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CONTENTS OF SELECTED MACRONUTRIENTS IN VARIOUS MARINE FISH FROM THE ARABIAN SEA

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Twelve marine fish species from the Arabian Sea were selected for the estimation of calcium, sodium, potassium and magnesium by atomic absorption technique. The species included in the study were salmon, tuna, pomfret black, pomfret silver, longtail tuna, Indian oil-sardine, toli shad, giant catfish, talang queen fish, silver grunt and gold lined seabream. The macronutrient estimation was performed in the edible muscle of these species to check their nutritional quality on the basis of recommended dietary allowances laid down internationally. The observed clacium range was 95-210 μg/g (wet weight basis) with an average of 131.5 μg/g for all species. The potassium content ranged from 1648 to 3015 μg/g, while the levels of magnesium ranged from 150 to 330 μg/g. Similarly, sodium levels were averaged at the extremum values of 350 and 1210 μg/g. On the whole, almost all the fish species were found to be potential sources of the macronutrients.

Key words: Macronutrients in fish, Marine fish analysis.

INTRODUCTION

The biological significance of calcium, sodium, potassium and magnesium as macronutrients is well known and these elements are considered essential to sustain life [1,2]. Also, they play vital role in human growth, development and reproduction. Sodium and potassium are distributed throughout the human body in the form of body fluids activating metabolic processes of varied nature [3]. Magnesium ions chiefly participate in functions within cells and are complexed to nucleic acids for nerve impulse transmissions, while calcium ions have greater affinity for oxygen-containing ligands, supporting the formation of bones and of calcium salts (phosphate, oxalate etc) in the blood.

Freshwater and marine fish are a potential source of these macronutrients. Ever since the problem of fish contamination by mercury was discovered in 1973 [4], the essential mineral nutrients too were suspected of contaminating fish when present in excessive amounts. The present work on the estimation of four macronutrients in local commercial marine fish was undertaken to check if a health hazard was associated with the consumption of these fish. The study was thus undertaken both from a nutritional and a health hazard point of view. Also, in the absence of comparative data, this information was justifiably assumed to serve as a baseline for further study leading to the nutritional quality assessment of these and other fish in the region. The study would thus extend the required information on the amount of sodium, potassium, calcium and magnesium in the edible muscle tissue of the local marine fish. The fish included in the study were: salmon (salmon sole), tuna (*Thunnus thynnus*), pomfret silver (*Pampus argenteus*), pomfret black (*formioniger*), longtail tuna (*Thynnus tonggel*), Indian oil-sardine (*Sardinella longiceps*), toli shad (*Tenualosa toli*), giant catfish (*Arius thala*), talang queenfish (*Scomberoides commersonianus*), threadfin bream (*Nemipterus japonicus*), silver grunt (*Pomadasys argyreus*) and goldlined sea bream (*Rhabdosargus sarba*), all abundantly available along the coastal line of the Arabian Sea off the Karachi shore (Fig. 1). The fish samples were collected through local fisherman during September 1986 to April 1987.

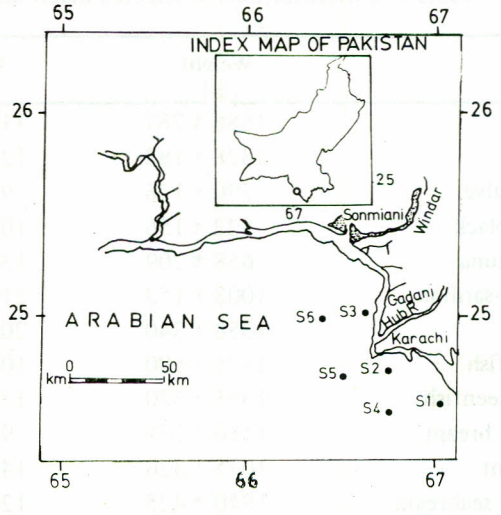

Fig. 1. Location of sampling sites along Karachi coast.

EXPERIMENTAL

The individual samples, consisting essentially of the muscle tissue (≃ 100 g), were washed with distilled water only sparingly to remove any foreign contamination. These were then drained gently under folds of filter paper, ground in an electric blender, packed in thick plastic envelopes and deep frozen at -10° until analyzed.

The analytical procedure consisted in taking 15.0 g of sample in an acid washed, previously dried crucible and exposing it to infra-red heat lamp for 5 hr. to dry and char. After that the crucible containing the sample was placed in a furnace at 400° for 24 hr. when finally a white ash was obtained. To the crucible were then added 10 ml of 10 % nitric acid and it was heated gently for 2 hr. The content of the crucible was filtered through Whatman paper No. 40 with several rinsings using 5 % nitric acid and finally made up to 50 ml with the acid. The digest was used for the estimation of macronutrients in a given sample by the atomic absorption technique. Hitachi atomic absorption spectrophotometer, model 170-10, was used in this investigation using air-acetylene flame. FAO standards were run in parallel to our own standards. Blank runs on the acid used were conducted to incorporate background correction. Replicate measurements (3-5) were undertaken to ensure reliability of data. Control samples of fish were routinely analyzed to check the precision and accuracy of the method.

RESULTS AND DISCUSSION

The concentrations of the selected macronutrients in the edible muscle of various marine fish species are given in Table 1. The reported data are expressed at ± S(standard deviation) level and as such appear as averages over the entire weight range for individual species of fish. The selection of weight of a given fish was rather tentative in terms of preference of fish eaters.

In the twelve fish species studied the incidence of occurrence of Ca, K, Mg and Na was found to be 100 %. Of all the species, only two (pomfret silver and threadfin bream) showed the minimum marginal concentration of Ca at levels of 95 μg/g and 98 μg/g, although their mean weight differential was significant, 590 g vs 1150 g. The maximum concentration of 210 μg/g Ca was found in Indian oil-sardine having a mean weight of 1003 g. Thus the observed Ca range was 95-210 μg/g, with an average for all the twelve species standing at 131.5 μg/g. This was in good agreement with 124 mg/kg for ten species of fish reported by Gordon and Roberts [5]. The data are also in agreement with those reported by Yoshiko *et al.* on average basis at 160 μg/g (wet weight) for various fish [6]. Although Gordon and Roberts' study included the Pacific cod, Dover sole, Pacific whiting and other species uncommon in Pakistan in our study, yet a direct comparison was effected to justify the nutritional content in the local fish. The present data on Ca indicate that the fish samples were not bone-contaminated as none of the estimated Ca concentrations was abnormally high, as for instance, to the tune of 280 mg/kg reported by Sidwell *et al.* [7]. The present data on Ca content in pomfret silver (95 ± 18 μg/g) also compare well with those reported by Teeny *et al.* for pomfret (88±25 μg/g) from the Gulf of Alaska [8].

In the case of K, the observed range was between 1648 to 3015 μg/g. As in the case of Ca, the K content of the fish under investigation did not turn out to be weight-dependent. Salmon had the least K content while Indian

Table 1. Concentrations of selected macronutrients in edible muscle of various marine fish at ± S level.*

Species	Weight (g.)	Ca	K	Mg	Na
Salmon	1888 ± 787	115 ± 22	1648 ± 550	150 ± 26	751 ± 140
Tuna	1328 ± 183	127 ± 27	2243 ± 348	194 ± 28	991 ± 127
Pomfret silver	590 ± 126	95 ± 18	3000 ± 450	205 ± 31	897 ± 200
Pomfret black	522 ± 156	101 ± 22	1978 ± 550	264 ± 40	371 ± 140
Longtail tuna	658 ± 209	130 ± 31	2439 ± 380	254 ± 47	1204 ± 301
Indian oil-sardine	1003 ± 153	210 ± 35	3015 ± 650	289 ± 29	750 ± 210
Tolishad	1350 ± 340	200 ± 30	2220 ± 351	330 ± 27	975 ± 205
Giant catfish	1875 ± 500	104 ± 19	1998 ± 302	329 ± 32	834 ± 184
Talang queenfish	1365 ± 370	133 ± 32	3011 ± 500	175 ± 21	1082 ± 96
Threadfin bream	1150 ± 275	98 ± 18	2896 ± 540	275 ± 29	350 ± 147
Silver grunt	1075 ± 320	145 ± 37	2722 ± 370	324 ± 48	1210 ± 129
Goldlined seabream	1970 ± 425	120 ± 25	1972 ± 390	315 ± 31	1073 ± 150

*Percent incidence - 100 %.

oil-sardine contained maximum potassium content. The average potassium content for the twelve fish was found to be 3370.8 μg/g, as compared with 4370 mg/kg quoted by Gordon and Roberts, 3300 mg/kg by Thurston [9], 2900 mg/kg by Takako *et al.* [10] and 3730 mg/kg by Basil [11].

The levels of Mg averaged as minimum (150 μg/g) for salmon and as maximum (330 μg/g) for tolishad were comparable to those in Talang queenfish and giant catfish within the limits of experimental error. As in case of Ca and K, the levels of Mg varied from species to species although there was no marked difference between these contents and the placement of the geographical areas of catch. This was the basic reason for combining the data on average weight basis. This approach was considered justifiable since the fish represented almost the same biotope. The Mg content was found to be comparable with those reported by various workers: 270 mg/kg Mg in pomfret silver [11]; 330 mg/kg in grunt [10] and 306 mg/kg in shad [8].

Sodium levels averaged at a minimum of 350 μg/g for threadfin bream and a maximum of 1210 μg/g for silver grunt. The average Na content for all the species was computed to be 874 μg/g, as compared with 680 mg/kg quoted by Thurston [9], although for different species of fish having different origins. The Na content was again found to be highly species-specific and in close agreement with the reported values for various fish in the literature. Maximum sodium was reported by Takako [10] in the Pacific saury (3960 mg/kg), with an average of 1420 mg/kg for various fish. Our results are thus on the lower side.

The present study reveals that the local marine fish species are rich in nutritional quality. All the fish species had macronutrient levels according to the recommended daily dietary allowance (RDA) for the safe intake by humans. The estimated safe and adequate daily dietary intakes (EDI) for Ca, K, Mg and Na as recommended by NRC [12] are 120 mg/kg, 2900 mg/kg, 279 mg/kg and 704 mg/kg respectively for the edible muscle tissue of fish. On the basis of this standard pomfert silver and threadfin bream do not meet the requirement for Ca intake per kg. Also the K requirement is not met with by salmon, pomfret black, tolishad, giant catfish and goldlined seabream.The same is true about salmon, tuna, pomfret silver and talang queenfish in the case of Mg, while pomfret black and threadfin bream were labelled as deficient in Na content.

In conclusion, the local fish on the whole are a potential source of these macronutrients and as such do not possess excessively high levels to pose any physiological problem for the consumers.

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