

Composition of the Edible Portion of Raw (Fresh or Frozen) Crustaceans, Finfish, and Mollusks. IV. Vitamins

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ABSTRACT—*This report summarizes data from 157 publications referring to the vitamin content of commonly eaten seafoods. Included are references to vitamins A, D, and E, choline, ascorbic acid, inositol, biotin, thiamin, riboflavin, niacin, pyridoxine, folic acid, vitamin B₁₂, and pantothenic acid.*

INTRODUCTION

In Part I, Sidwell et al. (1974) described the data bank being established at the Southeast Fisheries Center College Park Laboratory¹ of the National Marine Fisheries Service, NOAA, College Park, Md. The objectives of the data bank project are: 1) To develop a comprehensive, systematic data retrieval system containing available information on the chemical and nutritional composition of fish and fishery products; 2) to publish information on the nutrients found in fishery products based on a wide survey of the literature and 3) to point out aspects of chemical composition of fish which need further investigation. Part I also summarized the data on the content of protein, fat, moisture, ash, carbohydrate, energy (calories), and cholesterol in commonly eaten seafoods.

In Part II, Sidwell et al. (1977) reviewed the data on the concentration of sodium, potassium, calcium, phosphorus, chlorine, and magnesium found in edible portions of seafood.

In Part III, Sidwell et al. (1978) as-

sembled the data from literature on the concentrations of various microelements (trace elements) in seafood.

This paper, Part IV, summarizes the data on the various vitamins in fish and shellfish muscle. There is a need in the medical community for such information, e.g., in the evaluation of nutritional aspects and in the calculation of special diets. Industry can use the data to encourage the use of nutritional labeling. And the nutrition-conscious consumer wants to know the nutritional aspects of fish.

RESULTS AND DISCUSSION

In this report we assembled, from 157 references, data on the vitamins present in the flesh of 140 different species of aquatic animals.

The averages and ranges for each vitamin were calculated from the data reported by various investigators. These data were in the form of an average based on multiple determinations, or were reported as individual values from which an average could be calculated. Regardless, only averages were used to calculate the overall average, standard error of the mean, and range appearing in Tables 1 and 2. With the aforementioned statistics is the number of aver-

ages used to make the statistical calculations.

A limited number of analyses are available for many species of finfish or shellfish listed in Tables 1 and 2. A number of commonly caught species have not been analyzed for vitamin content. Wherever the information for a specific fish and/or vitamin is limited, the recorded value should be regarded only as an estimate of what can be expected. More data are necessary to obtain a value that has a higher degree of reliability.

As noted in Tables 1 and 2, the range of values for each of the vitamins in the flesh of the same species of animal is quite large. A portion of this variation within each species is undoubtedly associated with seasonal and biological differences, e.g., size of the animal, its age, sex, degree of sexual maturation, and method of handling the fish after it left the water and before the flesh was analyzed for the various vitamins. Also, some of the variation may be related to the technique used in the preparation of the sample before it is analyzed or the method of analysis used by the investigator.

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Table 1 lists the values for the fat-soluble vitamins A, D, and E, and the water soluble vitamins choline, ascorbic acid, inositol, and biotin. The amount of vitamin A in the flesh is associated with the amount of fat present in the flesh. Dark flesh is higher in fat than the light; therefore, there is more vitamin A in the dark meat. Vitamin A is not synthesized by the aquatic animal, but is derived from the carotene in its foods. If the whole mollusk is used in the analyses, the amount of vitamin A will be influenced by the plankton in the intestinal tract of the animal.

So little data are reported on the amount of vitamin E present in the flesh of finfish or shellfish that no conclusion can be made. There is little evidence that more vitamin E is present in the flesh of the fatty fish.

The information on the three B-vitamins—choline, inositol, and biotin—is minimal. As noted in Table 1, raw fish flesh does contain varying amounts of vitamin C. In some fish, the amounts are large enough that one serving (100 g or 3.5 ounce) will make a sizable contribution to a person's daily requirement, ranging from 30 mg to 100 mg depending upon a person's body size.

Of the B-vitamins listed in Table 2, riboflavin and niacin are present in significant amounts; therefore, a serving of fish will contribute considerably to a person's daily needs. Thiamin content is found in notably lesser amounts. Mollusks, especially oysters, are rich in Vitamin B₁₂.

The data summarized in this report will provide the medical community with an estimate of the various vitamins found in seafoods for the calculations of special diets. The information will be also appreciated by those concerned with consumer education.

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Table 1.—Composition of the edible portion of raw (fresh or frozen) crustaceans, finfish, and mollusks. IV. Vitamins: A, D, E, choline, ascorbic acid, inositol, and biotin.

	A (I.U.)	D (I.U.)	E (mg)	Choline (mg)	Ascorbic acid (mg)	Inositol (μ g)	Biotin (μ g)	References
----- per 100 g -----								
Abalone Haliotidae spp.	61							64
	1							
Amberjack and yellowtail <i>Seriola</i> spp.	11 \pm 11 20-22 32	27 \pm 27 0-53 2	0.2 \pm 0 0.1-0.2 5	59 1	2.0 \pm 0.4 1.0-2.8 4			48, 55, 61, 62, 80, 103
Anchovies Engraulidae spp.	635							33
	1							
Barracudas Sphyrnidae spp.	51 \pm 7 40-62 3							57
Basses, sea Serranidae spp.	129 \pm 36 61-184 3							33, 57
Breams and porgies Sparidae spp.	53 \pm 31 7-144 4			31 \pm 4 18-39 3	2.9 \pm 0.5 0.4-1.7 4			33, 57, 61, 80, 82
Butterfishes Stromateidae spp.	182							69
	1							
Carp Cyprinidae spp.	262 \pm 127 29-1,020 8		630 1	2.0 \pm 0.4 0.6-3.1 6	18.5 \pm 6.9 0-160 24	8,894 \pm 823 7,585-11,000 4		36, 55, 57, 61, 62, 67, 81, 83, 87, 122, 130, 140
Catfishes, airbreathing Clariidae spp.	633							33
	1							
Catfishes, freshwater Ictaluridae spp.		500 1			9.3 \pm 1.9 6.0-12.5 4	6,620 1		36, 122, 130
Catfishes, sea Ariidae spp.	96				7.8 \pm 3.9 0-11.7 3			33, 36, 83, 122
	1							
Characins Characidae spp.					0 \pm 0 0-0 2			27
Cichlids Cichlidae spp.	58 \pm 41 17-99 2				1.0 1			6, 33, 80
Clams, mactra Mactridae spp.	33							80
	1							
Clams, razor Solenidae spp.	64 \pm 47 17-110 2							80, 81
Clams, Veneridae Veneridae spp.	1,124 \pm 237 887-1,360 2				14.2 \pm 1.1 13.1-15.2 2			33, 44, 114
Clams Miscellaneous species	370 \pm 172 11-1,317 7	4.4 \pm 4.4 0-8.8 2	0.5 \pm 0.2 0-0.9 4	58 \pm 0 58-58 2	11.2 \pm 3.6 2.0-30.0 7		2.3 1	1, 7, 33, 36, 40, 64, 78, 80, 86, 101, 103
Codfish Gadidae spp.	25		0.2 \pm 0 0.2-0.2 2				1.2 \pm 0.7 0.2-2.6 3	1, 16, 19, 67, 86
	1							
Crabs Mixed species	5,115 \pm 3,755 1,360-8,870 2				7.7 \pm 5.4 2.2-13.1 2			33, 44, 85, 114
Cusk <i>Brosme brosme</i>							2.5 \pm 2.0 0.5-4.5 2	16, 19
Cusk eels and brotulas Ophidiidae spp.							0.1 1	141

Table 1.—Continued.

	A (I.U.)	D (I.U.)	E (mg)	Choline (mg)	Ascorbic acid (mg)	Inositol (μ g)	Biotin (μ g)	References
	per 100 g							
Cuttlefishes					2.3±0.7			42, 79, 80, 97,
Miscellaneous species					0.9-5.3			113, 147
					6			
Dace					1.0			87
Cyprinidae spp.					1			
Dolphins	179±154							55, 80
Coryphaenidae spp.	26-333							
	2							
Drums	199±155				10.2±3.9			4, 36, 57, 69,
Sciaenidae spp.	31-508				2.5-14.1			85, 122
	3				3			
Eels, conger					1.0			42
Congridae spp.					1			
Eels, freshwater	3,295±764	200			1.0±0.8			8, 30, 36, 61,
Anguillidae spp.	1,500-5,700				0.2-1.7			67, 80, 81, 96
	6	1			2			
Eels, snake	17							80
Ophichthidae spp.	1							
Eels, swamp	62±19							33, 80
Flutidae spp.	43-81							
	2							
Flounders, lefteye	335±182	43	140		1.0	7,519±609		48, 57, 62, 80, 130
Bothidae spp.	114-695				1	6,015-8,520		
	3	1	1		1	4		
Flounders, righteye	48±13	60	0.4		1.0±1.0		1.2	1, 3, 48, 80, 83, 111
Pleuronectidae spp.	34-73				0.0-2.0		1	
	3	1	1		2			
Goatfishes	104							33
Mullidae spp.	1							
Gobies	891				0.5±0			6, 33, 42
Gobiidae spp.	1				0.5-0.5			
					2			
Greenlings	0							7
Hexagrammidae spp.	1							
Grunts	136							57
Pomadasyidae spp.	1							
Gurnards, flying	59				0.0			27, 57
Dactylopteridae	1				1			
Haddock	50				0.0		2.6±2.3	13, 19, 86, 138
<i>Melanogrammus aeglefinus</i>	1				1		0.2-4.8	
							2	
Hake					1.0			35
Gadidae spp.					1			
Halibut	440	44			0.0	8,350±5,407	8.1±1.5	9, 26, 83, 130
Pleuronectidae spp.						1,400-19,000	6.6-9.5	
	1	1			1	3	2	
Herrings	814±620	1,627			9.0±3.8	9,590		8, 35, 69, 78,
Clupeidae spp.	100-4,531				0.0-27.7			81, 83, 88, 89,
	7	1			9	1		95, 122, 130
Jacks	125±53				3.3			33, 61
Carangidae spp.	72-177				1			
	2							
Lampreys	30,060±6,584	260±140						36, 51, 148
Petromyzontidae spp.	9,060-44,300	120-400						
	6	2						

Table 1.—Continued.

	A (I.U.)	D (I.U.)	E (mg)	Choline (mg)	Ascorbic acid (mg)	Inositol (μ g)	Biotin (μ g)	References
	per 100 g							
Lings <i>Molva</i> spp.							1.1 \pm 0.1 1.0-1.2 2	16
Lizardfishes <i>Synodontidae</i> spp.					3.0 1			80
Lobsters and crayfishes Mixed species	17 1				3.0 \pm 0.9 0.0-5.0 6		5.0 \pm 0.2 4.8-5.2 2	42, 78, 80, 83, 86, 87
Mackerels <i>Scombridae</i> spp.	107 \pm 40 0-711 17	1,036 \pm 273 143-2,000 6		11.1 \pm 4.4 2.5-29.2 6	3.0 1	8,060 1		5, 8, 15, 33, 48, 57, 58, 67, 80, 81, 89, 95, 130
Milkfishes <i>Chanidae</i> spp.	537 \pm 137 400-673 2							33, 80
Minnows <i>Cyprinidae</i> spp.	79 1							57
Mojarras <i>Gerreidae</i> spp.	62 1							33
Mussel <i>Mytilidae</i> spp.	1,226 \pm 1,193 33-2,418 2		0.5 \pm 0 0.4-0.6 3		4.1 \pm 1.4 1.1-9.0 6			15, 33, 36, 42, 53, 80
Octopuses Mixed species					0 1			83
Oysters <i>Ostreidae</i> spp.	273 \pm 36 170-366 5	40 1			10.7 \pm 5.4 0-38.1 7		41 \pm 31 10-72 2	33, 42, 46, 78, 80, 81, 83, 86, 95, 145
Perches <i>Percidae</i> spp.					1.2 \pm 0.0 1.1-1.2 2			87
Perches, climbing <i>Anabantidae</i> spp.	218 1							80
Plaice <i>Pleuronectidae</i> spp.							90 1	19
Pollock <i>Gadidae</i> spp.	32 1						3.7 \pm 2.4 1.3-6.1 2	3, 16
Pompanos <i>Carangidae</i> spp.	5.1 1				0.0 1			4, 27
Sardines and pilchards <i>Clupeidae</i> spp.	156 \pm 51 50-303 5	2,310 \pm 873 532-5,400 5						15, 33, 48, 103, 140
Sauries <i>Scomberesocidae</i> spp.	1,551 \pm 1,493 58-3,044 2				2.0 1			57, 80
Sawfish <i>Pristidae</i> spp.					0.0 1			83
Scad and mackerels <i>Carangidae</i> spp.	60 \pm 33 11-122 3		0.4 1		1.4 \pm 0.6 0.8-2.0 2			33, 35, 48, 57, 62, 80
Scallops <i>Pectinidae</i> spp.	0 1				3.0 1		0.3 1	78, 86
Sea chubs <i>Kyphosidae</i> spp.	19 1							57

Table 1.—Continued.

	A (I.U.)	D (I.U.)	E (mg)	Choline (mg)	Ascorbic acid (mg)	Inositol (μ g)	Biotin (μ g)	References
	----- per 100 g -----							
Sea cucumbers Mixed species					0.0 1			40
Sea robins Triglidae spp.					1.0 1			42
Shad Clupeidae spp.	138 1							33
Sharks, dogfish Squalidae spp.	797 \pm 211 114-1,600 8	15 1						8, 49
Sharks Miscellaneous species			270.0 1		0.0 1			27, 62
Sheathfishes Siluridae spp.	67 1							80
Shrimp and prawns Mixed species	108 \pm 35 20-297 8	150 \pm 0 150-150 2			1.5 \pm 0.6 0.0-3.0 5	542 \pm 319 4-2,400 7	1.0 1	5, 15, 27, 33, 36, 64, 76, 78, 80, 81, 83, 86, 98
Silversides Atherinidae spp.					1.0 1			83
Smelts Osmeridae spp.	96 1				1.4 \pm 1.4 0.0-2.8 2			57, 61
Snails Mixed species	83 1				15.0 1			80, 118
Snappers Lutjanidae spp.	187 1				0.3 1			65, 69
Snooks Centropomidae spp.					0.0 1			83
Soapies Leiognathidae spp.	33 1							80
Soles Pleuronectidae spp.	39 1							3
Spadefishes Ephippidae spp.	98 1							33
Squid Mixed species					4.9 1			113
Surfperches Embiotocidae spp.	62 \pm 17 45-79 2							57
Surgeonfishes Acanthuridae spp.					1.3 1			61
Therapons Theraponidae spp.	29 1							57
Threadfins Polynemidae spp.	172 1			8.0 \pm 0.0 8.0-8.0 2				10, 12, 69
Tilefishes Branchiostegidae spp.	17 1					6,350 1		80, 130

Table 1.—Continued.

	A (I.U.)	D (I.U.)	E (mg)	Choline (mg)	Ascorbic acid (mg)	Inositol (μ g)	Biotin (μ g)	References
per 100 g								
Trout, salmon Salmonidae spp.	173 \pm 49 3-600 17	360 \pm 107 30-1,200 12			7.1 \pm 1.9 1.3-9.0 4	19 1	3.7 \pm 1.4 0.9-5.3 3	7, 8, 9, 15, 19, 26, 46, 53, 55, 78, 81, 86, 89, 95, 120
Trout, trout Salmonidae spp.	41 \pm 28 13-69 2			87 1	1.1 \pm 1.1 0.0-2.2 2			31, 53, 83, 111
Tuna Scombridae spp.	129 \pm 66 0-963 14	1,125 \pm 307 700-2,000 4		37 1	2.6 \pm 1.2 0.0-10.7 9		1.5 1	8, 15, 27, 33, 39, 46, 57, 69, 78, 80, 83, 86, 89, 95, 102
Turbon Turbanidae spp.	233 1				2.0 1			80
Turbots Pleuronectidae spp.	39 1							3
Whales <i>Physeter macrocephalus</i>	267 1							15
Whitings Sillaginidae spp.	54 \pm 54 0-107 2							33, 36
Wrasses Labridae spp.	48 1							57

¹Average of the means.²Range of the means.³Number of mean values.Table 2.—Composition of the edible portion of raw (fresh or frozen) crustaceans, finfish, and mollusks. IV. Vitamins: Thiamin, riboflavin, niacin, pyridoxine, folic acid, B₁₂, and pantothenic acid.

	Thiamin (μ g)	Riboflavin (μ g)	Niacin (mg)	Pyridoxine (μ g)	Folic acid (μ g)	B ₁₂ (μ g)	Pantothenic acid (μ g)	References
per 100 g								
Abalone Haliotidae spp.	¹ 210 \pm 30 ² 180-240 ³ 2	85 \pm 27 56-140 3	1.4 \pm 0.1 1.2-1.6 3	0.6 1		0.7 1	2,300 \pm 0 2,300-2,300 2	50, 64, 80, 81, 100, 151
Amberjacks and yellowtails <i>Seriola</i> spp.	115 \pm 33 27-180 4	84 \pm 17 40-120 4	8.3 \pm 8 6.8-10 4		3.5 \pm 0.3 3.2-3.7 2	4.2 \pm 1.4 1.3-5.6 3	598 \pm 3 595-600 2	2, 50, 64, 80, 85, 102
Anchovies Engraulidae spp.	19 \pm 7 8-37 4	104 \pm 24 79-152 3	3.1 \pm 0.4 2.3-3.5 3	181 \pm 27 144-260 4	12.3 1	6.3 \pm 0 6.3-6.3 2		44, 64, 66, 80, 84, 85, 93, 111, 116, 134, 153
Augar shells <i>Terebralia aulacatua</i>					21.1 1	12.6 1	60 1	80
Barracudas Sphyraenidae spp.	92 \pm 21 44-134 4	70 \pm 11 27-90 5	4.1 \pm 0.6 2.4-5.9 5	350 \pm 101 150-470 3	11.9 1	1.4 \pm 0.4 0.2-1.8 4		64, 80, 82, 85, 88, 150, 153, 154
Basses, sea Serranidae spp.	79 \pm 13 20-170 14	114 \pm 33 35-374 13	2.4 \pm 0.4 1.1-4.3 12	300 1	8.8 1	5.0 \pm 2.4 0.3-9.1 4	7,530 1	3, 19, 27, 43, 44, 64, 65, 80, 82, 85, 130
Basses, temperate Percichthyidae spp.	100 1	52 1	2.4 1					44
Bigeyes Scombroptidae spp.				400 1				155
Billfishes Istiophoridae spp.	100 1	60 1	4.5 1					80

Table 2.—Continued.

	Thiamin (μg)	Riboflavin (μg)	Niacin (mg)	Pyridoxine (μg)	Folic acid (μg)	B ₁₂ (μg)	Pantothenic acid (μg)	References
	per 100 g							
Bluefishes Pomatomidae spp.	135±15 120-150 2	120±30 90-150 2	1.9±0 1.9-1.9 2					23, 82, 146
Bombay duck <i>Harpadon nochereus</i>	30±10 20-40 2	70±20 50-90 2	5.7±5.1 0.6-10.7 2	970 1				66, 80
Breams and porgies Sparidae spp.	77±18 10-190 15	96±21 20-250 15	5.4±6 1.5-7.8 12	460·0 460-460 2	1.6·1.2 0.4-4 3	1.8±0.4 0.1-2.8 7	213±8 205-220 2	2, 50, 64, 66, 85, 153
Burbot Gadidae spp.	388±27 306-455 6	141±1 140-142 2	1.6±0 1.6-1.6 2					43, 63, 71, 72, 139
Butterfishes Stromateidae spp.	163±1 163-164 2	223±109 90-550 4	4.8±1.2 2.6-8.1 4	450 1		2.3±0 2.3-2.3 2		29, 70, 80, 85, 116, 126
Butterflyfishes Chaetodontidae spp.	33±4 25-40 3	45±26 19-70 2	4.5±0.1 4.4-4.6 3					44, 64, 80, 109
Caesios Caesionidae spp.	24±4 20-28 2	24±4 20-27 2	3.8±0.6 3.2-4.3 2	190 1		2.3±0.8 1.5-3.1 2		50, 64, 80, 85
Carps Cyprinidae spp.	114±32 5-448 20	81±23 10-180 7	3.0±0.7 1.3-1.1 16	71±60 11-130 2	70±68 2.8-138 2	3.2±1.2 0.1-9 8	150 1	10, 11, 12, 29, 63, 71, 72, 80, 85, 109, 110, 111, 134, 136, 137, 149, 153, 154
Catfishes, airbreathing Clariidae spp.	44±23 8-110 4	36±5 31-40 2	1.7±0.6 0.5-3.2 4		13.6±1.7 12.0-15.3 2	3.5±0.1 3.4-3.7 4	460 1	10, 11, 29, 36, 64, 80, 85, 109
Catfishes, freshwater Ictaluridae spp.	0 1		1.8±0.5 1.0-2.5 3		3.1±1.2 1.9-4.3 2	3.7±0.4 2.2-4.6 7	464±4 460-468 2	10, 11, 29, 50, 111, 116, 124, 135
Catfishes, sea Ariidae spp.	61±8 40-80 4	115±22 80-197 5	2.4±0.6 0.5-4.5 6	370 1	82.5±67.5 15-150 2	2.4±0.2 2.2-2.5 2	570 1	64, 109, 124, 138
Characins Characidae spp.	30±12 10-50 3	87±19 50-110 3	3.7±1.4 1.7-6.3 3			1.6 1		27, 65
Chimaeras Chimaeridae spp.					2.7 1		310 1	50
Cichlids Cichlidae spp.	30±0 30-30 2	85±35 50-120 2	2.3±0.8 1.5-3.1 2	320 1		2.9±0.2 2.7-3.0 2		82, 85
Clams, arkshells Arcidae spp.	2 1	200 1	1.5 1		17 1	13.6±6.4 7.2-20 2	790 1	50, 64, 151
Clams, freshwater Corbiculidae spp.					17 1	12.1 1	360 1	33, 50, 151
Clams, maetra Mactridae spp.	72±52 20-128 2	114±16 98-130 2				0.4±0.2 0.2-0.7 3		25, 151
Clams, razor Solenidae spp.	95±5 90-100 2	355±155 180-490 2	1.6±0.1 1.5-1.6 2			8.6 1		80, 81, 151
Clams, softshell Myacidae spp.	21±19 1-79 4	180±29 95-219 4	1.9±0.4 1.2-2.5 3	88±9 77-106 3		71.5±22.4 7.1-105.0 4	293±17 260-311 3	21, 59, 121, 125
Clams, Tellin Tellinidae spp.	10 1	20 1	2.2 1	70 1	10.9 1			80
Clams Veneridae spp.	100±33 10-240 7	381±147 20-940 7	2.9±0.6 1.1-5.0 6			3.9±1.7 2.2-5.6 2		23, 44, 64, 85, 109, 125

Table 2.—Continued.

	Thiamin (μ g)	Riboflavin (μ g)	Niacin (mg)	Pyridoxine (μ g)	Folic acid (μ g)	B ₁₂ (μ g)	Pantothenic acid (μ g)	References
	per 100 g							
Clams	49±12	238±47	1.3±0.2	75±42	25.1±6.5	9.8±2.5	531±91	23, 45, 64, 75, 78, 80,
Miscellaneous species	2-139 14	12-780 16	0.2-2.3 9	0-350 8	2.7-58.0 7	0.2-62.3 34	440-622 2	86, 94, 100, 111, 123, 125, 127, 142, 151
Codfishes	71±9	121±23	2.5±0.4	221±25	5.0±1.6	0.6±0.2	163±20	14, 16, 18, 19, 23, 36,
Gadidae spp.	18-150 17	11-325 16	0.2-6.7 14	170-288 4	1.8-6.7 3	0.1-2 11	96-400 14	43, 50, 59, 60, 73, 80, 81, 86, 90, 97, 110, 111, 112, 125, 134, 138, 141, 144, 146, 155
Cornet						0		153
Fistulariidae spp.						1		
Crabs	85±20	382±280	2.5±0.2					23, 43, 44, 90
Mixed species	10-140 6	60-940 3	2.3-2.7 2					
Croakers	85±26	98±19	3.2±0.9	0.2		2.5		80, 81, 92
Sciaenidae spp.	40-160 4	60-150 4	1.7-5.5 4	1		1		
Cusk	38±6	303±160	2.7±0.2	304±30		1.0	261±44	16, 19, 23, 90, 138, 146
<i>Brosme brosme</i>	32-51 3	94-940 5	2.3-3.0 3	274-333 2		1	273-310 3	
Cusk eels and brotulas	175	35±3	1.8±0.4		2.0	0.6±0.3	115	65, 141
Ophidiidae spp.	1	32-37 2	1.4-2.2 2		1	0.3-0.9 2	1	
Cuttlefishes	96±59	480±430	2.1±0.8					70, 80, 113, 147
Miscellaneous species	9-210 3	50-910 2	1.2-2.9 2					
Dolphins	20	70	6.1			0.1		80, 153
Coryphaenidae spp.	1	1	1			1		
Dories				952		0		93, 153
Zeidae spp.				1		1		
Drepanes	29±2	111±30	3.2±0.4					64, 80
Drepanidae spp.	27-30 2	81-140 2	2.8-3.7 2					
Drums	63±14	131±46	3.1±0.7			2.4±1.5		2, 27, 59, 64, 65,
Sciaenidae spp.	20-130 9	31-530 10	0.5-8.9 11			0.2-5.3 3		70, 102, 124
Eels, arrowtooth				230			150	127
Dysommidae spp.				1			1	
Eels, conger	60	40±0	4.3±0.8			3	240	80, 138
Congridae spp.	1	40-40 2	3.5-5.0 2			1	1	
Eels, freshwater	191±31	335±51	2.3±0.5	254±15	11.6±1.6	1.0±0	141±6	19, 50, 59, 61, 80, 81,
Anguillidae spp.	144-280 4	190-520 6	1.4-3.5 4	230-300 5	10.0-13.1 2	1.0-1.0 3	125-150 4	84, 96, 111, 119, 134
Eels, moray	10	30	3.1			0.3±0.2		64, 153
Muraenidae spp.	1	1	1			0.1-0.4 2		
Eels, pike conger	60	90	2.7			0.2		80, 153
Muraenesocidae spp.	1	1	1			1		
Eels, snake	41±7	120	1.3±0.5			1.5±0.5		10, 12, 80, 85,
Ophichthidae spp.	30-53 3	1	0.5-2.3 3			1.0-2.6 3		109, 124, 149
Eels, spiny	60							109
Motacanthidae spp.	1							
Eels, swamp	85±45	135±85	2.2±0.4					33, 80
Flutidae spp.	40-130 2	50-220 2	1.8-2.5 2					
Featherbacks	85±35	55±15	3.3±2.6			3.4		29, 80, 135, 136, 137
<i>Notopterus</i> spp.	50-120 2	40-70 2	0.4-8.5 3			1		

Table 2.—Continued.

	Thiamin (μg)	Riboflavin (μg)	Niacin (mg)	Pyridoxine (μg)	Folic acid (μg)	B ₁₂ (μg)	Pantothenic acid (μg)	References
	per 100 g							
Flatheads Percophidae spp.	20±1 19-20 2	60±30 30-90 2	4.7±0.4 4.3-5.0 2				240 1	64, 80
Flounders, lefteye Bothidae spp.	85±15 70-100 2	73±27 46-100 2	5.3±0.4 5.0-5.7 2	130 1		1.3 1	900 1	65, 80, 153, 154
Flounders, righteye Pleuronectidae spp.	103±31 30-400 11	84±23 40-335 12	2.3±0.4 0.8-3.8 9	191±24 137-250 4	5±0 5-5 2	5.4±4.6 0.8-10 2	863±240 245-1,700 6	3, 19, 50, 59, 80, 81, 83, 84, 97, 110, 111, 115, 125, 134, 138, 146
Flyingfishes Exocoetidae spp.	17±7 4-26 3	56±10 40-80 4	3.9±0.6 3.0-5.6 4		2.8 1	1.0±0.4 0.3-1.3 3		64, 80, 85, 153
Gars Lepisosteidae spp.				900 1				134
Goatfishes Muliidae spp.	36±6 25-43 3	59±21 38-80 2	1.5±0.1 1.4-1.6 2	1.7 1				64, 80, 93, 109
Greenlings Hexagrammidae spp.	72±15 43-105 4	49±8 38-73 4		540 1	7.4±0 7.4-7.4 2	13.2±4.8 3.6-18.0 3	188±3 185-190 2	50, 67, 80, 111, 125, 140
Grunts Pomadasyidae spp.	77±23 18-200 7	226±126 32-900 7	4.2±0.9 2.0-8.6 7	200 1	7.0±3.5 3.5-10.5 2	0.4±0.3 0.1-0.7 2	270±0 270-270 2	27, 44, 50, 64, 65, 66, 80, 153, 154
Gurnards, flying Dactylopteridae spp.	85±75 10-160 2	75±5 70-80 2	2.8±0.7 2.1-3.4 2	480 1	1.8 1	0.3 1	225 1	27, 50, 80, 153, 154
Haddock <i>Melanogrammus aeglefinus</i>	39±5 9-100 19	69±11 12-210 24	3.6±0.1 2.4-4.3 20	231±16 122-300 11	0.8 1	1.3±0.1 0.5-3.5 19	145±17 49-380 20	18, 19, 20, 23, 43, 59, 60, 83, 86, 90, 111, 119, 127, 138, 141, 147
Hake Gadidae spp.	89±27 39-132 3	75±5 70-80 2	1.6±0.6 1.0-2.2 2	875 1				35, 44, 93, 119
Halibut Pleuronectidae spp.	83±11 40-180 13	80±11 44-185 15	7.5±1.0 2.8-14.2 11	400±15 347-430 5	2.6±0.3 2.0-2.9 3	0.8±0.1 0.7-1.0 6	303±50 111-595 11	7, 9, 19, 23, 25, 26, 50, 59, 77, 80, 83, 84, 86, 90, 110, 111, 125, 130, 134, 138, 141
Herring Clupeidae spp.	46±8 6-170 27	261±39 50-1,000 26	3.8±0.4 0.6-9.6 25	310±43 160-450 6	10.3±2.9 1.7-14.0 4	11.4±4.3 1.4-34.0 9	2,427±1,415 970-9,500 6	2, 9, 10, 11, 12, 14, 27, 29, 31, 36, 59, 64, 66, 67, 70, 73, 78, 80, 81, 82, 84, 95, 97, 110, 111, 117, 124, 125, 127, 138, 153, 154
Jacks Carangidae spp.	59±17 15-122 5	60±10 25-81 5	5.7±0.5 3.9-7.1 5	670 1		7.5±1.6 5.9-9.1 2		64, 80, 85
Lampreys Petromyzontidae spp.	339±256 46-850 3	520±93 427-612 2	4.7 1	195±25 170-220 2	25.5±1.7 23.6-29.0 3	4.1±0.3 3.8-4.4 2	425±145 280-570 2	50, 51, 80
Lings <i>Molva</i> spp.		80 1	2.5±0.2 2.3-2.7 2	265±44 221-309 2		1±0.5 0.5-1.9 3	320 1	10, 18, 97, 138
Lizardfishes Synodontidae spp.	92±12 80-104 2	39±11 28-50 2	2.9±0.5 2.4-3.4 2					64, 80
Lobsters and crayfishes Miscellaneous species	99±24 7-165 7	64±10 10-130 10	2.3±0.3 1.2-4.3 8	210 1	0.6±0 0.6-0.6 2	1.6±0.6 0.5-2.7 4	410±0 410-410 2	38, 59, 64, 78, 80, 83, 86, 90, 111, 138, 141, 149
Longarays Ambasidae spp.	11 1	39 1	1.5 1					64

Table 2.—Continued.

	Thiamin (μg)	Riboflavin (μg)	Niacin (mg)	Pyridoxine (μg)	Folic acid (μg)	B ₁₂ (μg)	Pantothenic acid (μg)	References
	per 100 g							
Mackerels Scombridae spp.	90±11 10-237 31	263±49 27-940 30	12.4±2.0 2.7-58.0 27	654±76 270-1,000 10		4.2±1.2 0.4-16.2 14	444±82 160-850 8	17, 23, 38, 43, 44, 50, 52, 54, 59, 64, 65, 66, 74, 80, 81, 85, 90, 101, 102, 105, 107, 109, 111, 112, 127
Milkfishes Chanidae spp.	57±44 13-100 2	77±23 54-100 2	6.1±0.3 5.8-6.4 2	420 1	15.9 1	3.4±0 3.4-3.4 2		64, 80, 85
Minnows Cyprinidae spp.	30 1	100 1	3.5 1	130 1				80, 154
Mojarras Gerreidae spp.	51±21 30-92 3	85±3 80-90 3	5.0±0.3 4.5-5.3 3	360 1	21.4 1	2.4±0.5 1.9-3.4 3		64, 65, 80, 85
Mussels Mytilidae spp.		150±30 120-180 2	1.6±0.4 1.2-2.0 2	98±92 6-190 2	41.8 1	10.2 1		1, 42, 80, 85
Needlefishes Belonidae spp.	4 1	39±2 37-40 2	0.9±0 0.9-0.9 2	655±85 570-740 2		1.9±0 1.9-1.9 2		64, 80, 85, 111
Ocean perches <i>Sebastes marinus</i>		110 1	2.0 1				360 1	138
Octopuses Mixed species	67±26 20-140 5	73±14 40-110 5	3.2±1.2 1.3-5.3 3	360 1				80, 83, 111, 125
Oysters <i>Ostreidae</i> spp.	153±11 9-300 36	188±15 16-340 29	1.8±0.2 0.7-7.1 34	166±25 30-320 18	84.4±77.8 3.7-240 3	17.2±2.6 11.5-33.0 9	365±22 184-530 22	1, 9, 22, 23, 34, 38, 40, 45, 59, 64, 78, 79, 80, 81, 83, 85, 91, 94, 95, 97, 100, 111, 115, 121, 127, 141, 142, 145, 151
Parrotfishes Scaridae spp.	29±24 5-53 2	57±6 50-70 3	1.4±0 1.4-1.5 3	180 1		0.6 1		64, 65, 80
Perches Percidae spp.	187±63 60-250 3	119±46 28-170 3	1.9±0.2 1.4-2.3 4					19, 28, 30, 63
Perches, climbing <i>Anabantidae</i> spp.	39±12 19-99 6	274±49 190-361 3	2.4±0.7 0.8-3.7 4	200 1	2.7±1.3 1.0-5.2 3			11, 12, 36, 64, 80, 109, 124
Pikes <i>Esocidae</i> spp.				135±17 115-150 2				111, 134
Plaice <i>Pleuronectidae</i> spp.	137±32 105-200 3	163±33 130-195 2	4.0 1	217±14 182-250 4		1.4±0.4 1.0-2.2 3	800±0 800-800 2	19, 84, 90, 111, 134
Pollock <i>Gadidae</i> spp.	82±18 45-160 6	122±18 80-200 7	2.6±0.6 1.6-2.9 4	238±60 60-473 6	65 1	2.1±0.5 1.0-3.5 5	274±41 140-380 5	3, 16, 18, 23, 45, 50, 59, 67, 80, 90, 111, 138, 146, 154
Pomfrets <i>Bramidae</i> spp.	120±70 50-190 2	190±110 80-300 2	0.6±0.2 0.4-0.8 2					66, 80
Pompanos <i>Carangidae</i> spp.	254±154 90-562 3	91±17 60-118 3	4.7±1.5 3.0-8.1 3					27, 44
Rays, stingray <i>Dasyatidae</i> spp.	50±10 36-80 4	44±5 30-50 4	3.5±0.6 2.5-4.6 4			0.1 1		64, 80, 153
Rockfishes <i>Scorpaenidae</i> spp.	96±18 29-153 7	150 1	3.0 1	143±88 55-230 2	4.7±4.3 0.4-9 2	1.0 1	177±92 80-360 3	50, 80, 111, 125, 154
Sandfishes <i>Trichodontidae</i> spp.	100 1	50 1			7.8±0 7.8-7.8 2		630±0 630-630 2	50, 80

Table 2.—Continued.

	Thiamin (μg)	Riboflavin (μg)	Niacin (mg)	Pyridoxine (μg)	Folic acid (μg)	B ₁₂ (μg)	Pantothenic acid (μg)	References
	per 100 g							
Sardines and pilchards Clupeidae spp.	19±8 1-90 10	107±38 30-387 9	6.3±1.0 2.4-10 9	424-231 150-882 3	2 1	5.6±2.3 1.1-17.0 7	1,030±30 1,000-1,090 3	8, 15, 23, 33, 36, 45, 48, 50, 64, 80, 82, 85, 93, 103, 110, 111, 116, 140, 153, 154
Sauries Scomberesocidae spp.	50±1 48-54 5	112±11 87-132 5	6.0 1	660 1	6.4 1		850 1	50, 80, 99, 154
Sawfishes Pristidae spp.	140 1	190 1	4.1 1					83
Scad and mackerel Carangidae spp.	139±19 26-180 8	141±13 77-190 7	6.0±1.3 1.5-11.0 7	406±98 300-700 4	4.3±2.4 1.9-6.6 2	5.3±1.4 0.2-12.7 11	350±0 350-350 2	19, 45, 50, 57, 64, 80, 85, 101, 102, 103, 140, 149, 153, 154
Scallops Pectinidae spp.	85±45 40-130 2	83±18 65-100 2	1.3±0.1 1.2-1.4 2			8.9±7.6 1.2-24.0 3	138±6 132-143 2	78, 81, 94, 100, 111, 141
Scorpionfishes Scorpaenidae spp.				55 1		7.6±4.4 3.2-12.0 2	80 1	67, 111
Sculpins Cottidae spp.			3.2 1			6.1 1	100 1	50, 153
Sea cucumber Mixed species	53±18 35-70 2	90±0 90-90 2	0.5 1			1.4±0.3 0.5-2.0 4		45, 80, 94, 125
Sea robins Triglidae spp.	90 1							43
Shad Clupeidae spp.	46±35 10-150 4	240-0 240-240 2	8.4 1				608 1	23, 33, 59, 64, 80, 111
Shark, dogfish Squalidae spp.	52±8 40-66 3	264±155 80-573 3	2.9±1.2 1.0-5.2 3		3.2 1	1.8±0 1.8-1.8 2	747±57 690-860 3	43, 50, 70, 80, 90, 111, 138
Sharks, hammerhead Sphyrnidae spp.	14 1	81 1	3.2 1					64
Sharks, mackerel Lamnidae spp.	105±25 80-130 2	91±10 81-100 2	9.5±2.5 7.0-12.1 2			3.0±0.4 2.6-3.4 2	330 1	2, 138
Sharks, sand tiger Odontaspidae spp.	20 1	30 1	4.4 1					44
Sharks Miscellaneous species	40±16 5-110 6	57±15 19-110 6	4.0±0.9 0.9-6.6 6			0.4±0.2 0-0.7 3		27, 64, 65, 80, 102, 116
Sheathfishes Situridae spp.	10 1	40 1	1.4 1					80
Shiners Cyprinidae spp.						1.4 1		10
Shrimp and prawns Mixed species	41±6 10-143 28	76±11 13-190 26	2.7±0.3 0.7-4.9 17	66±13 16-125 10	5.2±2.2 3.0-7.4 2	3.8±1.0 0.9-8.1 7	278±16 165-372 15	27, 36, 38, 64, 78, 80, 81, 83, 84, 85, 86, 90, 98, 108, 111, 125, 127, 134, 138, 141, 143, 149
Siganids Seganoidae spp.	203±43 160-245 2	129±2 127-130 2	4.8±0.4 4.4-5.1 2	140 1		0.1 1		64, 80, 153
Silversides Atherinidae spp.	88±71 10-230 3	65±15 50-80 2	2.9±1.6 1.3-4.5 2					43, 80, 83

Table 2.—Continued.

	Thiamin (μ g)	Riboflavin (μ g)	Niacin (mg)	Pyridoxine (μ g)	Folic acid (μ g)	B ₁₂ (μ g)	Pantothenic acid (μ g)	References
	per 100 g							
Sleepers Eleotridae spp.	26 1							109
Smelts Osmeridae spp.	54-26 10-130 4	143±33 43-360 8	1.9±0.4 1.3-3.0 4	120 1	5.0±1.3 3.7-6.3 2	1.8±1.6 0.2-3.4 2	919±281 638-1,200 2	15, 50, 59, 63, 80, 86, 125, 141, 153, 154
Snails Mixed species	56±54 2-110 2	169±111 58-280 2	1.5±0.2 1.3-1.6 2	120 1	31.8 1	26.7±7.1 9.0-77.0 10		64, 80, 85, 151
Snappers Lutjanidae spp.	88±18 46-170 6	81±17 38-131 5	3.6±0.6 2.5-5.2 5	100±100 0-200 2				43, 44, 64, 65, 80, 83
Snooks Centropomidae spp.	134±47 48-350 8	150±59 48-440 7	1.4±0.4 0.7-3.1 8		65.0 1	3.4±0 3.4-3.4 2		10, 11, 12, 29, 36, 44, 64, 66, 80, 83
Soapies Leiognathidae spp.	43±16 13-70 4	39.3±0.8 37-40 4	2.1±0.1 1.9-2.5 4	170 1	23.6 1	3.6±0 3.6-3.6 2		64, 80, 85
Soles Pleuronectidae spp.	62±5 38-88 10	48±2 37-57 7	1.1 1	1,045 1	3.0±0.1 2.9-3.1 2	0.1 1	420±197 155-805 3	3, 9, 50, 93, 111, 119, 125, 153
Soles Soleidae spp.	72 1							15
Spadefishes Ephippidae spp.	66±46 20-158 3	157±7 150-170 3	5.2±0.1 5.0-5.3 3			2.6±0 2.6-2.6 2		33, 64, 65, 80
Squid Mixed species	43±19 8-150 7	218±104 50-836 7	2.6±0.5 1.2-4.7 7	623±360 70-1,300 3	12.5 1	4.5±2.9 1.3-13.0 4	680 1	45, 54, 65, 80, 81, 93, 98, 100, 113
Suckers Catostomidae spp.	15±11 4-36 3	50 1	1.3±0.1 1.1-2.0 7				464 1	19, 44, 63, 71, 72, 111
Sunfishes Centrarchidae spp.			0.5 1				512 1	111, 124
Surgeonfishes Acanthuridae spp.	29±2 27-30 2	28±2 26-30 2	3.8±0 3.8-3.8 2		10 1	1.1±0.5 0.6-1.6 2	320 1	64, 80, 153
Tarpons Elopidae spp.	54±21 16-90 4	52±5 39-60 4	3.6±0.7 1.6-5.1 5					29, 64, 80
Therapons Theraponidae spp.	23±2.5 20-28 3	71±5 63-81 3		600 1		4.9±2.2 2.7-9.2 3		57, 64, 80, 85
Threadfins Polynemidae spp.	25±5 19-40 4	93±26 50-160 4	2.6±0.6 1.5-4.6 5		70 1			11, 64, 66, 79, 80
Tilefishes Branchiostegidae spp.	80 1	111 1	2.8 1	45 1				80, 154
Tonguefishes Cynoglossidae spp.	50 1	150 1	3.3 1					80
Trout, salmon Salmonidae spp.	130±15 30-348 23	143±13 46-231 26	7.2±0.2 5.6-8.8 15	745±54 590-975 6	3.9±0.4 2.2-4.8 6	1.7±0.5 0.1-5.0 13	988±144 490-2,080 15	15, 19, 23, 24, 25, 26, 43, 47, 53, 55, 59, 73, 78, 80, 81, 84, 95, 97, 101, 104, 106, 111, 120, 125, 127, 132, 134, 138, 141, 144, 146, 149, 153
Trout, trout Salmonidae spp.	80±9 10-140 12	109±17 10-210 15	4.2±0.6 2.5-7.8 9	690±0 690-690 2		3.3±0.8 1.0-5.0 6	1,843±77 1,630-2,000 5	19, 38, 44, 59, 61, 80, 83, 111, 125, 138, 152, 153

Table 2.—Continued.

	Thiamin (μg)	Riboflavin (μg)	Niacin (mg)	Pyridoxine (μg)	Folic acid (μg)	B ₁₂ (μg)	Pantothenic acid (μg)	References
	per 100 g							
Trout, whitefish Salmonidae spp.	88±5 27-126 26	120±0 120-120 3	2.8±0.2 0.6-4.6 15					19, 43, 63, 71, 72
Tunas Scombridae spp.	120±21 10-434 22	164±31 13-660 28	9.7±1.1 0-23.4 21	647±72 190-920 10	2.1±0.7 0.6-3.2 4	6.2±2.5 0.2-47.0 19	917±313 186-3,280 9	2, 15, 17, 18, 27, 45, 56, 64, 70, 74, 80, 82, 84, 89, 95, 105, 110, 127, 131, 134, 138, 141, 146, 147, 149, 153, 154
Turbons Turbanidae spp.	60 1	60 1	3.0 1	1,700 1	7.3±0 7.3-7.3 2	0.3 1	305±45 260-350 2	45, 50, 80
Turbots Pleuronectidae spp.	46±14 18-60 3	86±28 40-137 3	1.1±0.4 0.6-1.5 2			1.3±0.3 1.0-1.5 2	250±0 250-250 3	3, 15, 111, 119, 127, 138
Whiting Sillaginidae spp.	36±15 21-50 2	80±20 60-100 2	6.1±0.7 5.4-6.9 2					64, 80
Wolffishes Anarhichadidae spp.				350 1		2.0 1	570 1	111
Wrasses Labridae spp.				80 1		3.0±2.3 0.7-5.3 2		42, 57, 153, 154

¹Average of the means.

²Range of the means.

³Number of mean values.

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