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Mineral and proximate composition of some commercially important fish of the Arabian Gulf

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The information available on the chemical composition of the fish being harvested from the Arabian Gulf is very limited. The levels of nine nutrient minerals and the proximate components of the raw (fresh) edible portions of some commercially important finfish and shellfish were determined. All the fish investigated were fairly high in protein (18–22%) while the lipid content was less than 3%. Small amounts of carbohydrates were detected only in shellfish. The moisture and ash content varied within a narrow range. The levels of minerals varied from one fish species to the other. In finfish the most abundant mineral was potassium followed by phosphorus with lower levels of sodium, magnesium and calcium. Similar trends were observed in shellfish except for sodium which was present in amounts comparable to that of potassium.

INTRODUCTION

Fish is an important constituent of human diet (Dore, 1984). This is particularly true for the countries of the Arabian Gulf which are dominated by desert regions. Whereas these countries have poor agricultural potential and thus have to import most of their food, they are to a large extent self-sufficient in seafood (Kadidi *et al.*, 1988). However, in spite of their enormous economic values, very limited information is available on the chemical composition of the fish (Das *et al.*, 1976). Since reliable composition data are essential for nutritional and dietary evaluation (USDA, 1987), the authors now report on the mineral constituents and proximate value of some fish of the Arabian Gulf. Although there are more than 465 fish species in the Gulf (Relyea, 1981; Kuronuma & Abe, 1986), a large number of these species have little commercial value because they are inedible, too small or not yet exploited. The fish species chosen for the present investigation are important resources for the economics of the Gulf countries and to the inhabitants' diet (Wray, 1979).

MATERIALS AND METHODS

Sampling

Fish samples were obtained from the Saudi Fisheries Company in Dammam over the period from May to October 1990. For each species of finfish, five fresh specimens representing the common marketable sizes were obtained; for each shellfish, 10 fresh specimens were collected. The muscle tissues (fillet) of each finfiish were obtained by cutting the fish across the body near the gills, along the ventral edge from the gills to the tail and finally across the body near the tail. Care was taken that the cuts were not deep enough to penetrate the viscera. The skin and any bony elements were removed. The raw muscle tissues were minced and subsequently analyzed; the raw edible portions of shellfish were removed from the shell and then minced and analyzed.

Proximate analyses

The proximate analyses were performed in duplicates in accordance with AOAC procedures (AOAC, 1984). Moisture was determined in an oven at 105°C overnight. Total nitrogen was determined by the

Table 1. Mean (g/100 g, wet tissue) proximate composition (± standard error) of commercially important fish of the Arabian Gulf[a,b]

Species	Protein	Fat	Moisture	Ash
Ablennes hians, Flat needle fish	20·2 ± 0·41	0·66 ± 0·20	77·10 ± 0·78	1·47 ± 0·05
Acanthopagrus bifasciatus, Black banded bream	19·7 ± 0·30	0·52 ± 0·10	77·97 ± 0·79	1·50 ± 0·05
Carangoides bajad, Orange spotted travally	18·8 ± 0·25	2·03 ± 0·52	76·60 ± 0·85	1·46 ± 0·01
Epinaphelus tauvina, Greasy grouper	19·2 ± 0·27	0·58 ± 0·30	77·70 ± 0·62	1·29 ± 0·03
Lethrinus nebulosus, Sprangled emperor	19·2 ± 0·24	0·93 ± 0·11	78·52 ± 0·71	1·40 ± 0·04
Lupa pelagica, Crab	19·3 ± 0·23	0·80 ± 0·10	78·10 ± 0·50	1·70 ± 0·02
Lutjanus malabaricus, Malabar red snapper	19·3 ± 0·33	1·10 ± 0·15	78·69 ± 0·85	1·36 ± 0·03
Penaeus semisculcatus, Grooved tiger prawn	20·3 ± 0·20	0·51 ± 0·31	76·94 ± 0·73	1·30 ± 0·02
Plectrohynchus gaterinus, Black spotted rubberlip	19·2 ± 0·32	0·80 ± 0·23	78·45 ± 0·66	1·26 ± 0·06
Pomadasys argenteus, Silvery grunt	20·0 ± 0·30	0·70 ± 0·19	78·20 ± 0·79	1·20 ± 0·05
Rachycentron canadus, Cobia	19·7 ± 0·31	0·45 ± 0·12	78·65 ± 0·76	1·32 ± 0·04
Scomberomorus commerson, Narrow barred spanish mackerel	21·9 ± 0·48	1·82 ± 0·29	74·90 ± 0·70	1·44 ± 0·03
Seriola dumerili, Yellow tail travally	20·3 ± 0·40	2·95 ± 0·44	75·05 ± 0·90	1·49 ± 0·04
Siganus canaliculatus, White spotted spine foot	17·9 ± 0·31	1·90 ± 0·31	78·62 ± 0·76	1·47 ± 0·05
Sphyraena obtusata, Obtuse barracoda	18·6 ± 0·26	0·98 ± 0·17	79·50 ± 0·75	1·01 ± 0·03
Thenus orientalis, Flathead locust lobster	20·4 ± 0·26	0·81 ± 0·12	75·47 ± 0·50	1·30 ± 0·03

[a] A total of five individual raw samples (fillet) were analyzed for each finfish, and 10 samples (edible portion) for each shellfish (i.e. crab, prawn and lobster).
[b] English common names and scientific names (in Latin) of fish are according to Fischer and Bianchi (1984).

macro-Kjeldahl method and protein values were obtained by multiplying by the factor of 6·25 (Jones, 1941). Ash content was determined by combustion in a muffle furnace at 550°C overnight. Lipids were determined by a modified procedure of Bligh and Dyer (Christie, 1982).

Elemental analyses

Metals were analyzed by inductively coupled plasma atomic emission spectrometry on an Applied Research Laboratories ICP-3580 vacuum version, equipped with a monochromator and a simultaneous polychromator for 48 elements. Calibration standards were prepared from the National Institute of Science and Technology spectrometric standard solution. The fish muscle tissues were digested as follows: approximately 5·00 g of the homogenized tissues was weighted in a tared 250 ml Vycor beaker and 10 ml of concentrated (68%) nitric acid was added to the beaker. The contents were mixed thoroughly with a glass rod to wet the tissue sample and the glass rod rinsed with a minimum amount of distilled deionized water. The beaker was covered with a watch glass and left at room temperature for 1 h followed by heating at 90°C for 2–3 h until a viscous residue was obtained. An additional 10 ml of concentrated nitric acid was added to the cool beaker and the contents heated again at 90°C. The beaker was transferred to a muffle furnace at room temperature. The temperature of the furnace was set at 100°C for the first hour, then increased to 150°C for 3 h, followed by 100°C increments every hour to a temperature of 450°C. The sample was ashed in the muffle furnace at 450°C for 12 h until a white residue was finally obtained. Ten millilitres of 25% hydrochloric acid were added to the cool residue, followed by warming on a hot plate until dissolution. The contents of the beaker were finally transferred into a 50 ml class A volumetric flask and diluted to the mark with distilled deionized water (El-Faer *et al.*, 1991).

RESULTS AND DISCUSSION

The proximate composition of muscle tissues taken from 13 finfish and three shellfish which were harvested from the Arabian Gulf are shown in Table 1. Data on some mineral constituents of fish are listed in Table 2.

Since the moisture, protein, lipid and ash contents of the finfish were independently determined, the sum of the percentages of these constituents would not necessarily be equal to 100%. The relative lipid content varied from one fish to the other (Table 1), but all the fish showed lipid values below 3%. Lipid contents of muscle tissues of fish vary with the season of the year (Lambertsen, 1973) and are affected by such diverse factors as age, sex, spawning cycle and environmental conditions (Exter *et al.*, 1975). However, fish with less than 5% fat are classified as 'lean' and since these store their fat in the liver, they are generally not expected to exhibit significant seasonal variations in lipid content of muscle tissues. Carbohydrate content of shellfish can be calculated as the difference between 100 and the total percentages of moisture, protein, lipids and ash. Hence, the crab, the grooved tiger prawn, and the flathead locust lobster showed carbohydrate contents

Table 2. Mean (mg/100 g, wet tissue) mineral elements (± standard error) of commercially important fish of the Arabian Gulf[a,b]

Species	Ca	Cu	Fe	K	Na	Mg	Mn	P	Zn
Ablennes hians, Flat needle fish	46·6 ± 10·1	0·033 ± 0·061	0·45 ± 0·25	471 ± 10	72·8 ± 8·9	35·0 ± 1·2	0·006 ± 0·002	263 ± 6	0·41 ± 0·03
Acanthopagrus bifasciatus, Black banded bream	41·8 ± 20·5	0·057 ± 0·050	0·33 ± 0·10	463 ± 15	66·7 ± 9·3	32·2 ± 2·4	0·008 ± 0·004	268 ± 38	0·44 ± 0·20
Carangoides bajad, Orange spotted travally	21·0 ± 8·6	0·054 ± 0·030	0·64 ± 0·40	449 ± 10	55·7 ± 9·2	31·3 ± 2·1	0·007 ± 0·002	255 ± 6	0·43 ± 0·12
Epinaphelus tauvina Greasy grouper	33·3 ± 14·1	0·027 ± 0·012	0·17 ± 0·04	430 ± 32	49·0 ± 3·6	29·0 ± 1·2	0·008 ± 0·004	227 ± 8	0·58 ± 0·28
Gnathanodon speciousus, Golden toothless travally	25·0 ± 2·5	0·004 ± 0·003	0·41 ± 0·30	311 ± 20	82·5 ± 8·7	28·4 ± 1·3	0·010 ± 0·004	175 ± 10	0·27 ± 0·02
Lethrinus nebulosus Sprangled emperor	55·8 ± 9·9	0·041 ± 0·027	0·21 ± 0·09	461 ± 49	60·5 ± 9·8	33·9 ± 3·4	0·007 ± 0·003	275 ± 33	0·44 ± 0·17
Lupa pelagica, Crab	95·9 ± 32·5	0·37 ± 0·28	0·22 ± 0·06	362 ± 63	366 ± 55	44·7 ± 2·5	0·023 ± 0·010	230 ± 39	2·74 ± 0·34
Lutjanus malabaricus, Malabar red snapper	10·0 ± 0·7	0·033 ± 0·013	1·01 ± 0·73	386 ± 16	59·8 ± 9·9	26·8 ± 2·0	<0·003	197 ± 6	0·34 ± 0·01
Penaeus semisculcatus, Grooved tiger prawn	29·9 ± 7·1	0·48 ± 0·12	0·16 ± 0·06	373 ± 72	226 ± 42	44·0 ± 2·0	0·013 ± 0·003	301 ± 38	1·34 ± 0·06
Plectrohynchus gaterinus, Black spotted rubberlip	23·9 ± 13·1	0·050 ± 0·050	0·44 ± 0·18	433 ± 12	76·5 ± 6·5	31·3 ± 1·5	0·005 ± 0·004	219 ± 14	0·33 ± 0·09
Pomadasys argenteus, Silvery grunt	48·6 ± 10·5	0·061 ± 0·030	0·90 ± 0·60	438 ± 14	93·0 ± 9·9	30·6 ± 2·0	0·007 ± 0·002	226 ± 9	0·23 ± 0·08
Pristipomoides typus, Sharptooth snapper	26·4 ± 7·6	0·011 ± 0·006	0·17 ± 0·07	456 ± 11	76·3 ± 9·3	32·1 ± 1·1	0·007 ± 0·003	256 ± 7	0·30 ± 0·08
Rachycentron canadus, Cobia	5·73 ± 1·10	0·037 ± 0·020	0·30 ± 0·22	432 ± 11	48·1 ± 5·2	25·0 ± 0·2	<0·003	222 ± 2	0·37 ± 0·06
Scomberomorus commerson, Narrow barred spanish mackerel	7·5 ± 2·6	0·021 ± 0·013	0·34 ± 0·20	439 ± 48	52·2 ± 8·1	33·9 ± 3·9	0·005 ± 0·002	253 ± 25	0·38 ± 0·10
Seriola dumerili, Yellow rail travally	13·6 ± 5·8	0·065 ± 0·017	0·21 ± 0·071	410 ± 25	68·2 ± 12·2	30·2 ± 1·1	<0·003	242 ± 9	0·36 ± 0·04
Siganus canaliculatus, White spotted spine foot	22·1 ± 11·4	0·068 ± 0·026	0·31 ± 0·09	477 ± 27	93·4 ± 14·9	33·2 ± 1·4	0·013 ± 0·006	248 ± 13	0·33 ± 0·04
Sphyraena obtusata, Obtuse barracoda	45·5 ± 15·1	0·032 ± 0·010	0·20 ± 0·05	390 ± 17	90·6 ± 11·4	26·6 ± 1·0	0·005 ± 0·003	218 ± 11	0·31 ± 0·06
Thenus orientalis, Flathead locust lobster	46·1 ± 13·7	0·25 ± 0·07	0·14 ± 0·06	347 ± 26	368 ± 91	47·8 ± 3·6	0·052 ± 0·018	255 ± 34	1·40 ± 0·11

[a] A total of five individual raw samples (fillet) were analyzed for each finfish, and 10 samples (edible portion) for each shellfish (i.e. crab, prawn and lobster).
[b] English common names and scientific names (in Latin) of fish are according to Fischer and Bianchi (1984).

of about 0·1, 1·0 and 2·0%, respectively. The carbohydrate content of finfish is negligible (Sidwell *et al.*, 1974). The amounts of protein in all the fish investigated were relatively high and varied within a very narrow range. This was also generally true for the moisture and ash contents, both of which exhibited relatively small variations in the various finfish and shellfish (Table 1).

Among the nine nutrient minerals investigated, the most abundant in finfish was potassium followed by phosphorus (Table 2). However, considerable amounts of sodium were found in shellfish and, in the case of crab and lobster, the levels of sodium were actually slightly higher than the levels of potassium. The amount of calcium varied from one fish species to the other with the maximum value (95·9 mg/100 g) found in crab and the minimum value (5·73 mg/100 g) observed in cobia. Magnesium varied within a relatively narrow range in finfish (25·0–35·0 mg/100 g) and was present in higher concentrations in shellfish (44·0–47·0 mg/100 g). This was also true for zinc and copper, both of which were found in relatively higher concentrations in shellfish. However, since shellfish are more susceptible to pollutants in the marine environment, the high levels of zinc and copper might be due to contamination. Iron was found in low amounts (Table 2) whereas only traces of manganese were detected in all the fish investigated.

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