FREE AMINO ACIDS AND PROTEIN CONTENT IN PELAGIC AND DEMERSAL EGGS OF TROPICAL MARINE FISHES

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Introduction

The content of free amino acids (FAA) in newly spawned marine fish eggs vary in proportion to egg size (Rønnestad & Fyhn, 1993). However, accumulating evidence suggests that the relative size of the FAA pool also is correlated to the spawning behaviour of the fish species, *i.e.* whether the eggs are demersal or pelagic. The pool of FAA in pelagic eggs seems to be markedly larger than that of demersal eggs. This observation may be related to the role of FAA in the process of final oocyte hydration; a function that appears to be more important in marine fishes with pelagic eggs (Thorsen & Fyhn, 1995). This final swelling of the oocyte seems to result from an osmotic water influx due to the hydrolysis of a specific yolk protein (Fyhn, 1993; Thorsen & Fyhn, 1995).
Most of our understanding of the roles served by FAA during fish embryogenesis is based on species from boreal waters (Rønnestad & Fyhn, 1993; Finn et al, 1995a,b). To increase the database in this area, a comparative study was therefore undertaken on newly spawned eggs of 23 species of marine tropical fishes belonging to 8 families from 5 different suborders of Perciformes. This report summarises the first results from the study.

Results and discussion

A comprehensive statistical evaluation of the data from the egg material is currently in progress. This analysis will also include other parameters (oil globule volume, yolk volume, dry weight, energy content, lipid classes and total fatty acids).

The data on FAA and protein contents (Table I, Figure 1) show that the pelagic eggs were characterised by a high total content of FAA, and with the pool profile spread out on several amino acids. The protein content was on average about 30% of the egg DW although the variation was substantial. The three species belonging to the suborders of Acanthuroidei and Percoidei had relative egg DWs which were markedly higher than that of the pelagic eggs from the suborder Labroidei. Differences in chorion solubility in the 1 M NaOH used in preparing the eggs for protein analysis, may partly be responsible for the variation in protein content among the pelagic eggs (Fyhn & Govoni, 1995). The FAA represented about a third of the total amino acid content (sum of protein-bound and free amino acids) in the pelagic eggs, thus supporting the notion that marine pelagic fish eggs in general contain a large pool of FAA (Rønnestad and Fyhn, 1993).

The demersal eggs showed a significantly higher protein content, about 45% of egg DW, but a FAA pool which ,in total, amounted to only about 8% of that in the pelagic eggs. The FAA

Table 1. Egg weight, free amino acid (FAA) and protein content of newly spawned eggs of 23 species of marine tropical fish all belonging to the order Perciformes. The data are presented as mean (± SD) of five batches from separate females.

Suborder	Family	Species	Egg	DW (µg/ind)		total FAA (µmol/gDW)		total FAA (mg/gDW)		% of FAA Ess	% of FAA Non-ess	Protein (mg/gDW)		FAA % of tot AA*
Blennioidei	Blenniidae	*Ophioblennius atlanticus*	D	30,2	(2,3)	150,2	(15,8)	19,1	(1,8)	18,1	77,4	430,1	(62,3)	4,3
Gobioidei	Gobiidae	*Corypheopterus dicrus*	D	13,3	(1,1)	94,0	(22,1)	12,0	(2,8)	20,9	75,9	492,1	(61,6)	2,4
Gobioidei	Gobiidae	*Coryphopterus personatus*	D	9,6	(0,4)	121,8	(15,8)	15,4	(2,0)	16,3	81,6	518,5	(39,2)	2,9
Percoidei	Pomacentridae	*Abudefduf saxatilis*	D	47,5	(3,5)	66,0	(16,3)	8,5	(2,5)	14,3	82,2	509,2	(103,2)	1,7
Percoidei	Pomacentridae	*Abudefduf troschelii*	D	36,6	(2,4)	42,9	(10,0)	4,2	(2,4)	13,2	76,3	495,0	(26,7)	1,1
Percoidei	Pomacentridae	*Chromis atrilobata*	D	14,9	(1,4)	47,9	(19,5)	5,3	(2,2)	8,7	86,8	524,3	(27,5)	1,0
Percoidei	Pomacentridae	*Chromis multilineata*	D	18,6	(1,4)	71,3	(10,5)	8,2	(1,1)	10,8	87,7	498,1	(36,4)	1,6
Percoidei	Pomacentridae	*Microspathodon chrysurus*	D	28,8	(1,2)	93,1	(12,3)	12,4	(1,4)	10,3	89,8	429,0	(9,3)	2,8
Percoidei	Pomacentridae	*Stegastes planifrons*	D	27,1	(6,0)	139,2	(28,3)	17,7	(3,7)	20,8	79,2	391,8	(17,2)	4,3
Percoidei	Pomacentridae	*Stegastes variabilis*	D	29,5	(3,2)	113,2	(24,9)	14,6	(3,3)	16,3	83,7	380,8	(25,8)	3,7
Acanturoidei	Acanthuridae	*Acanthurus coeruleus*	P	11,3	(0,1)	900,3	(165,0)	112,2	(21,1)	49,4	50,1	377,5	(5,6)	22,9
Percoidei	Chaetodontidae	*Chaetodon capistratus*	P	14,3	(2,3)	712,8	(322,6)	59,0	(55,3)	50,0	49,6	426,5	(49,6)	18,0
Percoidei	Haemulidae	*Haeumulon flavolineatum*	P	24,3	(0,6)	263,9	(200,5)	33,1	(24,8)	50,7	47,7	542,9	(29,4)	5,6
Labroidei	Labridae	*Bodianus diplotaenia*	P	13,3	(1,9)	1 458,9	(227,7)	186,3	(29,6)	56,4	43,3	215,1	(38,7)	47,2
Labroidei	Labridae	*Bodianus rufus*	P	19,9	(0,5)	1 518,2	(7,8)	193,4	(8,3)	55,6	44,1	301,0	(27,0)	39,2
Labroidei	Labridae	*Clepticus parrae*	P	13,4	(1,6)	1 321,1	(188,0)	169,4	(23,3)	55,3	44,2	280,9	(35,7)	37,7
Labroidei	Labridae	*Halichoeres bivittatus*	P	8,3	(1,4)	1 150,5	(132,3)	148,5	(17,7)	57,2	42,8	210,6	(15,1)	41,4
Labroidei	Labridae	*Halichoeres garnoti*	P	11,6	(0,9)	1 233,1	(117,0)	158,5	(15,2)	57,9	41,8	298,3	(24,9)	35,6
Labroidei	Labridae	*Halichoeres poeyi*	P	8,4	(2,2)	1 154,2	(88,8)	150,5	(10,4)	57,4	41,8	235,1	(15,2)	39,5
Labroidei	Labridae	*Thalassoma bifasciatum*	P	4,6	(0,4)	1 396,4	(56,5)	178,9	(9,1)	55,2	44,0	194,6	(10,0)	47,9
Labroidei	Scaridae	*Scarus iserti*	P	12,5	(1,5)	1 178,3	(53,6)	125,8	(62,0)	52,3	47,3	235,7	(17,2)	39,1
Labroidei	Scaridae	*Sparisoma aurofrenatum*	P	17,8	(8,2)	1 499,9	(140,4)	161,5	(80,7)	52,0	48,0	215,4	(26,4)	47,4
Labroidei	Scaridae	*Sparisoma rubripinne*	P	11,3	(1,6)	1 264,1	(76,3)	165,6	(9,7)	52,6	47,4	224,6	(10,7)	42,4

D: Demersal eggs

P: Pelagic eggs

**: FAA as % of total amino acids (AA: free+ protein amino acids) comprised only 2-3% of the total amino acid content in the demersal eggs, and the pool profile was strongly dominated by a single amino acid. These findings are in line with earlier observations on demersal fish eggs from boreal waters (Thorsen, 1995).

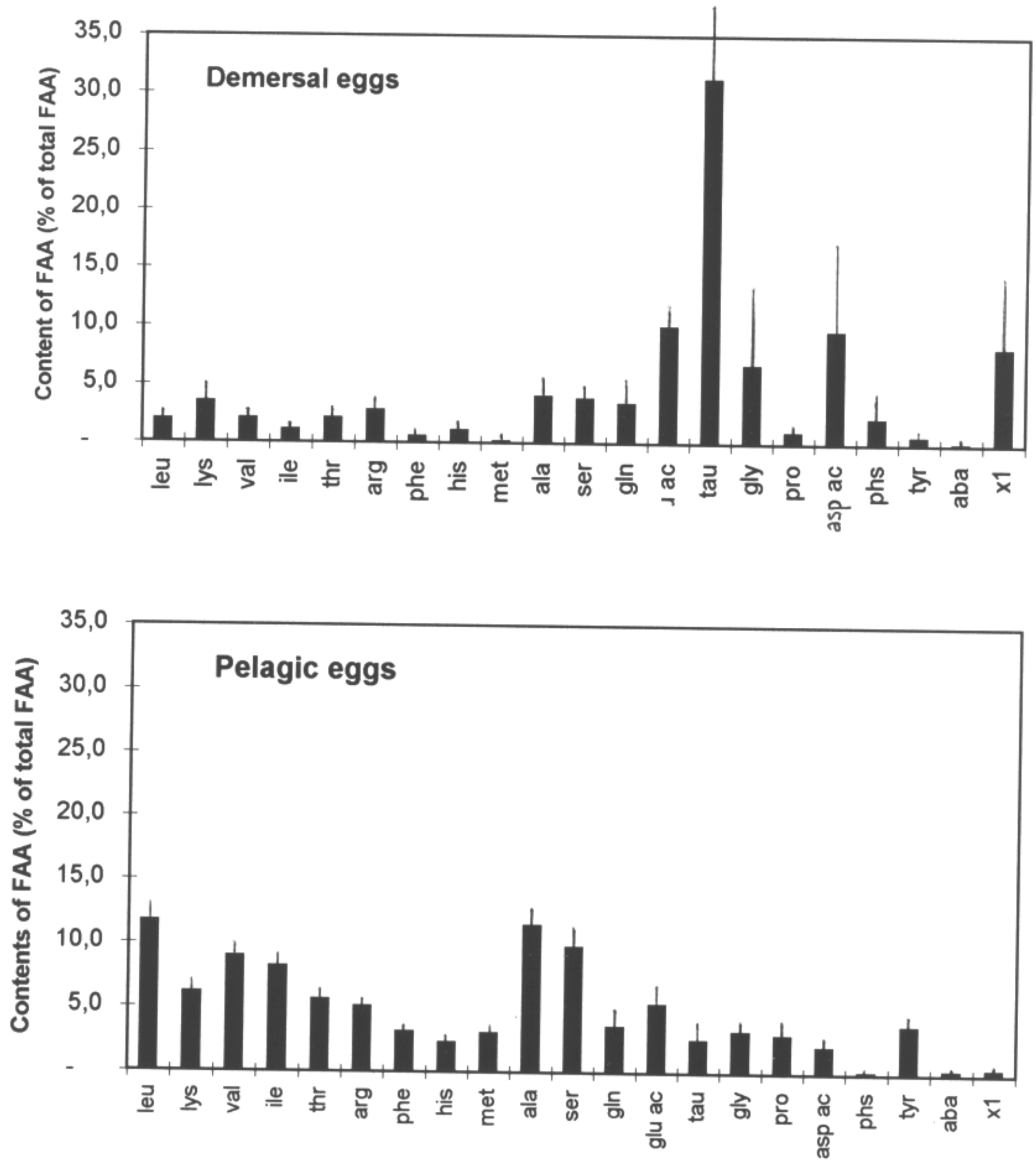

Figure 1. Average free amino acid content of newly spawned demersal and pelagic eggs of 23 species of marine tropical fish all belonging to the order Perciformes.

The FAA profiles (Fig. 1) showed the pelagic eggs to have similar pool composition and to be in agreement with the previously described profile of pelagic eggs from boreal fishes (Rønnestad and Fyhn, 1993). Essential and non-essential amino acids made up about equal proportions of the pool. Leucine, valine, and isoleucine dominated among the essential amino acids whereas alanine and serine dominated among the non-essentials. The similarity of the FAA profile among all teleosts tested so far suggests that this reflects an phylogenetically ancient and central process in their adaptation to life in seawater. The FAA profile of the demersal eggs differed strongly from that of the pelagic eggs. Moreover, the demersal eggs had a more variable FAA pool, and essential amino acids accounted only for about 15% of the FAA. Taurine which is not incorporated into proteins, was the dominating amino acid in the FAA pool of the demersal eggs suggesting influx and not proteolysis to be the mechanism of accumulation in these eggs before spawning.

Conclusions

The notion that pelagic marine fish eggs contain a large pool of FAA is further strengthened, and pelagic eggs of tropical fishes are not different from those of boreal fishes in this respect. The similarity of the FAA pool in these eggs supports the idea that the pool originates from hydrolysis of a single yolk protein, and that this is a primitive trait among marine fishes, central in their adaptation to life in the sea. The difference between pelagic and demersal eggs with respect to FAA and protein content is so clear cut that it can be used as a diagnostic tool to discriminate between randomly collected eggs of the two types.

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