Effect of Traditional Chinese Medicine on Fish Growth: A Meta-Analysis Study

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Abstract

Fish productivity has long been the subject of studies using traditional Chinese medicine (TCM). To validate TCM's effectiveness on weight gain rate (WGR) and specific growth rate (SGR), a meta-analysis study was conducted. Of the 58 studies collected from PubMed, Scopus, and Cochrane Library, 4 eligible studies were analyzed quantitatively. The extracted data were then analyzed using Review Manager (RevMan) online to determine the standard mean difference (SMD), random effect, heterogeneity, and 95% confidence intervals (95% CI). As a result, TCM administration had a favorable effect on WGR (SMD = 8.33; p = 0.0001) and SGR (SMD = 8.12; p = 0.0004). In conclusion, this meta-analysis study emphasized the efficacy of TCM to improve fish production performance.

Keywords: aquaculture, fish growth, herbal medicine, marine fish, traditional chinese medicine

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INTRODUCTION

Since ancient times, traditional Chinese medicine (TCM) has been utilized as a form of treatment due to its abundance of resources, low cost, and natural state. TCM as a feed additive is of considerable significance in increasing the immune function and disease resistance in fish, especially since food safety issues draw consumers' attention to healthy aquaculture methods and the usage of green fisheries medications (Shen *et al*., 2002). It has been established that the Asian aquaculture industry benefits greatly from using TCM in aquaculture (Zhai and Li, 2019).

TCM is a potential substitute vaccine and antibiotic that can be used as immune boosters or antibiotics to avoid fish infections. TCM is also thought to enhance growth, increase appetite, and reduce stress (Li *et al*., 2019). Furthermore, several studies have demonstrated that applying a combination of herbal medicines has a greater impact on disease resistance than using a single herbal medicine. For example, a combination of *Ocimum basilicum*, *Cinnamomum zeylanicum*, *Jugpans regia*, and *Mentha piperita* in a herbal formulation improved the common carp's non-specific immunity and disease resistance to *Aeromonas hydrophila* (Hajibeglou and Sudagar, 2010).

Drug interactions in TCM compound composition are intricate. It is a more economical method when compared to the usage of a single plant since it might have a greater impact on immunological activation or enhanced disease resistance in fish. Information regarding compound preparations containing more than three forms of TCM as feed additives is currently lacking. Thus, the present meta-analysis study aimed to integrate the findings of previous studies and reveal the efficacy of TCM on fish growth performance.

MATERIALS AND METHODS

Ethical Approval

No animals were involved so this study did not require ethics approval.

Study Period and Location

The process of identifying pertinent literature, collecting and organizing data, and completing data analysis was carried out between December 2023 and March 2024 at the Department of Health and Life Sciences, Faculty of Health, Medicine, and Life Sciences, Universitas Airlangga, Banyuwangi, Indonesia.

Search Strategy and Selection of Studies

The PubMed, Scopus, and Cochrane Library databases were systematically screened in order to find pertinent publications discussing the effectiveness of herbal or traditional Chinese medicine in fish. It was validated that every relevant and comprehensive keyword was included in the MeSH term. The sample search algorithm used by the databases was as follows: #1 "traditional Chinese medicine"[MeSH Terms] OR "herbal medicine"[All Fields] #2 "fish growth"[MeSH Terms] OR "fish production performance"[Title/Abstract].

With the following inclusion criteria in consideration, we followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flow diagram to find pertinent studies: original research articles in English that were open access and full text accessible, reporting in vivo studies and randomized clinical trials (RCTs). Furthermore, we eliminated redundant research from the database, unrelated studies, non-English publications, full-text unavailability, case studies, and literature reviews (Figure 1).

Data Extraction

The data characteristics lead to the classification of the information as follows: study references, fish species, TCM composition, and treatment (Table 1). Weight gain rate (WGR), specific growth rate (SGR), and total samples were the data retrieved for quantitative analysis.

Statistical Analysis

The statistical analysis was conducted using Review Manager (RevMan) online (Cochrane Collaboration, UK). Between the TCM and control groups, a pairwise meta-analysis of the data was conducted to calculate the standard mean difference (SMD), random effect, and 95% confidence intervals (95% CI). To measure the degree of heterogeneity among the studies, Chi-square (Chi^2) was employed. Statistically significant heterogeneity was defined as a p-value < 0.05 and an I^2 value $> 50\%$. Tables were used to validate and represent the data that was displayed in the forest plot and funnel plot.

RESULTS AND DISCUSSION

According to the present meta-analysis, TCM administration had a favorable effect on WGR (SMD = 8.33; p = 0.0001) (Figure 2) and SGR (SMD = 8.12; p = 0.0004) (Figure 3). The data were symmetrically distributed according to the funnel plot (Figure 4), and both parameters also revealed heterogeneity level $I^2 = 99\%$.

The effectiveness of growth and feed utilization can both be improved by TCM. Prior research showed that grass carp (*Ctenopharyngodon idella*) fed a meal with 10–40 g/kg of honeysuckle extract (*Lonicera japonica*) gained weight at a substantially greater rate (Meng *et al*., 2019). The growth of the young northern snakehead fish (*Channa argus*) was positively impacted by a basal meal with 10–40 mg/kg TCM (*Allium mongolicum* Regel) (Li *et al*., 2019). The growth and feed utilization of African fish (*Clarias gariepinus*) were significantly enhanced by the dietary addition of *Aloe vera* polysaccharides (Gabriel *et al*., 2019).

The palatability or attractiveness of the diets, which encourages an increase in feed intake and an improvement in growth performance, maybe the cause of the improvement in fish growth and feed utilization (Tantikitti, 2014). Furthermore, dietary TCM supplementation may raise the number of beneficial microbes, block possible pathogens in the digestive tract, and/or boost the activity of microbial enzymes, all of which could improve feed digestibility and nutrient absorption. There is mounting evidence that herbs and/or diets supplemented with probiotics have specific roles in fish and terrestrial animal immunity (Caipang and Lazado, 2015).

Table 1. Characteristics of the studies

References	Fish species	TCM composition	Treatment
Abarike *et al*., 2018	*Oreochromis niloticus*	*Astragalus membranaceus*, *Angelica sinensis*, *Crataegus hupehensis* and probiotic Bacillus species (BS) of composition *Bacillus subtilis* and *Bacillus lincheniformis*	• Control • TCM at 3 g/kg and BS at 7 g/kg • TCM at 5 g/kg and BS at 5 g/kg • TCM at 7 g/kg and BS at 3 g/kg
Abarike *et al*., 2019	*Oreochromis niloticus*	*Astragalus membranaceus*, *Angelica sinensis*, and *Crataegus hupehensis*	• Control • TCM 10 g/kg
Choi *et al*., 2014	*Ctenopharyngodon idellus*	*Radix scutellaria* and *Rhizoma coptidis*	• Control • TCM 0.5% • TCM 1% • TCM 2%
Wang *et al*., 2019	*Oncorhynchus masou*	*Scutellaria baicalensis* 15 g, *Coptis chinensis* 15 g, *Citrus reticulata* peel 8 g, *Radix liquiritia* 10 g, *Radix scrophulariae* 12 g, *Platycodon grandiflorum* 6 g, *Forsythia suspense* 20 g, *Radix isatidis* 30 g, *Radix bupleuri* 30 g, *Lasiosphaera fenzlii* 10 g, *Bombyx batryticatus* 20 g, *Cimicifugae racemosae* 6 g, *Mentha haplocalyx* 3 g, *Fructus arctii* 12 g	• Control • TCM 0.08% • TCM 0.05% • TCM 0.04%

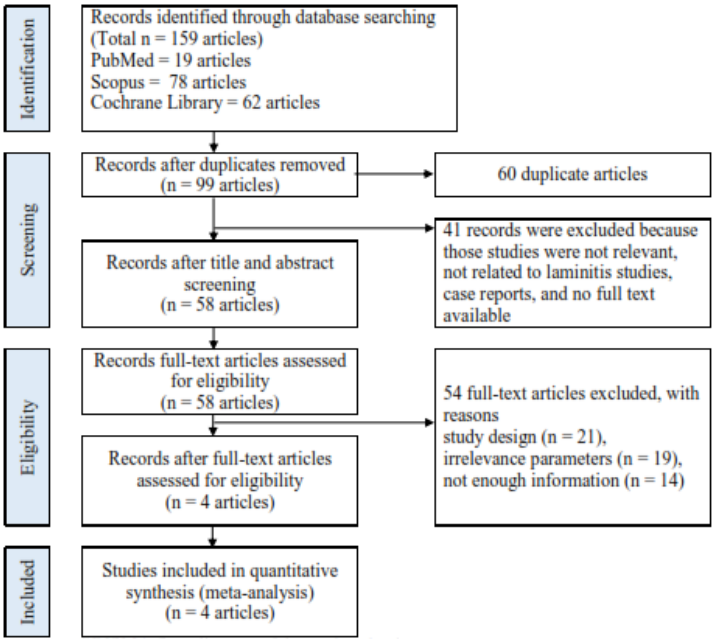


Figure 1. PRISMA flow diagram of the study selection process.

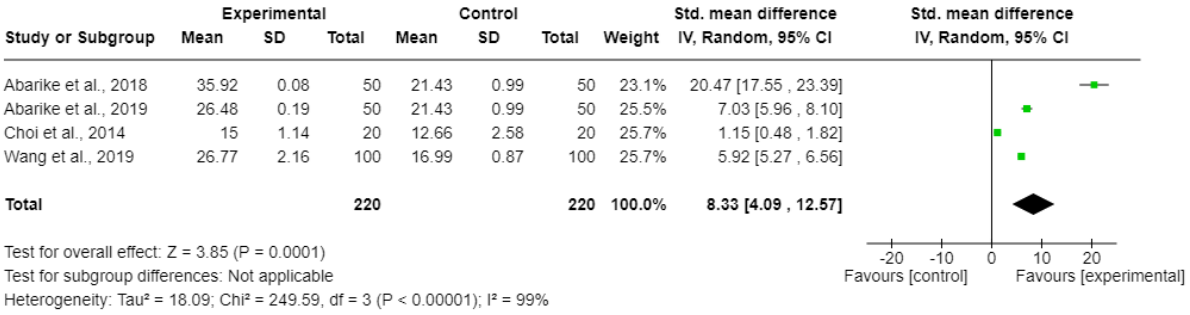


Figure 2. Forest plot analysis for weight gain rate (WGR).

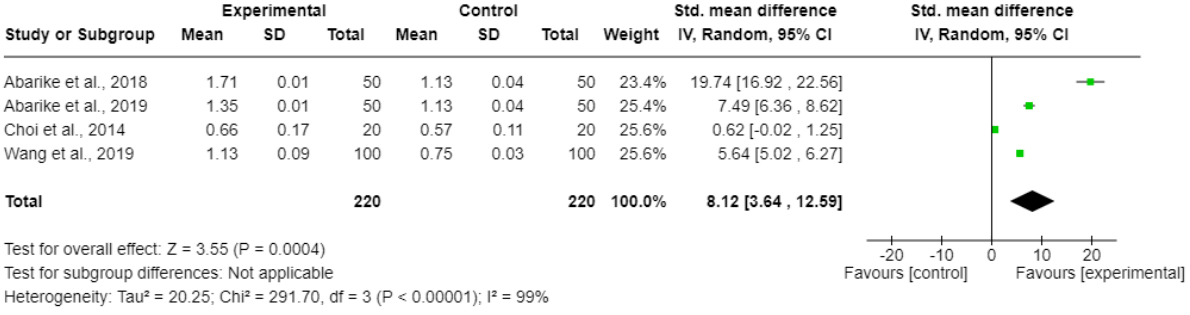
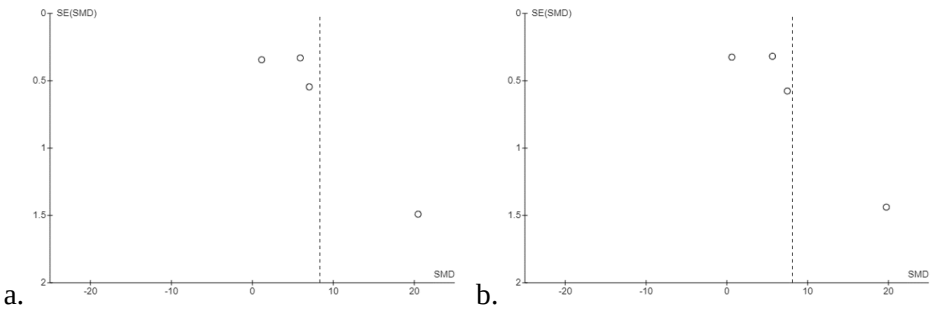


Figure 3. Forest plot analysis for specific growth rate (SGR).



a. b.

Figure 4. Funnel plot for (a) weight gain rate (WGR) and (b) specific growth rate (SGR).

It has been documented that protease and antiprotease enzymes are crucial for both initiating the innate and adaptive immune systems and defending against pathogen infections (Dubin *et al*., 2013). Fish protease and antiprotease activity has been shown to be affected differently by the use of herbs and/or probiotics. In European seabass, *Dicentrarchus labrax*, for example, probiotic-enriched diets and date palm fruit extracts were found to reduce serum protease and antiprotease activities (Guardiola *et al*., 2016).

To enhance fish health, very few research have looked into the potential synergistic benefits of applying multispecies probiotics and herbs at the same time. It's unknown whether herbal-probiotic multispecies compositions can aid in the host's improvement of health. Data indicate that TCM supplementation in fish diets may potentially improve fish health, even though no significant difference was seen between the diets (Wu *et al*., 2018). However, according to these facts, further mechanisms need to be investigated.

CONCLUSION

The favorable impacts of TCM on specific growth rate (SGR) and weight gain rate (WGR) were confirmed by this meta-analysis study. Despite its positive effects, further study is required in ethnomedicine, and any potential toxicity resulting from secondary metabolites should also be investigated.

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AUTHORS' CONTRIBUTIONS

MB, and Su: Retrieved papers from database. Sa and ALM: Selected papers using PRISMA method. Su: Analyzed data. Sa, ALM, MB, and Su: Writing and revising draft manuscripts. All authors have read, reviewed, and approved the final manuscript.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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