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THE EFFECT OF CERTAIN PHYTO-ADDITIVES ON FISH REPRODUCTION – REVIEW

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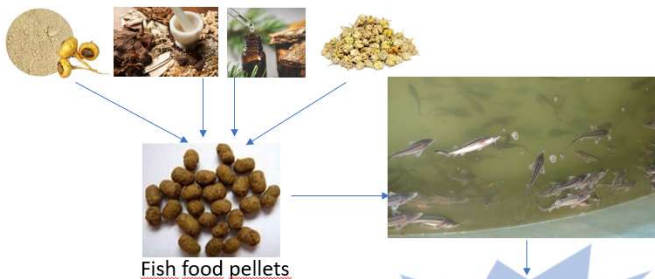
Abstract: *Aquaculture plays a pivotal role in providing a sustainable and reliable source of protein, but its environmental impact remains a pressing concern. As a result, recent efforts have focused on fostering sustainable practices that mitigate adverse effects. One promising approach involves the use of phyto-additives, which have proven to be valuable tools for achieving sustainable aquaculture. They bolster fish immunity and growth, improve water quality and feed efficiency, and minimize pollution through enhanced digestibility and nutrient management. Along with these benefits, research indicates that phyto-additives can directly or indirectly influence the reproductive function of fish. This review aims to explore these aspects in depth, examining the existing body of knowledge on the potential benefits and implications of phyto-additives on fish reproduction. By better understanding the interactions between these additives and reproductive health, aquaculture practices can be refined to maximize productivity while minimizing unintended environmental consequences*

• Introduction

Phyto-additives, also known as phyto-genic additives have garnered increasing recognition for their capacity to modulate hormonal profiles, which are essential for the reproductive health of fish. Derived from various plant extracts, these natural additives can boost the secretion of reproductive hormones, thereby improving the quality of oocytes and enhancing overall reproductive performance. Their beneficial effects extend to increasing the fertility rates, supporting healthier offspring, and potentially leading to more sustainable aquaculture practices by reducing the need for synthetic hormones. As a result, phyto-genic additives are becoming a vital component in the advancement of fish farming and the promotion of environmentally friendly aquaculture solutions.

This review aims to summarize the current scientific knowledge about the main phyto-genic additives used in aquaculture and the very encouraging results for new trends related to sustainable aquaculture, with a special focus on their impact on fish reproduction.

Phyto-additives



Fish food pellets

Effects on fish
reproductive
health

• Material and method

The scientific literature from the main international data bases was used to extract the main information related with the subject of this review.

• Conclusions

Phyto-genic additives significantly enhance fish reproductive health by modulating hormonal profiles and improving oocyte quality. Compounds like carvacrol, thymol, and astaxanthin influence hormone secretion and protect reproductive cells from oxidative damage. Flavonoids and phytoestrogens promote vitellogenin synthesis and oocyte maturation, while saponins can favor male sex ratios and stimulate spermatogenesis. These benefits highlight the potential of phyto-genic additives to improve reproductive outcomes and support sustainable aquaculture practices.

• Results and discussions

Phyto-genic additives can **influence hormonal profiles**, enhancing the secretion of reproductive hormones, improving oocyte quality and positively affecting overall reproductive performance (Swelum et al., 2021). Active compounds from **essential oils** such as carvacrol and thymol have demonstrated **endocrine-modulating properties** by influencing the hypothalamic-pituitary-gonadal axis. These oils can enhance the secretion of gonadotropins, which are critical for reproductive hormone regulation (Serradell et al., 2020). **Carotenoids** such as astaxanthin act as antioxidants, protecting reproductive cells from oxidative damage and supporting overall reproductive health, playing a crucial role in oocyte development by enhancing vitellogenin synthesis (Iskandar et al., 2023). **Flavonoids** such as quercetin and kaempferol have been shown to modulate estrogen receptor activity and influence the synthesis of reproductive hormones. Quercetin and kaempferol act as ligands for estrogen receptors and have been shown to induce estrogenic activities in fish (Siegenthaler et al., 2017). **Phytosterols** like beta-sitosterol may help maintain or modulate the hormonal balance in fish, affecting endocrine functions by mimicking estrogen. In goldfish, beta-sitosterol treatment led to significant changes in testosterone and estrogen levels, enhancing reproductive readiness (Maclatchy & Vanderkraak, 1995). **Saponins** have been found to **modulate the sex ratio of fish**, favouring males in several studies. Dietary *Quillaja* saponin increased the male-to-female ratio (Francis et al., 2002). Weekly immersion in different concentrations of *Tribulus terrestris* extract which contains steroidal saponins, lead to a significantly higher number of males, with the highest concentration producing about 87% males (Çek et al., 2007). Histological examinations indicated that *Tribulus terrestris* extract **stimulates spermatogenesis**, likely due to increased testosterone and androgen levels (Gauthaman & Ganesan, 2008).

In various fish species, the presence of **carotenoids** and phytoestrogens in the feed significantly **enhanced vitellogenin production**, supporting oocyte growth and maturation (Iskandar et al., 2023). **Phytoestrogens** such as genistein and daidzein in the diet can **accelerate oocyte maturation** by mimicking endogenous estrogens, thus promoting the synthesis of vitellogenin and enhancing the overall reproductive performance of fish (Inudo et al., 2004). Carvacrol and thymol have demonstrated support the synthesis of vitellogenin, thereby **improving oocyte quality** (Serradell et al., 2020). **Flavonoids** such as quercetin and kaempferol enhance the antioxidant capacity of reproductive tissues, thereby improving oocyte quality and reproductive performance (Siegenthaler et al., 2017).