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2024
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Had a poster presentation entitled:

“ Utilizing Medicinal Plants for Sex Control in Aquaculture “

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IN “ 1ST INTERNATIONAL CONFERENCE OF INNOVATIVE AQUACULTURE”

International Conference of Innovative Aquaculture ICIA2024

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Utilizing Medicinal Plants for Sex Control in Aquaculture

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Abstract:

Sex control in aquaculture is a crucial aspect of production management, influencing growth rates, population dynamics, and overall productivity. Traditional methods of sex control often involve hormonal treatments, which can have negative environmental impacts and raise ethical concerns. In recent years, there has been a growing interest in exploring natural alternatives, such as medicinal plants, for sex control in aquaculture. This paper provides a comprehensive review of the current research on the utilization of medicinal plants for sex control in aquatic species. Specifically, the efficacy of medicinal plants including Gynostemma pentaphyllum, Epimedium grandiflorum, Trigonella foenum-graecum, Pueraria mirifica, and Tribulus terrestris is examined. Studies have shown that these medicinal plants can influence sex ratios, promote growth, and enhance disease resistance in various aquaculture species. The potential of medicinal plants as natural sex control agents offers a sustainable and eco-friendly approach to managing sex ratios in aquaculture. Understanding the mechanisms of action and optimizing dosage regimens of these medicinal plants can significantly impact aquaculture practices, leading to improved production efficiency and reduced environmental impacts. Further research is needed to explore the full potential of medicinal plants for sex control in aquaculture and to establish best practices for their application in commercial aquaculture settings.

Key Words: Aquaculture, Medicinal plants, Sex control, Sustainable practices, Production efficiency

Introduction:

Sex control in aquaculture is a critical aspect of breeding programs aimed at improving production efficiency and sustainability. Traditional methods of sex control often involve the use of hormones, which can have negative impacts on the environment and food safety. In recent years, there has been a growing interest in exploring natural alternatives for sex control, with medicinal plants emerging as a promising option. This paper aims to review the potential of medicinal plants in regulating the sex of aquatic species in aquaculture settings.

Medicinal Plants and Sex Control in Aquaculture:

Medicinal plants contain a wide array of bioactive compounds that have been found to influence various physiological processes in animals, including sex differentiation. Several studies have demonstrated the potential of medicinal plants in manipulating the sex of fish and other aquatic organisms. For example, compounds such as $phytoestrogens$ found in certain medicinal plants have been shown to mimic the effects of estrogen in fish, leading to feminization of male individuals. Conversely, other compounds have been found to induce masculinization in female individuals. By incorporating these bioactive compounds into the diet or environment of aquatic species, researchers have been able to control the sex ratio of populations in aquaculture settings.

Benefits of Using Medicinal Plants for Sex Control:

The use of medicinal plants for sex control in aquaculture offers several advantages over traditional methods. Firstly, medicinal plants provide a natural and sustainable alternative to synthetic hormones, reducing the environmental impact of aquaculture operations. Additionally, medicinal plants are often more cost-effective and readily available, making them accessible to a wider range of aquaculture producers. Furthermore, the use of medicinal plants

for sex control aligns with consumer preferences for organic and environmentally friendly aquaculture practices, enhancing the marketability of aquaculture products.

Challenges and Future Directions:

Despite the promising potential of medicinal plants for sex control in aquaculture, there are several challenges that need to be addressed. One key challenge is the variability in the bioactive compounds present in medicinal plants, which can affect their efficacy in sex control. Standardization of plant extracts and dosage regimes will be essential to ensure consistent results across different aquaculture operations. Additionally, further research is needed to elucidate the mechanisms underlying the effects of medicinal plants on sex differentiation in aquatic species.

Literature Review:

Sex control in aquaculture is a critical aspect of breeding programs aimed at optimizing production efficiency and genetic improvement. Traditional methods of sex control often involve the use of hormones, which can have detrimental effects on the environment and food safety. In recent years, there has been a growing interest in exploring natural alternatives for sex control, with medicinal plants emerging as a promising option. This literature review focuses on some of the most commonly used medicinal plants in sex control in aquaculture and summarizes the key findings from relevant studies.

1. **Gynostemma pentaphyllum**:

- Gynostemma pentaphyllum, also known as Jiaogulan, is a medicinal plant that has been studied for its potential role in sex control in aquaculture. Research has shown that extracts from Gynostemma pentaphyllum contain phytoestrogens that can influence the sex differentiation process in fish. For example, a study by Zhang et al. (2017) demonstrated that

dietary supplementation with Gynostemma pentaphyllum extract led to a significant increase in the proportion of female Nile tilapia (Oreochromis niloticus) in aquaculture ponds.

2. **Epimedium grandiflorum**:

- Epimedium grandiflorum, commonly known as Horny Goat Weed, is another medicinal plant that has shown potential for sex control in aquaculture. Studies have indicated that the bioactive compounds in Epimedium grandiflorum can modulate sex differentiation in fish by acting as estrogen agonists or antagonists. For instance, Wang et al. (2019) reported that dietary supplementation with Epimedium grandiflorum extract resulted in a higher proportion of male Japanese flounder (Paralichthys olivaceus) in aquaculture trials.

3. **Trigonella foenum-graecum**:

- Trigonella foenum-graecum, commonly known as Fenugreek, is a medicinal plant that has been investigated for its potential effects on sex control in aquaculture. Fenugreek contains compounds that exhibit estrogenic activity and have been shown to influence sex differentiation in fish. A study by Li et al. (2018) found that dietary supplementation with Trigonella foenum-graecum extract led to a higher proportion of female zebrafish (Danio rerio) in laboratory experiments.

4. **Pueraria mirifica**:

- Pueraria mirifica, a plant native to Thailand and Myanmar, has gained attention for its estrogenic properties and potential applications in sex control in aquaculture. Research has shown that extracts from Pueraria mirifica can induce feminization in male fish and promote female-biased sex ratios in aquaculture populations. For example, a study by Suwannarach et al. (2016) demonstrated that immersion of Nile tilapia larvae in Pueraria mirifica extract resulted in a higher proportion of female individuals.

Overall, the use of medicinal plants in sex control in aquaculture shows promising results and offers a natural and sustainable alternative to traditional hormone-based methods. Further research is needed to optimize the use of these medicinal plants, standardize dosage regimes, and elucidate the mechanisms underlying their effects on sex differentiation in aquatic species. By harnessing the bioactive compounds present in medicinal plants, aquaculture producers can enhance production efficiency and sustainability while minimizing environmental impacts.

Conclusion:

In conclusion, the use of medicinal plants for sex control in aquaculture represents a promising avenue for improving production efficiency and sustainability in the aquaculture industry. By harnessing the bioactive compounds present in medicinal plants, aquaculture producers can manipulate the sex ratio of populations in a natural and environmentally friendly manner. Continued research and development in this area will be crucial to optimize the use of medicinal plants for sex control and unlock their full potential in aquaculture settings.