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[OVERVIEW]

Recent Advances in Endocrine and Neuroendocrine Systems

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The endocrine and neuroendocrine systems exert powerful and broad control over the regulation of homeostasis in animals. Secreted hormones play significant roles in lifetime-related events such as germ cell development, sexual maturation, development, metamorphosis, aging, feeding, and energy metabolism. Additionally, hormones, particularly sex steroid hormones, are involved in reproduction, including sexual behavior and dimorphism. Changes in body color protect against external enemies, and circadian rhythms direct physiology and behaviors in synchrony with light and dark cycles. Water and electrolyte metabolism are essential for survival in land or seawater. Both aquatic and terrestrial animals have developed a variety of endocrine and neuroendocrine systems that exquisitely manage water and electrolyte metabolism to support survival. In zoological science, many animal species are investigated for their unique life history phenomena, and many researchers bring original and unique research approaches to understand these phenomena. Exploring such a variety of animal species leads to an understanding of diversity and unity, and contributes to the development of comparative endocrinology. This Special Issue contains 15 papers focusing on the endocrine mechanisms involved in the aforementioned life phenomena.

Key words: endocrinology, aging, growth, metamorphosis, energy metabolism, reproduction, environmental adaptation

INTRODUCTION

Endocrinology is the scientific discipline that examines the integrative regulation of living organisms by humoral factors generally known as hormones. Hormones such as peptide hormones, steroid hormones, and amino acid derivatives tightly control various physiological processes in animals. Throughout history, endocrinology has developed substantially through the application of various scientific approaches, including those based on morphology and histology, as well as recent research that employs molecular biology to investigate gene expression and molecular evolution. Zoological scientific research has contributed to understanding both the physiological functions of hormone molecules across species and the diversity and unity of hormonal systems from a molecular evolutionary perspective.

Undoubtedly, endocrinology is a vital area of study within zoology. To this end, we have prepared this Special Issue dedicated to endocrinology and have invited respected leading researchers in comparative endocrinology to share their work. Consequently, we have selected seven original research papers, seven review articles, and one essay for publication. The animal species covered in these reports include a broad collection of insects, crustaceans, ascidians, fish, amphibians, reptiles, birds, and mammals. Similarly, and as are introduced here below, these papers address a broad range of topics related to endocrine and neuroendocrine systems, such as aging, development, growth, metamorphosis, feeding and energy metabolism, reproduction, social behavior, biological rhythms, body color regulation, water and electrolyte metabolism, and more.

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METABOLISM AND DEVELOPMENT

Qian and Niwa (2024) review the aging, lifespan, and age-related physiology in the fruit fly, *Drosophila melanogaster*. Their report focuses on the roles of insulin-like peptides, ecdysteroids, juvenile hormones, biogenic amines, and gut-derived hormones.

Toyota et al. (2024) describe the isolation of two crustacean hyperglycemic hormones (CHHs) from the sinus glands of the Japanese spiny lobster, *Panulirus japonicus*. They also demonstrated that the hyperglycemic activity of lobster CCH was found in the red-swamp crayfish, *Procambarus clarkii*.

Hayasaka et al. (2024) found that Sirt1 is necessary for the hypoxia/reoxygenation-induced catch-up growth in zebrafish (*Danio rerio*) embryos. They additionally showed that Sirt1 activated the somatotropic mitogen-activated protein kinase (Mapk) pathway.

Matsumoto et al. (2024) investigated the mRNA expressions of adenohypophyseal hormones, hypothalamic hormones, and their receptors in tadpoles of bullfrog (*Rana catesbeiana*) at various developmental stages in both summer and winter. These data indicate that the neuroendocrine system is essential to frogs' seasonal progression/stasis of metamorphosis.

Kaiya (2024) delivers a focused report on feeding inhibition by ghrelin in birds. Moreover, the recent findings were reviewed to clarify feeding regulation by various neurotransmitters in the brain. In this regard, urocortin, a corticotropin-releasing hormone family peptide, is a fundamental factor for ghrelin action in birds.

Kato et al. (2024) identified cDNAs encoding two small proteins, NPGL and NPGM, in the hypothalamus of the Japanese quail, *Coturnix japonica*. These data show that NPGL and NPGM may have different physiological functions in quail, and contribute to sex differences in energy metabolism.

REPRODUCTION

Satake et al. (2024) review neuropeptidergic regulations in premature follicle growth, oocyte maturation, and ovulation in the ascidian, *Ciona intestinalis* type A (*Ciona rubusta*). These data provide comparative and evolutional views of ovarian follicle development throughout chordates.

Ryu et al. (2024) give a focused report on the androgen receptor (Ar) gene in teleost fishes, which experienced whole genome duplication. They describe how Ar ohnologs participate in male-specific reproductive traits, including fin elongation, courtship behavior, nuptial coloration, and immunity.

Yazawa et al. (2024) present the diversity of androgens in vertebrates. They describe and focus on the significance and characteristics of androgens, including testosterone and 11-ketotestosterone, and on the history of their discoveries and synthetic pathways.

Yamagishi and Miyagawa (2024) focused on the neuroendocrine control of reproduction and social behaviors in reptiles. They describe the progress made in the last decade toward understanding behavior control by sex steroid hormones, seasonal reproduction by melatonin and gonadotropin-releasing hormone, and social interaction by arginine vasotocin.

Shahjahan et al. (2024) investigated the lunar age-dependent mRNA expressions of kisspeptin, gonadotropin-inhibitory hormone, and their receptors in the brain and pituitary of the grass puffer, *Takifugu alboplumbeus*. Their data suggest that these expressions may be necessary to control the precisely-timed semilunar spawning of the grass puffer.

HOMEOSTASIS AND RHYTHM

Hattori and Suzuki (2024) report on the action of melatonin through receptor-dependent and -independent pathways in vertebrates. They discuss melatonin as a key regulator of the circadian rhythm, bone metabolism, and glucose uptake. Furthermore, melatonin has antioxidant properties as a non-receptor-mediated action.

Yang et al. (2024) investigated the effects of water temperature on body color and the expressions of genes related to body color regulation in goldfish, *Carassius auratus*. They show that the expressions of melanin-concentrating hormone and its receptor are modulated depending on temperature in the case of white background.

Hibino et al. (2024) investigated the ontogenetic expression of aquaporins in the kidney and urinary bladder of the Japanese tree frog, *Dryophytes japonicus*. They show that the expression of aquaporins at developmental stage 42 may contribute to water reabsorption and acclimation to terrestrial environments.

The essay by Takei (2024) discusses the important contribution of metabolic water to hydromineral homeostasis in vertebrates inhabiting dehydrating environments. The data show that metabolic water production plays a role in counteracting dehydration before the reversal of regulated water movement from excretion in freshwater to acquisition in seawater.

As described above, this Special Issue encompasses a wide array of disciplines in zoological science and the advantage of comparative endocrinology approaches. We hope that the readers find the entire issue enjoyable, and use this opportunity to discuss future studies in zoological science.

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COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS

KU and RO wrote the manuscript.

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