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The Inorganic Phosphate Contents in the Muscles of some Teleosts of Different Feeding Habits in the Red Sea

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The inorganic phosphate (Pi) contents of the muscles of some economically important Red Sea teleosts were determined. The fish species included were of different feeding habits: carnivorous, omnivorous and herbivorous. Herbivore group showed the highest level of inorganic phosphate followed by omnivore and carnivore. The variations of the total content of inorganic phosphate existed in the muscle of fish of the same feeding habit do exist.

Key words: Teleost fish, Inorganic phosphate, Muscle, Red sea, Feeding habit.

Introduction

The major building blocks of living animals are covalent molecules, polymers proteins, polysaccharides and nucleic acids. Living matter has a huge demand for phosphorus. DNA and RNA are nucleosides joined by phosphodiester bridges, and the high energy phosphate bond of ATP is one of the major energy currencies of living organisms. Cell membranes are composed mainly of phospholipids, and the inorganic constituents of bone are primarily a calcium phosphate salt. A variety of enzymatic activities are controlled by cellular kinases and phosphatases. The metabolism of many substrates depends on the phosphorus as a cofactor and as a principal reservoir for metabolic energy in the form of ATP, creation phosphate and phosphoenolpyruvate (Shil *et al* 1984). Inorganic phosphate could serve as a protection factor in lipid peroxidation in certain fish (Han and Liston 1989). It also played an important role in light-induced activation of H^+pumps in the plasma membrane and tonoplast of *Chara corallina* (Takeshige *et al* 1992). It could be a pollution parameters in coastal water (Gupta 1997), an indicator of ovarian maturation (vitellogenesis) Srivastav and Srivastav 1998), a buffer component in the control of the intracellular pH in white muscle during anaerobic burst swimming (Ogata *et al* 1998), and on vitamin D level in feshwater fish (Srivastav *et al* 1997). In general, food sources high in protein (meat, milk, eggs and cereals) are also high in phosphorus. The relative contribution of the major food groups to the total phosphorus intake is about 60% from milk, meat, poultry, fish and eggs, 20% from cereals and legumes and 10% from fruits and fruit juices, whereas other beverages such as coffee and tea and soft drinks provide 3% (Knochel 1977). Chronic phosphorus deficiency in animals results in the loss of appetite, development of stiff joints, fragile bones and a marked increase in susceptibility to infection (Block *et al* 1985). This study was conducted to evaluate the total content of inorganic phosphate in the muscle of fish living in the red sea in relation to their feeding habits.

Materials and Methods

Ascorbic acid, EDTA (ethylenediamine tetra acetic acid, disodium salt, $2H_2O$), molybdic acid, dihydrogen potassium phosphate and hydrochloric acid were obtained from Sigma Chemical Co., St. Louis, MO, USA. All other chemicals were reagent grade.

Fish species. Twelve economically teleosts (bony fish) species collected from Red sea were used in this study. Fresh fish of same size obtained from the fish market in jeddah were analyzed for Pi content.

Carnivorous fish. (i) Hamoor *(Epinephelus malabaricus).* (ii) Thouaina *(Epinephelus tauvina).* (iii) Louati *(Variola louti).* (iv) Baiad *(Alepes djeddaba).* (v) Garba *(Synodus variegatus).*

Omnivorous fish. (i) Hafar *(Crenidens crenidens).* (ii) Rabaag *(Mylio bifasciatus).* (iii) Macaroona *(Athernomorus lacunosus).* (iv) Sardin. *(Herklotsich.thys quadrlmaculatus)* (v) Bagah *(Rastrelliger kanagurta).*

Herbivorous fish. (i) Harid *(Scarus harid).* (ii) Sigan *(Siganus rivulatus)*

Sample preparation. Fish muscles were feleted, cleaned from skin and scales, and cut into small pieces. Samples were kept in the freezer (-80°C). Two grams of each sample were digested in 6 N HCl in semi-closed bioling water bath for 5 hr.

Determination of inorganic phosphate. The method of Fiske and subbarow was used (Fiske and subbarow 1925). Inorganic phosphate could reacted with ammonium

molybdate to form phosphomolybdinlum ion which was then reduced with ascorbic acid and analyzed at 700 nm.

Statistical methods. The data collected entered into personal computer and analysis of the data were performed using SPSS statistical package.

Results and Discussion

Figure 1 shows the total content of inorganic phosphate in the muscle of different fish species. It seemed that the variations of the total content of inorganic phosphate existed in the muscle of fish of the same feeding habit. The total content of inorganic phosphate in the muscle of fish of different feeding habits. Herbivore group had the highest level of inorganic phosphate (540.4 μmole Pi/min mg protein) followed by omnivore (512.6 μmole Pi/min mg protein and carnivore (426.9 μmole Pi/min mg protein).

Any evaluation of dietary phosphorus adequacy should consider not only the quantitative aspects of phosphorus consumption, but also bioavailability of phosphorus from various food sources. In general, phosphorus bioavailability is greater from animal products than from plant-based foods and

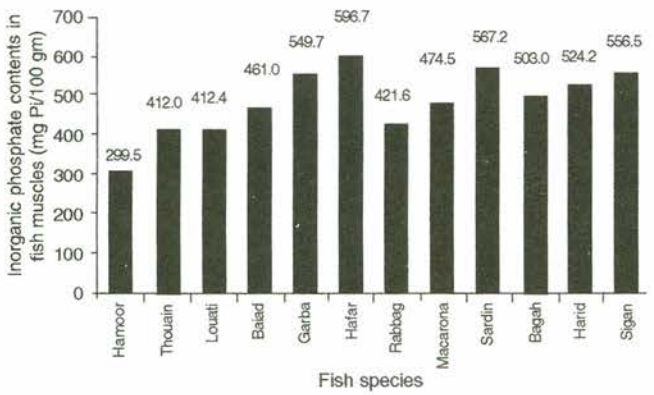

Fig 1. Inorganic phosphate contents in the fish muscle of different species. Hamoor, thousain, louati, baiad and garba are carnivorous fish, hafar, rabbag, macarona, sardin and bagah are omnivorous fish, and harid and sigan are herbivorous fish.

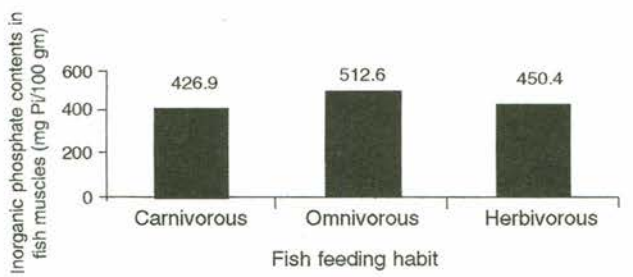

Fig 2. Inorganic phosphate contents in the fish muscle of different feeding habits.

the phosphorus from different meat source is well absorbed (> 70%) by humans (Schuette and Linkswiler 1982). Phosphorus in meat is found mainly as intracellular organic compounds that are mostly hydrolyzed in the gastrointestinal tract, releasing inorganic phosphorus that is available for intestinal absorption.

This study was aimed to determine the total contents of inorganic phosphate in the muscle of fish and to relate the value obtained to the fish feeding habit. Herbivore group has the highest level of inorganic phosphate content followed by omnivore then carnivore Fig 2. This may be due to the fact that herbivore risk has a broad spectra of plant sources that are rich of inorganic phosphate. Further research will directed towards analysis the content of inorganic phosphate in these plants which might be used as a direct source of inorganic phosphate for animal or human feed if it suitable.

Figure 1 also shows some variation in the total content of inorganic phosphate in the muscle of fish of the same feeding habit. It indicated that each fish has a specialized source of food (Suberkropp and Jones 1991).

Some fish with high content of inorganic phosphate are cheaper than others but are not preferable in our society. The knowledge of nutritional values of these fish might change their preferences.

References

Block G, Dresser CM, Hartman AM 1985 *Am J Epidemiol* **12** 213-26.

Fiske CH, Subbarow Y 1925 The colorimetric determination of Phosphorus. *J Biol Chem* **66** 375-400.

Gupta A 1997 Study of coastal water pollution in Tamil Nadu. *J Ecotoxicol Environ Monitoring* **7** (2) 89-93.

Han TJ, Liston J 1989 Lipid peroxidation protection factors in rainbow trout *(Salmo gairdnerii)* muscle cytosol. *J Food Sci* **54** (4) 809-813.

Knochel P 1977 The pathophysiology and clinical characteristics of severe hypophosphatemia. *Arch Intern Med* **137** 203-220.

Ogata HY, Konno S, Silverstein JT 1998 Muscular buffering capacity of the parr and smolts in Oncarhynchus masou. *Aquaculture* **168** (1-4) 303-310.

Schuette S, Linkswiler H 1982 Effects on Ca and P metabolism in humans by adding meat, meat plus mild, or purified proteins plus Ca and P to a low protein diet. *J Nutr* **112** 338-349.

Shils ME, Olson JA, Shike M 1984 In: *Modern Nutrition in Health and Disease:* Eighth edition, Lea Vol 1 & Febiger, Philadelphia.

Srivastav A K, Srivastave S K, Sasayama Y, Suzuki N, Norman

AW 1997 Vitamin D metabolites affect serum calcium and phosphate in freshwater catfish. Heteropneustes fossillis. *Zool Sci* **14** (5) 743-746.

Srivastav SK, Srivastav AK 1998 Annual changes in serum calcium and inorganic phosphate levels and correlation with gonadal status of a freshwater murrel, *Channa punctatus*. Braz *J Med Biol Res* **31** (8) 1069 1073.

Suberkropp K, Jones E O 1991 Organic phosphorus nutrition of some aquatic hyphomycetes. *Mycologia* **83** (5) 665-668.

Takeshige K, Mitsumori F, Tazawa M, Mimura T 1992 The role of cytoplasmic inorganic phosphate in light-induce activation H^+-pumps in the plasma membrane and tonoplast of *Chara coralinaPlanta J* **86** (3) 466-472.