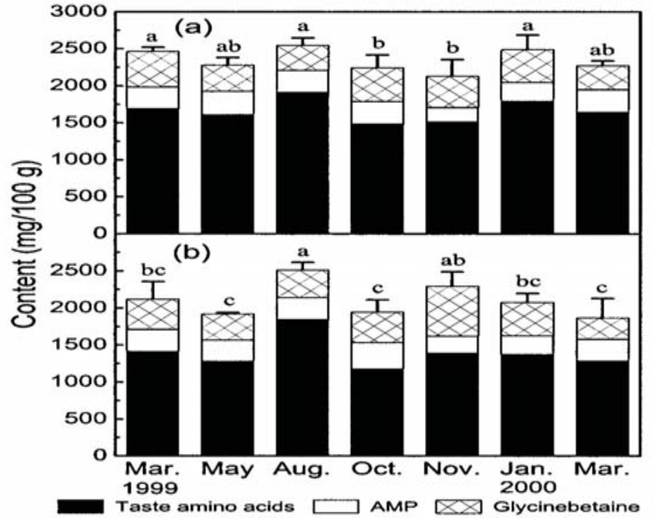


Fig. 4 Seasonal changes in level of taste components in the abdominal muscle of (a) male and (b) female mud crabs. Data are mean and SD ($n = 3$). Bars at the top of each column indicate the SD of the total content. Different letters indicate significant difference ($P < 0.05$) among different sampling times. Taste amino acids: glutamic acid + glycine + alanine + arginine; AMP (adenosine monophosphate): adenosine triphosphate + adenosine diphosphate + AMP + inosine monophosphate.

組織部位

- 魚類－背肉、腹肉；普通肉、血合肉之一般組成的差異
- 萃取物氮：魚類－普通肉＞血合肉
  ★游離胺基酸：魚類 普通肉＞血合肉；
  組胺酸及鵝肌肽的差異更大
  ★肌酸：普通肉＞血合肉
  ★核苷酸成分：普通肉＞血合肉
  ★牛磺酸：血合肉＞＞血合肉

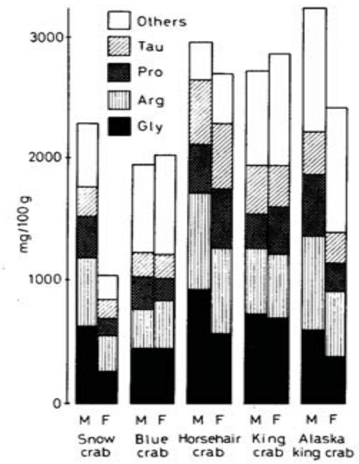


Figure 2. Free amino acids in crab extracts

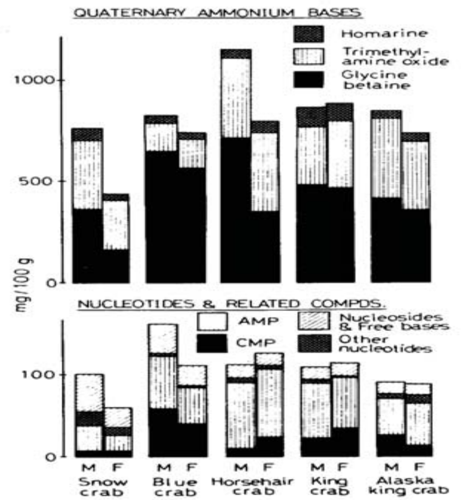
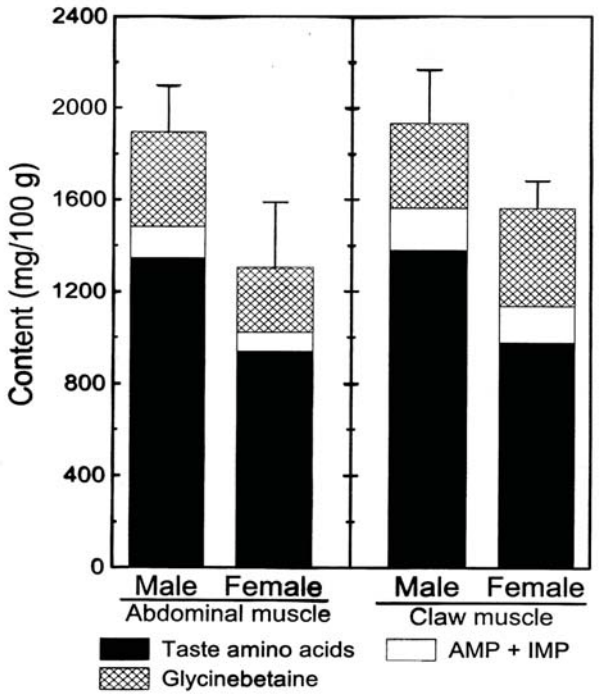
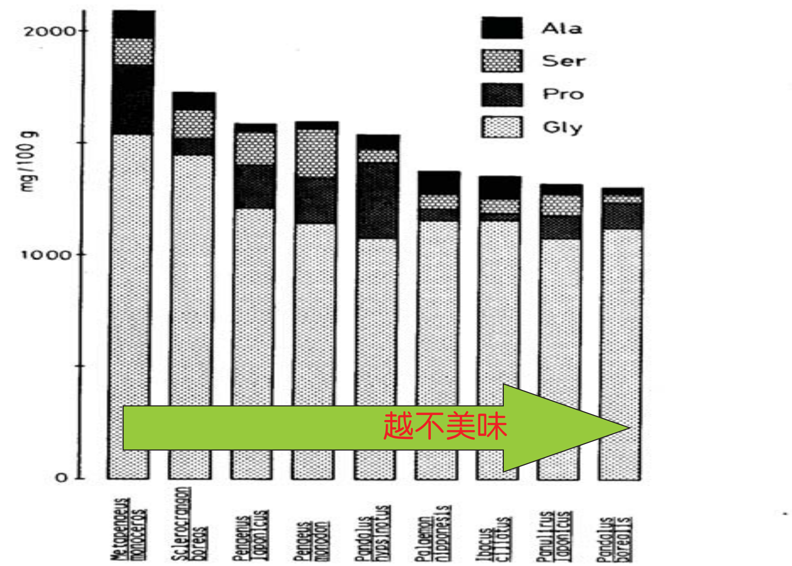


Figure 3. Nitrogenous components in crab extracts



養殖與野生天然魚

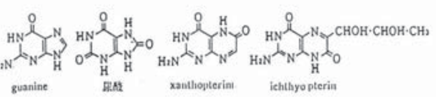
- 影響化學組成之因素
  飼料：飼料組成、異於天然餌料
  運動量：肉質特性
  養殖條件與環境因子
- 天然魚與養殖魚
  脂質含量：天然魚＜養殖魚
  風味：天然魚＞養殖魚
  肉質：天然魚＞養殖魚
- 體色：天然魚＞養殖魚

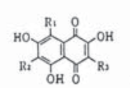


The content of glycine, proline, serine, and alanine in the muscle extracts of prawns and lobsters. They are arranged in decreasing order of palatability from left to right.

魚介類的滋味與萃取物成分

- 對整體滋味（風味）之貢獻或影響程度
  ◎萃取物成分的含量
  ◎呈味特性
  ◎閾值(threshold)
  ◎交互作用(interaction)：相加　相減　相乘
  ◎濃度的相對優勢
- 官能試驗法(sensory test)
  ◎ omission test
  ◎ addition test





	R_1	R_2	R_3
spinochrome A	OH	H	$COCH_3$
spinochrome B	H	H	OH
spinochrome C	OH	OH	$COCH_3$
spinochrome D	OH	H	OH
spinochrome E	OH	OH	OH
echinochrome A	OH	CH_2CH_3	OH

喋呤(pterin)類是類似於嘌呤類之色素化合物，有許多喋呤類具有螢光，螢光色因pH的不同而改變。現在已自鯉魚、鯽魚的鱗及泥鰍的皮膚中分離出黃喋呤(xanthopterin)、鮋喋呤(ichthyopterin)等成分。

自海膽的棘、殼、生殖巢等分離得到而命名爲棘色素(spinochrome)及海膽色素(echinochrome)之紅、紫、藍色的萘醌色素(naphthoquinone)，它們在棘及殼中可能係以鈣鹽或鎂鹽的狀態存在，而在生殖巢中可能以蛋白質複合體的狀態存在。

4-2　魚介類的味

魚介類的風味差異甚大，不同的種類各具有獨特的原味，且一般被視爲美味者爲數不少。今天，之所以廣泛地使用麩胺酸鈉及肌苷酸鈉作爲調味料，實導因於前人對水產物之海帶及柴魚鮮味成分的研究成果。不過，這也和水產物中多美味，及人們經常食用各種水產物有密切關連。

評價食品的美味特性，除眼睛看到的外觀色澤（視覺）、舌頭的觸感（觸覺）、鼻腔聞到的氣味（嗅覺）及牙齒的咀嚼聲（聽覺）等之外，飲食者的健康與生理狀態，甚至飲食習慣、飲食環境等許多的因素均有所影響。由此，若詢及爲何覺得食物鮮美或者不夠美味，欲以科學的見解作一

明確的回答，實非易事。

本節中，爲避免重複第三章3-6 節內容（魚介類肌肉的萃取物成分），主要僅針對會刺激味覺產生之物質（呈味成分）加以闡述[7~10]。

4-2-1　主要的呈味成分

1)　**胺基酸**　魚介類，毫無例外地，其所含的游離胺基酸是呈味成分中最爲重要的成分。胺基酸各有其獨特的風味，而到底在食品中發揮怎樣的呈味作用，基本上是受到各胺基酸的閾值及含量，或者和其它成分之間的相互作用等因素所決定。下面就將截至目前爲止，已經報告過而和魚介類的味道有關的主要胺基酸作一敘述。

麩胺酸　它的一種鈉鹽（麩胺酸鈉，monosodium glutamate, MSG）帶有鮮味(*)之成分。所有的魚介類，沒有例外，都含有麩胺酸，只是含量大多低於MSG的閾值(0.03%)。可是由於和死後魚肉中所蓄積肌苷酸(IMP)之間具有鮮味的相乘作用，因此於肌苷酸並存的情況下，即使含量低於閾值，仍有助於呈味（參見核苷酸項）。

甘胺酸　爲帶有爽快甜味之胺基酸。無脊椎動物，特別是甲殼類及海扇貝貝柱中的含量高，其大部份的甜味即來自甘胺酸。蝦類的美味與甘胺酸的含量之間也關係密切。

* 以麩胺酸鈉(MSG)及肌苷酸(IMP)、鳥嘌呤核苷單磷酸(GMP)等核苷酸鈉鹽所表現出來的味稱爲鮮味。雖然曾有以基本味如甜味、酸味、苦味及鹹味可合成出鮮味之說法，但最近味覺心理學的研究顯示，鮮味乃是上述基本味所無法合成之另一種獨立的味。另外，現在已經知道對麩胺酸鈉具有特異感應之受容體(receptor)，也存在於鯉魚及老鼠的化學感覺器官中，因此，將鮮味視爲基本味之一，乃更爲妥當之看法，此在國際上已逐漸得到認同。
鮮味並非本身即是鮮美的味道，而是鮮味的成分具有提高美味的作用；所以，將鮮味與美味予以區別，有其必要性。「鮮味」(日語爲「うま味」一詞，爲日本人所創，外語中找不到適當的譯詞，所以外國的專家們也就直接使用該詞的日語發音"umami"。

國立台灣海洋大學食品科學系：水產化學授課資料(二)- 萃取物成分組成之影響- 邱思魁1060503

丙胺酸　爲帶有弱苦味之甜味胺基酸。其含量大抵低於甘胺酸，但無脊椎動物中則含相當多的量，在慈愛蟹(snow crab)及海扇貝已確知係提供甜味之成分。

組胺酸　紅肉魚肉中蓄積有多量的這種胺基酸，但有的報告指出它和呈味有關，有的則認爲無關，因此尚未獲得明確的結論。不過有報告指出鰹柴魚中含量很高的組胺酸，和並存的多量的乳酸與磷酸二氫鉀(KH_2PO_4)共同地提高緩衝能，而有增強呈味之作用。由於和組胺酸一樣具有異吡唑基(imidazole group)之鵝肌肽(anserine)，鰹柴魚中亦含有多量，今後，這些成分的呈味作用有必要再詳細地探討。

精胺酸　爲帶有苦味之胺基酸。因而富含精胺酸的魚介類往往被認爲味道不佳，但相反地，含多量精胺酸的無脊椎動物則大多具有美味。探討慈愛蟹及海扇貝貝柱合成萃取物的結果，發現精胺酸並沒發出苦味，反而可增強風味的複雜性及濃厚性，具有提高整體美味之作用。

甲硫胺酸　它雖係苦味的胺基酸，卻是現出海膽的特有風味所不可欠缺的成分。而且有報告指出微量的甲硫胺酸能夠使麩胺酸鈉的呈味感覺更加濃厚。

纈胺酸　報告指出它與海膽特有的苦味有關。

脯胺酸　是帶有苦味之甜味胺基酸。因此有記載稱它對脯胺酸含量豐富的魚貝類的風味有所助益；但是在慈愛蟹合成萃取物的官能試驗結果，即使在每100mℓ中含163mg脯胺酸這種相當多量情況下，對美味仍未能有所幫助。附帶地說，L-脯胺酸的刺激閾值高達0.3%。

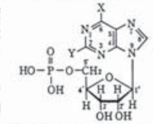
2)　**胜肽**　肌肽(carnosine)被認爲與牛肉萃取物的美味有關；而鰻魚肌肉中亦含有多量之此雙胜肽，但它與鰻魚的風味之間的關係尚無人探討。在鼠鯊肉合成萃取物中研究鵝肌肽(anserine)的結果，加入該胜肽可稍增強酸味及引出濃厚感。Balenine在鬚鯨肉合成萃取物中的官能試驗結果，被認爲具有增強鮮味及濃厚感之作用。由於這3種胜肽在中性酸鹼度附近均具有

苷強緩衝能，其所以引出濃厚感，可能與此性質有關。

3)　**核苷酸**　爲探討鰹柴魚煮汁的鮮味成分，1913年小玉氏分離得到肌苷酸組胺酸鹽，之後並了解其鈉鹽可以呈現相同強度的鮮味。鳥嘌呤核苷單磷酸爲天然食品的鮮味成分一事，係由國中氏於1960年研究香菇的呈味成分時最早發現的，鳥嘌呤核苷單磷酸在乾香菇及松茸中的含量高，魚介類中亦有少量存在。

國中氏的研究並闡明核苷酸的化學構造與鮮味產生之間的關係，即嘌呤基的第6位置上結合羥基和核糖的5'位置上接上磷酸酯，乃產生鮮味之必要條件。肌苷酸、鳥嘌呤核苷單磷酸及5'-黃苷酸(xanthylic acid; XMP)都能符合這個必要件，而腺苷酸(adenylic acid; AMP)則因第6位置上鍵結胺基而幾乎無味。

核苷酸的閾值，$IMP \cdot Na_2 \cdot 7.5H_2O$爲0.025%，$GMP \cdot Na_2 \cdot 7H_2O$爲0.0125 %，都相當低，和麩胺酸鈉所不同的是其鮮味強度不因用量增加而有明顯的提高。是故以核苷酸作爲呈味成分之意義，應是考慮其與麩胺酸鈉之間所產生的鮮味相乘效果。



	X	Y
IMP	OH	H
GMP	OH	NH_2
XMP	OH	OH
AMP	NH_2	H

該兩成分的相乘作用可以$y = u + 1200uv$關係式來表示，u及v分別代表混合液中麩胺酸鈉及肌苷酸的濃度，y則是具有和混合液相同的風味強度之麩胺酸鈉單獨的濃度（g／dℓ）。

麩胺酸鈉和核苷酸間的相乘作用所產生的鮮味，構成魚貝類的主要風味；但有趣的是本身幾乎無味的腺苷酸也能夠增強麩胺酸鈉的鮮味。雖異於蓄積肌苷酸之魚肉，這個事實足以說明蓄積腺苷酸之無脊椎動物肌肉爲何也具有強鮮味之原因。像這樣的麩胺酸鈉和核苷酸間的相乘作用，不僅是人類的感覺，從老鼠的味神經感應也獲得證明，亦即核苷酸結合於味受容膜之後，可提高麩胺酸鈉對受容體的親和力之故。

國立台灣海洋大學食品科學系：水產化學授課資料(二)- 萃取物成分組成之影響- 邱思魁1060503

4)　**次黃嘌呤**　爲具有苦味之嘌呤鹽基，由肌苷酸分解而生成。一般認爲它是造成冰藏鱈魚肉產生苦味之原因。

5)　**甘胺甜菜鹼(glycinebetaine)**　因具有甜味，一般認爲它有助於含量豐富之無脊椎動物肌肉甜味的產生。但是以慈愛蟹肉合成萃取物（100mℓ中含357mg甘胺甜菜鹼）所作的官能試驗，雖承認它對甜味有所助益，但在其含量降爲179mg時，其效果卻沒有太大的影響。另外，在海扇貝貝柱合成萃取物的官能試驗結果，於100mℓ含237mg甘胺甜菜鹼時，其呈味效果並不顯著，惟有趣的是合成萃取物中若再加入甘胺甜菜鹼，則會引出水產物般的香味(seafood-like flavor)。

6)　**氧化三甲基胺**　因具有甜味，一般認爲它能夠對含量高的魚貝類提供甜味，但在慈愛蟹肉合成萃取物（100mℓ中含169mg氧化三甲基胺，TMAO）的官能試驗中，被斷定不具呈味效果；而在鼠鯊肉合成萃取物（100mℓ中含1.12g氧化三甲基胺）的官能試驗中，報告指出氧化三甲基胺之加入可稍增強甜味。從上述的實驗結果，可知氧化三甲基胺唯有存在相當多量時，始能顯現出呈味效果。

7)　**有機酸**　琥珀酸在蜆、蛤、海扇貝等貝類中的含量多，一直被認爲是貝類的重要呈味成分。但琥珀酸係貝類死後或在嫌氣狀態下活存時所蓄積的，剛捕獲的貝類含量低。由於這樣的試料一定就不鮮美，故琥珀酸在呈味上的作用有待檢討。乳酸在鰹柴魚煮汁中係提高緩衝能之要因，一般認爲有增強味道的作用。

8)　**無機成分**　第三章中曾述及無機成分並不屬於一般的萃取物成分，然而鈉、鉀、氯、磷酸根等的離子，特別是鈉及氯離子對於風味的產生非常重要，將於下節舉例說明。

4-2-2　數種魚介類的風味組成

自食品中製造其萃取物，詳細分析其中的組成成份及其含量之後，依照分析結果之組成，混合高純度的試劑，這樣就能夠得到充分再現該食品

原味之溶液，此溶液稱爲合成萃取物(synthetic extract)。從合成萃取物中除去某個成分，然後採用官能試驗來檢討呈味性的變化情形，就能夠了解該成分在呈味上的作用，這樣的方法稱爲刪除試驗(ommision test)。目前解析魚介類風味之構成，即採用此種方法，以下就針對海膽、慈愛蟹及海扇貝等的研究，逐一介紹。

1)　**海膽**　牠的食用部分是生殖腺，除生食或蒸煮後食用，還有鹽醬等加工製品，具有濃厚且獨特的風味。食用海膽包括數種類，其中列爲高級品之馬糞海膽的萃取物成分組成如表4-3所示。根據其組成所製造的合成萃取物，在經過刪除試驗後所得的結果，歸納如下。

表4-3　馬糞海膽生殖腺萃取物的組成（mg／100g濕重）*

牛磺酸	105	苯丙胺酸	79	次黃嘌呤	32.1
天冬胺酸	4	色胺酸	39	鳥嘌呤	5.6
蘇胺酸	68	離胺酸	215	尿嘧啶	8.7
絲胺酸	130	組胺酸	54	胞嘧啶	4.1
麩胺酸	103	精胺酸	316	乙醯丙酸	21.8
脯胺酸	26	氨	14	丙酮酸	1.0
甘胺酸	842	甘胺甜菜鹼	6.8	延胡索酸	0.4
丙胺酸	261	腺苷三磷酸	4.2	乳　酸	15.5
纈胺酸	154	腺苷酸	10.4	蘋果酸	2.0
胱胺酸	12	肌苷酸	2.3	琥珀酸	1.2
甲硫胺酸	47	鳥嘌呤核苷單磷酸	1.9	焦穀胺酸	9.0
異白胺酸	100	尿苷酸	6.7	葡萄糖	193
白胺酸	176	胞苷酸	26.6	pH	6.2
酪胺酸	158	腺嘌呤	1.4		

* 將自150g生海膽製得的萃取物中所含之上述成份溶於500mℓ，並添加0.3%的食鹽。　（小俣，1964）

一般判定爲重要呈味成分者，只包括甘胺酸、丙胺酸、纈胺酸、麩胺酸、甲硫胺酸、肌苷酸及鳥嘌呤核苷單磷酸等7種成分，僅由這些成分調配

國立台灣海洋大學食品科學系：水產化學授課資料(二)- 萃取物成分組成之影響- 邱思魁1060503

而成的混合液，和包含全部的成分所組成的合成萃取物比較，除味道強度稍弱之外，味道的性質非常類似。

這些成分之中，甘胺酸對甜味貢獻很大，丙胺酸亦是如此，但程度上不及甘胺酸。纈胺酸賦與海膽特有的苦味，合成萃取物中若缺少纈胺酸，則味道的強度與性質都顯得大不相同。甲硫胺酸的呈味作用也重要，除去該成分，海膽獨特的風味與餘味均消失，而清淡無味。另外，含量亦高的肝醣，具有使整體的風味更爲調和之作用，合成萃取物中如再加入肝醣，就會產生更類似於天然海膽味的風味；然而僅是肝醣的溶液則是無味的。

2)　**慈愛蟹**　蟹類係許多人喜好的海鮮類之一，其中一般認爲最富美味的雄性慈愛蟹(snow crab)，將其腳肉合成萃取物(表4-4)，採用刪除試驗的結果，計有10種成分被判定在味道的構成上屬於重要者。茲將分別刪除各成分所引起呈味上的變化情形，歸納如下所述。

表4-4　慈愛蟹腳肉合成萃取物的組成（mg／100mℓ）*

牛磺酸	243	胞苷酸	6
天冬胺酸	10	腺苷酸	32
蘇胺酸	14	鳥嘌呤核苷單磷酸	4
絲胺酸	14	肌苷酸	5
肌胺酸	77	線苷二磷酸	7
脯胺酸	327	腺嘌呤	1
麩胺酸	19	腺苷	26
甘胺酸	623	次黃嘌呤	7
丙胺酸	187	肌苷	13
α-胺基-n-丁酸	2	鳥嘌呤	1
纈胺酸	30	胞嘧啶	1
甲硫胺酸	19	甘胺甜菜鹼	357
異白胺酸	29	氧化三甲基胺	338
白胺酸	30	Homarine	63
酪胺酸	19	乳　酸	100
苯丙胺酸	17	琥珀酸	9
鳥胺酸	1	葡萄糖	17
離胺酸	25	核糖	4
組胺酸	8	氯化鈉	259
τ－甲基組胺酸	3	氯化鉀	376
色胺酸	10	磷酸一鈉	83
精胺酸	579	磷酸二鈉	226

* 將自100g煮熟肉製得的萃取物中所含之上述成份溶於100ml，並調整pH爲6.60。刪除試驗時使用2倍稀釋液。　（林等人，1981）

甘胺酸：甜味及鮮味明顯減弱。丙胺酸：甜味稍爲減弱。精胺酸：蟹特有的風味變弱，同時整體的風味也變弱。麩胺酸：鮮味顯著地減弱之外，甜味及蟹般的風味也轉弱。腺苷酸-鳥嘌呤核苷單磷酸：分別使鮮味部份減弱，但若除去全部的核苷酸，則鮮味變成非常弱。鈉離子：甜味及鮮味銳減，蟹般的風味消失；相對地，苦味變強，並成爲不太能接受的味感。鉀離子：呈味變淡且不調和。氯離子：變成幾乎無味，在刪除單一成分所造成風味的變化中，它的變化最大。磷酸根離子：鹹味、甜味及鮮味均稍微變弱。

除此之外，刪除5'-胞苷酸(cytidic acid, CMP)的試驗液，在統計檢定上亦有1%水準的識別性，但所造成風味的變化並不太明確。甘胺甜菜鹼在刪除試驗結果中，被判定無效；惟僅由上述之有效成分所組成的合成萃取物中，若再加入甘胺甜菜鹼（添加試驗，addition test），則有5%水準的識別性，除甜味增加外，一部份品評員並指出能夠感覺出水產物特有的香氣。而包括含量多的牛磺酸、脯胺酸、氧化三甲基胺在內，其它成分均被判定無效；但僅包括上述有效成分之溶液，雖然在味道的性質上類似於包括所有成分組成的合成萃取物，然而其味道的強度只有合成萃取物的80%而已。由此可知那些個別成分雖未單獨對風味有所貢獻，但全部綜合起來就能發揮增強風味的效果。

從以上的結果，慈愛蟹風味之構成如圖4-5 所示，同心圓內圈中諸成分在蟹味的形成上扮演核心的角色；加上外側的成分則變得更近似蟹味；而再加入其它的成分之後，就能夠增強整體的風味。

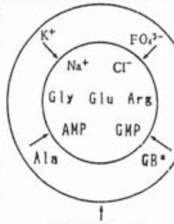


圖4.5 慈愛蟹呈味的構成模式
(*GB:glycinebetaine)

3)　**海扇貝**　貝柱（閉殼肌）作爲生食或加工製成罐頭品及煮乾品（干貝）等，

其甜味強，乃最美味的貝類之一。依其生鮮品的萃取物分析結果而得到的合成萃取物組成，如表4-5 所示，甘胺酸含量特別高為其特徵，而含有多量的精胺酸則與無脊椎動物為共通的性質：此外，腺苷三磷酸的分解產物係以腺苷酸的狀態蓄積，肌苷酸則並未測出。

表4-5 海扇貝貝柱合成萃取物的組成（mg／100mℓ）*

牛磺酸	784	離胺酸	5
天冬胺酸	4	組胺酸	2
蘇胺酸	16	精胺酸	323
絲胺酸	8	腺苷酸二鈉	195
麩胺酸鈉・1分子水	179	肌苷	14
脯胺酸	51	次黃嘌呤	2
甘胺酸	1925	甜菜鹼	339
丙胺酸	256	Homarine・HCl	100
纈胺酸	8	Trigonelline・HCl	40
胱胺酸	8	氧化三甲基胺・2分子水	30
甲硫胺酸	3	三甲基胺鹽酸鹽	31
異白胺酸	2	琥珀酸	10
白胺酸	3	氯化鈉	14
苯丙胺酸	2	磷酸鈉・12分子水	127
β-丙胺酸	2	磷酸鉀	395
鳥胺酸鹽酸鹽	1	pH	6.05

* 將自100g貝柱製得的萃取物中所含之上述成份，溶於100ml。刪除試驗時使用1.4倍稀釋液。

由刪除試驗的結果，甘胺酸、丙胺酸、麩胺酸、精胺酸、腺苷酸、鈉離子、鉀離子及氯離子等8種成分被判定為有效成分，而這些成分在呈味上的作用和上述慈愛蟹的情形大致相同。此外，含量多的牛磺酸在本試驗中亦被判定為無效，甘胺甜菜鹼的呈味效果也不甚明瞭。腺苷酸的呈味作用於前項中已有所敘述，本處的刪除試驗結果再度予以證實，即刪除腺苷酸時，會使鮮味減弱，風味的持續性、複雜性、濃厚性、調和性等下降，而整體美味性的評價也降低。另外，含量多的肝醣之呈味作用，得到和上述海膽同樣的結果。

4-2-3 主要呈味成分的作用

在前述幾種水產食品的呈味成分之研究與其它研究所得到的結果中，須特別強調的是麩胺酸和核苷酸兩種鮮味成分，以及精胺酸與無機成分的作用。

麩胺酸和核苷酸在各種場合中，在風味之構成上均扮演著核心的作用。該兩成分因相乘作用，不僅產生強烈的鮮味，並且賦與持續性及複雜性，促使濃厚性與調和性形成，而在整體的呈味上具有提高美味之作用。精胺酸本身雖帶有苦味，但即使含有相當多量也不會表現出苦味，反而顯示出和上述鮮味成分同樣地具有產生風味的持續性、複雜性及濃厚性等效果之作用，而值得重視。

無機成分，尤其是鈉及氯離子的作用，如前文所述，它們的存在與否，會使得味道受到極大的影響。對於食品的呈味成分，一般常僅顧及有機成分而已，但可以說只有在無機成分並存的狀態下，有機成分所產生的風味才能被有效地發揮出來。

然而，截至目前為止，針對水產無脊椎動物所做的探討，各萃取物中所含的成分在定性上，不論任何種類，均大抵相似，且呈味上判定為有效的成分，如胺基酸之甘胺酸、丙胺酸、麩胺酸及精胺酸，以及核苷酸之肌苷酸、鳥嘌呤核苷單磷酸及腺苷酸等鮮味成分，還有鈉、鉀、氯、磷酸根等離子之無機成分都是共通的成分。但儘管如此，各種食品仍具有獨特的風味之事實，除成分的組成在量上不同之外，可能也包括香氣成分及物性等其它要素的緣故，關於這方面期望今後能再加以研究。

4-2-4 旬（盛產期）

魚介類通常每年有一段時期最為美味，並且漁獲量也很多之時期。此時期稱為「旬」(盛產期)，被認為是最適合食用的時期。「旬」依魚介種類的不同而異，例如，據按田中氏[15]之報告，東京所產魚類的「旬」是：飛魚、鯛魚、蟲鰈等是在春天，鰈、泥鰍、海鰻、梭魚、鰹、黃鰭鮪、紅肉

國立台灣海洋大學食品科學系：水產化學授課資料(二)- 萃取物成分組成之影響- 邱思魁1060503

旗魚、幼鰤、黃條鰤、四破魚、眞鯵、鱸、三線雞魚、青沙鮻、剝皮魚、大眼鮪、六絨鮋、石鰈等是在夏天，眞鰮、秋刀魚、油魣、青花魚、巴鰹等是在秋天，臭肉鰮、鮭、pond smelt、鯰、鯉、鯽、烏魚、馬加鰆、鰤、嘉鱲、比目魚、櫻鰈、鮟鱇等是在冬天。大部分是產卵期之前，正值該時期。在此時期因接近產卵而活潑地攝餌，是大量蓄積脂肪和肝醣作為能量來源之時期。關於肝醣和味道的關係，已如前所述。油脂與食味之關係，可能主要是基於咀嚼感的問題，但是也有個例顯示其含量與食味不一定平行。另外，因為白肉魚的脂肪少，並且全年之間其含量的變動很少，所以也有研究者認為在旬之時期，其呈味成分可能也有增加。事實上，針對東北地方所養殖之眞海鞘的萃取物成分的季節變化所做之調查[16]，結果顯示從初夏至初秋之旬的時期，大部分的游離胺基酸和核苷酸都有增加，萃取物氮量也增加。又，一般認為斑節蝦在冬季因肉質緊縮而成為美味，但此時期據說都蓄積多量的甘胺酸[17]。雖然有這些個例，關於旬和呈味成分量之關係，仍尚未充分研究。

4-3 魚介類的香

氣味(odor)和味道、色澤、物性等都是決定食品評價之要素。食物美味與否或能否食用，常在不自覺中判斷其氣味之後才入口食用，尤其是味道和氣味的關係密切，英語中常使用的〝flavor〞即包含兩者。

魚介類的氣味，如生鮮品的氣味、隨鮮度下降而生成的氣味、調理及加工中生成的氣味等，以及有時生鮮魚介類帶有的異臭。食品的呈味成分在種類上較為有限，但臭氣成分的種類很多，在化學構造上亦分成許多的成分群，甚且比起呈味成分，在極微量時即散發強烈氣味者為數不少。本節中，針對與魚介類的氣味有關的主要揮發性成份，分為胺類、羰基化合物、含硫化合物、其它化合物（醇類、酯類、酚類、碳氫化合物）等項分別予以說明[18~20]。

國立台灣海洋大學食品科學系：水產化學授課資料(二)- 萃取物成分組成之影響- 邱思魁1060503

3. 主要呈味成分的作用

- 在前述幾種水產食品的呈味成分與其它研究所得到的結果中，須特別強調的是麩胺酸與核苷酸兩種鮮味成分，以及精胺酸與無機成分的作用。
- 麩胺酸和核苷酸在各場合，對風味之構成均扮演著核心的作用，該兩成分因相乘作用，不僅貢獻產生強烈的鮮味，並且賦與持續性及複雜性，促使濃厚性與調和性形成，而在整體的呈味上具有提高美味之作用。
- 精胺酸本身雖帶有苦味，但即使含有相當多量也不會表現出苦味，反而顯示出和上述鮮味成分同樣地促進味的持續性、複雜性及濃厚性等效果之作用，而值得重視。

國立台灣海洋大學食品科學系：水產化學授課資料(二)- 萃取物成分組成之影響- 邱思魁1060503

- 無機成分尤其鈉及氯離子的作用，如同在本節中所作的說明，它們的存在有否，會使得味道受到極大的影響。作為食品的呈味成分，一般常僅顧及有機成分而已，但可以說只有在無機成分並存的狀態下，有機成分所產生的風味才能被有效地發揮出來。
- 針對幾種水產物的探討，各主呈味成分的種類都很近似，如胺基酸之甘胺酸、丙胺酸、麩胺酸與精胺酸，核苷酸之IMP、GMP及AMP等鮮味成分，鈉、鉀、氯、磷酸根等離子之無機成分都是共通的成分。
- 儘管如此，各食品仍具獨特的風味實，除成分的組成在含量上不同之外，可能也包括香氣成分及物性等其它要素也有所關聯，期待能再研究。

Taste-active components in five kinds of seafoods (mg/100g)

	Abalone	Sea-urchin	Snow crab	Scallop	Short-neck clam
Glu	109	103	19	140	90
Gly	174	842	623	1925	180
Ala	98	261	187	256	74
Val	37	154	30	8	4
Met	13	47	19	3	3
Arg	299	316	579	323	53
Tau	946	105	243	784	555
AMP	90	10	32	172	28
IMP	–	2	5	–	–
GMP	–	2	4	–	–
Glycinebetaine	975	7	357	339	42
Succinic acid	–	1.2	9	10	65
Na^+	NA	NA	191	73	244
K^+	NA	NA	197	218	273
Cl^-	NA	NA	336	95	322
PO_4^{3-}	NA	NA	217	213	74

Taste-active components in dried skipjack and salted salmon eggs (mg/100g)

	Dried skipjack	Salted salmon eggs		Dried skipjack	Salted salmon eggs
Glu	23	18.6	TMA	19	2
Lys	29	9	Creatinine	1150	–
His	1992	2.1	Lactic acid	3415	–
Carnosine	107	2.8	Glucose	6	8.4
IMP	474	2.7	Na^+	434	117
HxR	186	7.8	K^+	688	19
Adenosine	–	4.2	Cl^-	1600	106
Guanosine	–	4.3	PO_4^{3-}	545	33
Uracil	–	3.1			