Fish Physiology

नमूना • SAMPLE

नमूना • SAMPLE

Fish Physiology

Saaduz Zafar Ali
Dr. Kunvar Dlip Prtap Singh

SAMPLE



AKHAND PUBLISHING HOUSE
DELHI (INDIA)

Published by



AKHAND PUBLISHING HOUSE

Distributors, Library Supplier, Online Bookstore & Exporter

Head Office : L-9A, First Floor, Street No. 42,
Sadatpur Extension, Delhi-110090 (INDIA)
Phone No.: 9968628081, 9555149955 & 9013387535
E-mail : akhandpublishinghouse@gmail.com,
akhandpublishing@yahoo.com
Website : www.akhandbooks.com

Fish Physiology

© Saaduz Zafar Ali, Dr. Kunvar Dlip Prtap Singh

Ist Edition 2021
ISBN 978-93-90870-67-7

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, transmitted or utilized in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the copyright owner Author/Editors. Application for such permission should be addressed to the Publisher and Author/Editors. Please do not participate in or do not encourage piracy of copyrighted materials in violation of the author's rights. Purchase only authorized editions.

The responsibility for facts stated, opinion expressed or conclusions reached and plagiarism, if any, in this book is entirely that of the author. Neither the publishers nor the editor will be responsible for them whatsoever.

Printed in India

Published by Jhapsu Yadav for Akhand Publishing House. Cover Designed and Laser Typesetting at VM Graphic and Printed at Aarna Enterprises, Delhi.

AKH • SAMPLE

Preface

Fish physiology is the scientific study of how the component parts of fish function together in the living fish. It can be contrasted with fish anatomy, which is the study of the form or morphology of fishes. In practice, fish anatomy and physiology complement each other, the former dealing with the structure of a fish, its organs or component parts and how they are put together, such as might be observed on the dissecting table or under the microscope, and the later dealing with how those components function together in the living fish.

Fish are an important resource worldwide, especially as food. Commercial and subsistence fishers hunt fish in wild fisheries or farm them in ponds or in cages in the ocean (see aquaculture). They are also caught by recreational fishers, kept as pets, raised by fishkeepers, and exhibited in public aquaria. Fish have had a role in culture through the ages, serving as deities, religious symbols, and as the subjects of art, books and movies. Fish are a huge group of animals, represented by over 28 000 different species. They are the oldest as well as the largest group of vertebrates.

Most fish exchange gases using gills on either side of the pharynx (throat). Gills are tissues which consist of threadlike structures called filaments. These filaments have many functions and "are involved in ion and water transfer as well as oxygen, carbon dioxide, acid and ammonia exchange. Each filament contains a capillary network that provides a large surface area for exchanging oxygen and carbon dioxide. Fish exchange gases by pulling oxygen-rich water through their mouths and pumping it over their gills. In some fish, capillary blood flows in the opposite direction to the water, causing countercurrent exchange. The gills

SAMPLE

push the oxygen-poor water out through openings in the sides of the pharynx.

In biology, reproduction is the process by which new individual organisms are produced. Reproduction is a fundamental feature of all known life; each individual organism exists as the result of reproduction. Although the term reproduction encompasses a great variety of means by which organisms produce new offspring, reproductive processes can be classified into two main types: Sexual reproduction and asexual reproduction.

In fish, fertilisation of eggs can be either external or internal. In many species of fish, fins have been modified to allow Internal fertilisation. Similarly, development of the embryo can be external or internal, although some species show a change between the two at various stages of embryo development. Thierry Lodé described reproductive strategies in terms of the development of the zygote and the interrelationship with the parents; there are five classifications - ovuliparity, oviparity, ovo-viviparity, histotrophic viviparity and hemotrophic viviparity.

The book describes candidly the life processes of fishes, particularly their functions that relate to organs and organ systems. Although fishes have many of the similar vertebrate characteristics found in humans, they differ remarkably in other ways because of the strict limitations placed on them and beacuse of the unique opportunities afforded to them by their aquatic environment.

Saaduz Zafar Ali
Dr. Kunvar Dlip Prtap Singh

Contents

Preface (*v*)

1. Nutrition **1**
- Alimentary Canal and It's Modification in Relation to Food and Feeding Habits Associated Glands
- Digestion and Energy Utilization

2. Circulatory System **48**
- Fish Anatomy
- Heart Structure and Blood Vessels

3. Respiration **92**
- Structure and Function of Gills, Gill Rackers and Their Uses
- Counter Current Mechanism
- Gas Exchange
- Transport of Oxygen and Carbon Dioxide
- Accessory Respiratory Organ and Physiology Adaptation in Air Breathing Fishes
- Swim Bladder

4. Excretion **154**
- Kidney Structure and Modifications Nitrogenous Excretory Products, Urine Formation

5. Osmoregulation **172**
- Osmoregulation in Fresh Water Fishes
- Osmoregulation in Migratory Fishes

SAMPLE

6. Endocrine Glands **203**

- Pineal, Hypophysis, Thyroid, Adrenal, Ultimobranchial Body
- Corpuscles of Stannous and Urophysis

7. Reproduction **234**

- Gonad Structure Spermatogenesis, Oogenesis, and Endocrine Control of Reproduction

Bibliography **273**

Index **275**

नमूना • SAMPLE



Nutrition

Animals need a variety of nutrients to meet their basic needs. These nutrients include fats and carbohydrates that provide energy, proteins that furnish amino acids, vitamins that serve as co-factors for enzymes and perform other functions, ions required for water balance and for nerve and muscle function, and selected elements that are incorporated into certain molecules synthesized by cells.

To determine the levels of nutrients that are needed to sustain normal activities, researchers monitor the relationship between nutrient intake, the levels of nutrients maintained in the body, and health. To determine how nutrition can affect athletic performance, researchers alter the intake of specific nutrients and assess how athletes respond.

For example, investigators have shown that athletes who ingest a high-carbohydrate diet for three days outperform individuals who ingest a high-fat, high-protein diet.

There are seven major classes of nutrients: carbohydrates, fats, fiber, minerals, protein, vitamin, and water. These nutrient classes can be categorized as either macronutrients (needed in relatively large amounts) or micronutrients (needed in smaller quantities). The macronutrients are carbohydrates, fats, fiber, proteins, and water.

The micronutrients are minerals and vitamins. The macronutrients (excluding fiber and water) provide structural material (amino acids from which proteins are built, and lipids

SAMPLE

from which cell membranes and some signaling molecules are built) and energy.

Some of the structural material can be used to generate energy internally, and in either case it is measured in joules or calories (sometimes called "kilocalories" and on other rare occasions written with a capital C to distinguish them from little 'c' calories). Carbohydrates and proteins provide 17 kJ approximately (4 kcal) of energy per gram, while fats provide 37 kJ (9 kcal) per gram., though the net energy from either depends on such factors as absorption and digestive effort, which vary substantially from instance to instance.

Vitamins, minerals, fiber, and water do not provide energy, but are required for other reasons. A third class dietary material, fiber (i.e., non-digestible material such as cellulose), seems also to be required, for both mechanical and biochemical reasons, though the exact reasons remain unclear.

Molecules of carbohydrates and fats consist of carbon, hydrogen, and oxygen atoms. Carbohydrates range from simple monosaccharides (glucose, fructose, galactose) to complex polysaccharides (starch).

Fats are triglycerides, made of assorted fatty acid monomers bound to glycerol backbone. Some fatty acids, but not all, are essential in the diet: they cannot be synthesized in the body. Protein molecules contain nitrogen atoms in addition to carbon, oxygen, and hydrogen. The fundamental components of protein are nitrogen-containing amino acids, some of which are essential in the sense that humans cannot make them internally. Some of the amino acids are convertible (with the expenditure of energy) to glucose and can be used for energy production just as ordinary glucose. By breaking down existing protein, some glucose can be produced internally; the remaining amino acids are discarded, primarily as urea in urine. This occurs normally only during prolonged starvation.

Other micronutrients include antioxidants and phytochemicals which are said to influence (or protect) some body systems. Their