Prolactin, the Diverse Function Enzyme

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Prolactin, a hormone most often known for its role in promoting milk secretion in mammals, is present in all vertebrates and some invertebrates, taking a widely differentiated role in each. This article aims to explore the diversification of evolution through the unique roles of prolactin in different animals.

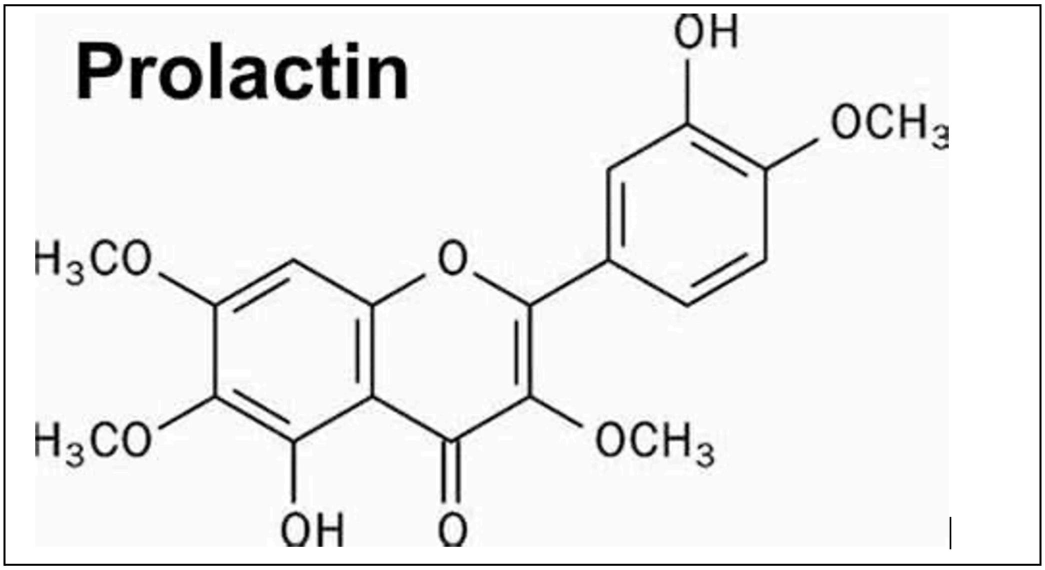

Figure 1: *Chemical structure of prolactin, a single chain polypeptide comprising 199 amino acids.*

Prolactin first appeared during the evolution of jaw fishes hundreds of millions of years ago. Since then, it has undergone multiple diversifications and is currently recorded to have more than 300 distinct functions. Despite the differences in functions, signs of common ancestry are shown in prolactin. They have three highly conserved intramolecular disulfide bonds [1] and a single polypeptide chain. Furthermore, the signaling pathways and regulation pathways are similar mechanisms in most animals. However, despite the common ancestry, prolactin functions vary significantly across animals.

For instance, in fish, prolactin function is extended from the usual breeding and reproduction. It is involved in migration, osmoregulation, reproductive development, brood care behavior, pregnancy, and nutrient provisioning to offspring [3]. For osmoregulation, prolactin promotes ion uptake in gill epithelial cells by increasing the activity of ion transporters. This process helps freshwater fish regain important ions like Na+ and Cl- that have diffused out of cells due to the concentration gradient. In euryhaline fish that can move between different salinity environments, prolactin levels can adjust to the salinity of the environment to control ion uptake and maintain osmoregulation.

In amphibians, prolactin stimulates behaviors in courtship, reproduction, larval development, skin permeability regulation, metamorphosis, and other diverse functions [4]. Male túngara frogs (*Engystomops pustulosus*) have shown elevated levels of prolactin during their breeding seasons. This is believed to cause the production of complex mating cells, which are essential for attracting females. Similarly, in rough-skinned newts (*Taricha granulosa*), a type of salamander, prolactin initiates the spermatophore transfer from males to females during mating.

In reptiles, prolactin alters the calcium levels of the animal by influencing its abundance in the gut, the bones, and the excreted solution of the kidneys [6]. By doing so, prolactin supports calcium metabolism and eggshell formation in reptiles that lay calcified eggs.

In birds, prolactin is implicated in the switch from breeding to brooding. All birds have demonstrated a rise in prolactin levels by late incubation, and research shows that prolactin drives the formation of the brood patch that facilitates heat transfer from the body to the eggs [5]. This formation is further enhanced by a positive feedback loop in which the nerve cells on the brood patch stimulate more prolactin to be released, reinforcing the development of the brood patches.

In mammals, prolactin is synthesized initially by lactotrophs in the anterior pituitary gland, a region of the brain just below the hypothalamus. It travels through the bloodstream to the breasts of females and stimulates milk production and the development of mammary glands within breast tissues. It promotes the growth of mammary alveoli, the site of milk production, and then causes these alveoli to synthesize components of milk like lactose [2].

In conclusion, prolactin is a hormone present in a large range of animals, from fish to mammals. Its common ancestry and diverse functions show that different organisms develop traits suitable for their survival and is a strong piece of evidence for evolution.

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