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Editorial

Effect of Dietary Supplementation on the Growth and Immunity of Fish and Shellfish

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With the rapid development of aquaculture, the shortage of high-quality dietary ingredients has become a critical problem limiting the sustainable development of aquaculture. Therefore, the innovation of new feed materials, especially protein and lipid sources, is of great significance for the healthy development of the aquaculture feed industry. Over the past few decades, a variety of new, high-quality dietary ingredients have been developed successfully with the advent of new technologies. Unfortunately, the database of precise nutritional requirements based on new feed ingredients is not yet perfect, although a preliminary database of nutritional requirements for aquatic animals (based on traditional ingredients) has been established. In addition, feed additives can promote animal growth and improve animal health, which provides important support for the development of functional feed. Therefore, this Special Issue focuses on the application of feed ingredients and additives in aquaculture, especially those more recently developed.

An accurate and reliable method for evaluating the growth performance of aquatic animals is the basic premise of scientific research on the effects of feed ingredients and additives. Traditionally, the condition factor is an empirical indicator and is positively correlated with body weight [1]. It was widely used as a morphological parameter to assess the growth or nutritional status of aquatic animals. However, the growth stages of fish and different feed formulations can lead to deviations from the ideal growth status, which may cause misjudgments [2]. In this Special Issue, the weight–length relationship and condition factor of Gibel carp (*Carassius auratus* CAS V) at different growth stages and feed formulations are investigated. The results indicate that the evaluation of fish growth requires considering diverse indicators such as weight, length, body depth, body width, and carcass ratio, as well as the condition factor, to avoid misjudging the actual growth situation [3]. This study provides a more accurate method for the evaluation of the effects of feed ingredients and additives on the growth of aquatic animals.

Protein is an important nutrient, and fish meal is an ideal high-quality protein source for aquatic animals [4]. Unfortunately, the production of fish meal is limited, and the supply exceeds the demand, leading to the increasing price of fish meal [5]. Therefore, replacing fish meal with plant protein of stable yield and low price is an important direction for aquatic animal nutrition [6,7]. However, plant protein sources cannot completely replace fish meal due to the anti-nutritional factors [8]. Some studies have found that new technological methods such as fermentation, hydrolysis, and enzymatic hydrolysis can eliminate anti-nutritional factors and improve the utilization of feed ingredients [8–10]. In this Special Issue, a study reported that the use of 25% dietary fermented cottonseed meal (FCSM) to partially replace fish meal improved nutrient absorption and reduced intestinal inflammation. However, a high proportion of FCSM negatively affected the intestinal microflora and nutrient absorption [11]. Stickwater hydrolysate (SWH) is obtained by

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Citation: Qi, C.; Xu, Q.; Ming, J.; Song, F.; Zhou, C. Effect of Dietary Supplementation on the Growth and Immunity of Fish and Shellfish. *Fishes* **2024**, *9*, 176. https://doi.org/10.3390/fishes9050176

Received: 7 May 2024
Accepted: 11 May 2024
Published: 13 May 2024

adding hydrolytic enzymes, which can improve the growth performance and feed utilization of fish [12]. In this Special Issue, it is reported that substituting fish meal with SWH or stickwater hydrolysate meal (SWM) does not adversely affect growth or meat quality. Moreover, replacing 15% fish meal with SWH and 5% fish meal with SWM can enhance the immunity of yellow catfish [13]. Similarly, another study in this Special Issue also reported that enzymatic soybean meal can completely replace fish meal in the juvenile Gibel carp's diets without causing adverse impacts on growth performance, antioxidant capacity, or the structure of liver and intestinal tissues [14]. Both of these studies found that partial replacement could even improve the antioxidant capacity and immunity of fish [13,14]. In summary, new technological methods such as fermentation, hydrolysis, and enzymatic hydrolysis can improve the utilization of feed ingredients and enhance the intestinal health of aquatic animals.

The quality of formula feed not only depends on the feed ingredients and their reasonable combination, but is also closely related to feed additives [7]. Feed additives can promote growth, feed utilization, and the health of aquatic animals [4]. Several different types of feed additives, particularly Chinese herbal medicines, are reported in this Special Issue. For example, it has been reported that *Coptis chinensis* supplementation effectively enhances the ability of tilapia to resist *Streptococcus agalactiae* infection by modulating various antioxidant enzymes, immune factors, antimicrobial enzymes, and antimicrobial peptides [15]. Similarly, another two studies in this Special Issue reported that both extracts of *Astragalus membranaceus* (EAms) and extract of *Ginkgo biloba* leaves (EGb) can improve the growth performance and antioxidant capacity of Jian Carp (*Cyprinus carpio* var. Jian) [16,17]. In summary, Chinese herbal medicines can be considered as potential natural antioxidants for aquatic animals.

Nutrients, both as feed ingredients and additives, are closely related to the growth and health of aquatic animals. This Special Issue showcases a collection of original research that highlights the latest discoveries on the applications of new feed ingredients and additives for aquatic animals. It can provide references for the development of high-quality formula feed.

Author Contributions: C.Q., writing—original draft and editing. Q.X., supervision. J.M., writing—review and editing. F.S., writing—review and editing. C.Z., writing—review and editing. All authors have read and agreed to the published version of the manuscript.

Institutional Review Board Statement: Not applicable.

Data Availability Statement: In this editorial, no new data were created. All the result we cited in this manuscript are published articles, which can be found in the database.

Acknowledgments: We deeply thank all of the authors and reviewers who have participated in this Special Issue. This work was supported by the Zhejiang Province R&D Plan (2023C02024), the Zhejiang Provincial Natural Science Foundation of China under Grant No. LTGN23C190003, and the Huzhou Natural Science Foundation (2021YZ14).

Conflicts of Interest: The authors declare no conflicts of interest.

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