

Application of Breeding Hormones (Pituitary Gland and Ovaprim) in fisheries sector, Pakistan

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ABSTRACT

The administration of the breeding hormones, especially Pituitary Gland (PG) and Ovaprim induce breeding is a reproductive phenomenon in aquatic species within Pakistan. Such endocrinological agents have taken the central stage as a tool applied in aquaculture practices for enhancing the success rates of reproduction. It presents a comprehensive evaluation of the endocrine processes, species-specific responses and the coordination between the prescribed amount and administration timing. The mean mass of broodfish ranges from 2-4 kg. Fish response regarding the two hormones, PGE and Ovaprim was compared. Their consequences for aquaculture resilience, offering intricate strategies for augmenting breeding protocols and tackling the inherent obstacles of hormonal stimulation methodologies.

Keywords: Breeding Hormones, Ovaprim, Pituitary Gland

1. Introduction

The Fisheries sector performs a fundamental role in worldwide food surety and nutrition, offering substantial sources of animal-based protein, indispensable fats, and vitamins [1]. In worldwide fish are a major source of dietary protein. In Southeast Asia, fish are the fundamental components of the diet, offering essential nutrients and providing nutritional security [2]. Globally, in developing regions, humans utilize 17% of animal protein, which is obtained from the fisheries sector. Fish and seafood are plentiful sources of imperative nutrients, such as omega-3 fatty acids which are particular kind of fatty acids, as well as diverse minerals and vitamins, all these provide significantly to amplifying human health [3]. Pituitary gland extract stimulates oocyte and sperm expulsion in fish through promoting ovarian and testicular function, bypassing the brain-pituitary axis. This hypophysation technique, in fish culture amenities to regulate spawning and improve spawn quality and timing, as compared to inconsistent natural spawning methods [4]. However, developments in aquaculture have implemented advanced techniques, including the use of synthetic hormones such as Ovaprim. Ovaprim is a hormonal therapy used to promote spawning in fish. Salmon-gonadotropin-releasing hormone (sGnRH α) coupled with the dopamine suppressor, domperidone, is a synthetic equivalent of Ovaprim. This amalgamation of these components enhances the gonadotropic hormones which are released by the pituitary gland, thus releasing eggs and sperm in reproductively mature fish [5]. Ovaprim is a synthetic hormone, so the fertilization rate of Ovaprim is higher than the Pituitary Gland. For instance, studies intailing Rohu and Grass carp, Ovaprim yielded a higher rate of breeding, attaining 86.3%, whereas PGE yielded a minimum rate of fertilization is 75% for Rohu and 53.36% for Grass carp. This suggests that Ovaprim induces breeding may be more consistent in these species. Both breeding hormones PGE and Ovaprim are commonly used to stimulate ovulation and spawning in various fish species, but their dosage, administration and effectiveness can vary [6].

2. Pituitary Gland Extract (PGE) in Induced Breeding:

Pituitary Gland is extracted from mature fish, usually from the conspecific or from closely related species. The pituitary gland synthesizes and secretes gonadotropins that exert effects on the gonadal tissues to mature, release eggs or sperm and modulate the reproductive cycles of fish [7].

2.1. Mechanism of Action:

The mechanism by which PGE induces spawning involves several steps:

2.1.1. Collection, Preservation and Preparation:

Induced breeding using pituitary glands of mature fish. The pituitary gland of fish is obtained through dissecting and excision of a segment of the scalp. Then preserve the pituitary gland by three methods:

1. Preservation by Absolute Alcohol
2. Preservation by Acetone
3. By Immediate Freezing

PGE is prepared immediately prior to administration, with the dosage determined according to weight of broodstock. The required amount is calculated with the aid of this formula:

$$\text{Weight of Pituitary Gland} = \text{Wt (g)} \times \text{Pt /1000}$$

Here, Wt symbolizes the total body mass of fish in grams(g), while Pt indicates the dosage of PGE in milligrams per kilogram of body weight [8].

2.1.2. Hormonal Injection:

PGE is administered to the broodstock via injection. The extract is characterized by a high concentration of gonadotropic hormones, predominantly including luteinizing-hormone (LH) and gonadotropin releasing hormone (GnRH) [9].

2.1.3. Stimulation of Gonadal Maturation:

Once injected, the gonadotropins in PGE mimic the natural hormonal signals which stimulates the maturation of the gonads, leading to the development of mature eggs in females and sperm in male.

2.1.4. Induction of Ovulation and Spermiation:

The elevated levels of gonadotropins trigger ovulation and spermiation in fish. Beyond physiological alterations, PGE can also elicit spawning behavior in fish.

2.1.5. Environmental stimuli Effect on mechanism of action:

This study provided significant evidence that the endocrine system in fish acts as a crucial intermediary between environmental factors and reproductive processes. In particular, the hypothalamus-pituitary neuroendocrine axis plays a vital role in converting environmental variations into reproductive cycles. The figure below illustrates the key physiological events that lead to the maturation of gametes and ultimately result in spawning [10].

2.2. Effectiveness of PGE:

The effectiveness of PGE varies depending on several factors:

2.2.1. Species Specificity:

PGE is generally species-specific.

2.2.2. Dosage and Administration:

For successful spawning induction, brood fish receive intra-peritoneal hormone injections at a 45° angle at the pelvic fin base. Females are administered two doses of pituitary gland extract, while males receive one concurrent with the second female dose. Post-injection, fish are promptly returned to a circular tank with water flow to facilitate gamete maturation and release. A priming dose precedes a resolving dose to ensure full gamete maturation [11].

2.3. Applications in Aquaculture:

PGE has been widely used in aquaculture for the induced breeding of various fish species, including Carps, Catfish and Tilapia. In Pakistan, PGE is particularly valuable for breeding indigenous fish species, contributing to the sustainability and productivity of local aquaculture practices.

3. Ovaprim in Induced Breeding:

Ovaprim, a commercial spawning inducer, combines a synthetic GnRH analogue with a dopamine antagonist. GnRH triggers gonadotropin release, promoting gamete maturation and release, while the dopamine antagonist enhances this effect by counteracting dopamine's suppression of gonadotropins. This synergy makes Ovaprim effective among diverse fish species [12].

3.1. Mechanism of Action:

The mechanism by which Ovaprim induces spawning involves several steps:

3.1.1. Hormonal Injection:

Ovaprim is administered to the broodstock via injection. The dose was given to a female inside the muscles by using 2ml graduated syringe at the angle of 30-45° [13].

3.1.2. Stimulation of Gonadal Maturation:

Ovaprim is a formulation combining gonadotropin-releasing hormone (GnRH), luteinizing hormone-releasing hormone (LH-RH) and Butyrophenone (1-Phenyl-1-butanone) hormone. This combination enhances breeding in fish.

3.1.3. Induction of Ovulation and Spermiation: The elevated levels of LH and FSH trigger release of eggs in females and sperm in males. This synchronization of gamete release timing optimizes the conditions for successful fertilization.

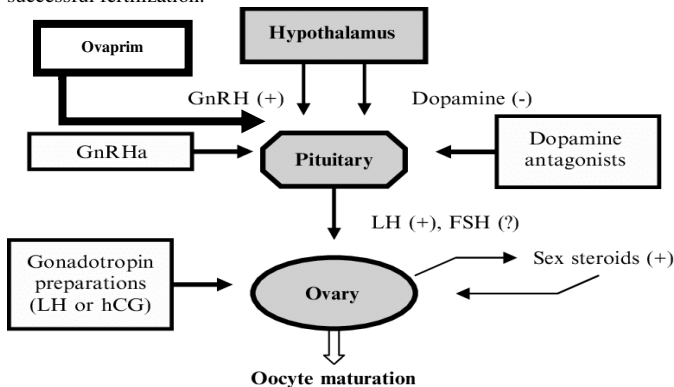


Fig. 1: Mechanism of action of Ovaprim aimed at inducing oocyte maturation [14].

3.2. Effectiveness of Ovaprim:

Ovaprim is widely used in aquaculture due to its high effectiveness in inducing spawning. Its benefits include:

3.2.1. High Efficacy:

Ovaprim effectively induces gonadal maturation and spawning in a wide range of fish species.

3.2.2. Synchronized Spawning:

Ovaprim ensures better synchronization of spawning, leading to higher fertilization rates.

3.2.3. Ease of Use:

Ovaprim is easy to administer and does not require complex handling or storage conditions [15].

3.3. Applications in Aquaculture:

Ovaprim has been successfully used in the induced breeding of various fish species, including:

Carp, Catfish, Tilapia. In Pakistan, Ovaprim is particularly valuable for breeding indigenous fish species, contributing to the sustainability and productivity of local aquaculture practices (Sarkar and Karmakar 2011).

4. Comparative Analysis of PGE & Ovaprim [16]

Comparison	Species Specificity	Variability in results	Cost & Availability
PGE	Highly Effective in same species (e.g; <i>Cirrhinus mrigala</i>)	Inconsistent (e.g; varying success in <i>Catla catla</i>)	Cost Effective Labor Intensive (e.g; in traditional aquaculture)
Ovaprim	Effective in wide range of species (e.g; <i>Oreochromis niloticus</i> , <i>Pangasius pangasius</i>)	Consistent (e.g; reliable in results in <i>Labeo rohita</i>)	More Expensive Reduce labor cost (e.g; in commercial hatcheries)

5. Current Practices and Challenges in Fish Breeding in Pakistan:

In Pakistan, freshwater fish farming, particularly of carps and catfish, relies on hormonal treatments like PGE and Ovaprim for induced breeding. Challenges include many parameters that effect on the production of fish is, irregular hormonal supply, deteriorated water quality, less biological oxygen demand (BOD), contamination, climatic variation and insufficient farmer training. For dealing with these problems, the sector may advance its knowledge, infrastructure, and increase regulatory assistance.

5.1. Challenges:

5.1.1. Extraction Process:

Extraction and preservation of the pituitary gland can be labor-intensive and necessitates professional expertise in aquaculture.

5.1.2. Species-Specific Responses:

Disparate species of fish may differ in response to the extraction of pituitary gland, which necessitates conspecific research [17].

6. Conclusion:

In Pakistan fisheries sector, both breeding hormones (Pituitary Gland Extract and Ovaprim) have demonstrated effective potential in induce breeding for improving fish quality and quantity, but Ovaprim showed more effectiveness contrasted to Pituitary Gland Extract.

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