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Research Article
Kombucha Tea as Feed Supplement for African Catfish, *Clarias gariepinus*

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Abstract

Background and Objectives: The fisheries sector plays a significant role in the national economy of Malaysia and considered an essential sub-sector of food production. Thus, to improve the overall fish well-being and increase production quality, many natural resources are being sought after. The success of kombucha tea in the poultry industry as a natural, highly beneficial and inexpensive source of feed supplement has yet to be studied in the aquaculture industry. An *in vivo* study was then conducted with an overall objective of determining the effects of kombucha tea as a feed supplement in African catfish, *Clarias gariepinus*. **Materials and Methods:** Assessment on the suitability of kombucha tea as feed supplement was done in terms of weight gain, specific growth rate and feed conversion ratio. Treatment diet containing kombucha tea culture was prepared and given to the treatment group while comparing with the control group, which was given with diet without any kombucha culture twice daily for thirty-five days. Weekly growth performance of the fishes was assessed throughout these periods. **Results:** The results showed a significant increase in growth performance whereby the weight gain, specific growth rate and feed conversion efficacy increased by two-folds in treatment group compare to the control group. **Conclusion:** This study proved that there was evidence of growth promoter property of kombucha tea in terms of weight gain, specific growth rate and feed conversion efficacy in African catfish.

Key words: Fermented tea, freshwater fish, growth promoter, feed supplement, *Clarias gariepinus,* feed conversion ratio, weight gain

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Freshwater aquaculture is second to brackish-water aquaculture in Malaysia, where it constitutes about 30% of the total aquaculture production in Malaysia. Out of all the commercially cultured freshwater species, catfish accounts for 45.19% which is highest of the freshwater aquaculture production with African catfish becoming one of the topmost cultured freshwater fish[1].

Over the years, as total world fishery production dropped to a certain extent, the human consumption for aquatic product has expanded[2]. The need for improved feed efficiency, growth performance and disease resistance of cultured organism become substantial as the costs of productions are likely to be reduced in a commercial setting. One of the options is feed additives which have been available for years to improve the growth performance of fish.

Feed additives are materials which are incorporated into animal feeds in little amounts to serve the functions other than the supply of nutrients[3]. Such additives are known to ameliorate growth performance through enhanced feed utilization, reduction of pathogenic bacteria within the gastrointestinal tract and production of metabolites that increase animal metabolism[4]. They have been used in aquaculture for enhanced growth performance and reduced fish mortality[4].

Fermentation of sugared tea with a symbiotic culture of acetic acid bacteria and yeasts produces kombucha tea or tea fungus that is consumed worldwide for its refreshing and beneficial properties on human health[5]. Besides, the addition of the fungal biomass as a supplement in feed increased feed consumption, body weight, performance efficacy factor and the carcass characteristics significantly in poultry[5].

Currently, however, usage of kombucha tea remains as an unexplored option in the aquaculture field. The success of kombucha in the poultry industry and suggestions that it can be used in the broiler's diet as an alternative to antibiotic growth promoters should be enough evidence for kombucha tea to be applied and manipulated directly as a feed supplement in the aquaculture industry. Use of kombucha tea as a feed supplement would not only provide beneficial effects, but they can also be obtained at a lower cost compared to synthetic growth promoters.

Based on the evidence conducted on human and poultry, kombucha tea has been proven to increase overall health, weight gain and increase feed conversion efficacy. Therefore, this study was conducted to investigate the potential of kombucha tea used as a feed supplement for African catfish, *Clarias gariepinus*, specifically to increase weight gain, specific growth rate and feed conversion ratio.

MATERIALS AND METHODS

Study area: The study was carried out at Aquatic Animal Health Lab, Faculty of Veterinary Medicine, Universiti Malaysia Kelantan from Dec 2017-Jan 2018.

Kombucha tea preparation: One litre of tap water was boiled in a beaker. As the water boils, fifty gram of sucrose was added into the water. Five gram of tea leaves was added into the boiling water and removed by filtration after five minutes. The solution was cooled to room temperature at approximately 28°C. Thereafter, twenty-four-gram tea fungus was inoculated and poured into a one-litre beaker previously sterilised with boiling water. Following this, 0.2 litres of previously fermented kombucha was added to lower the pH and inhibit the growth of undesirable microorganisms. The beaker was covered with a paper towel to keep insects away. The culture was incubated at room temperature (28°C) for ten to fourteen days. The remaining solution was filtered and was stored in a sealed bottle at 4°C.

Experimental diets preparation: The fermented kombucha tea and distilled water were mixed at a ratio of 1: 2. The diluted kombucha tea was then poured into a sterile spray bottle. Under sterile conditions, the treatment diet was prepared by spraying the kombucha tea culture into a clean plate containing the dry pellets (Star Feed 9910 commercial diet). Meanwhile, the treatment diet was mixed slowly for three to five minutes. The pellets were dried in the oven at a temperature of 35°C for 24 h, packed in air-tight bags, labelled and stored until use. The control diet was prepared by substitute kombucha tea with distilled water.

Experimental design: The experiment was conducted at the Aquatic Animal Health Laboratory, Faculty of Veterinary Medicine, Universiti Malaysia Kelantan. Sixty fingerlings African catfish, measuring approximately three to four cm was obtained from a local supplier from Machang, Kelantan few weeks prior to the experiment. They were allowed two weeks of adaptation period before being allotted to different dietary treatments. During the adaptation period, they were given a commercial starter diet fed to satisfaction twice a day.

After the adaptation period, the fishes were randomly distributed into 100 L tanks. The fishes were allocated randomly into three treatment groups and three control in which each tank consist of 10 fishes. Each tank contains aerated recirculated freshwater. A non-stop aeration to maintain the dissolved oxygen to the optimal level was provided. The fishes were fed for a period of 35 days with the experimental diets at 6% of body weight with two divided portion daily, during the morning at 8:00-9:00 am and the evening at 5:00-6:00 pm. The daily ration was adjusted accordingly. The feed consumption in each aquarium was recorded daily.

Uneaten feed and faeces were siphoned out every morning. Water qualities were monitored and mortality was recorded. Dead fishes from each aquarium were collected daily and weighed. Water was changed by 30% every alternated day.

Growth performance analysis: The fishes were weighed at the Day 1 (initial), Day 7, Day 14, Day 21, Day 28 and Day 35 (final). The growth performance was assessed based on the weight gain (WG), Specific Growth Rate (SGR) and Feed Conversion Ratio (FCR) with the formula[6]:

$$\text{Weight Gain (WG)} = \text{Final weight (W1)-Initial weight (W0)}$$

$$\text{Specific Growth Rate (SGR)} = \frac{\text{WG}}{\text{Day(s)}} \times 100\%$$

$$\text{Feed Conversion Ratio (FCR)} = \frac{\text{Food consumed (g)}}{\text{Weight gain (g)}}$$

Statistical analysis: Data on the weight gain (WG), Specific Growth Rate (SGR) and Feed Conversion Ratio (FCR) between two groups were analysed independent t-test. Level of significance was tested at 95% confidence interval level and all statistical analyses were carried out using the SPSS Version 22.

RESULTS

In the present study, better performance in term of weight gain (WG), Specific Growth Rate (SGR) and Feed Conversion Ratio (FCR) were obtained in the treatment group whereby fishes were fed with supplemented feed with kombucha tea. Table 1 showed that fishes in the treatment group had a significant increase in weight gain in which the total weight gain after 35 days was 32.50±0.53 g compared with the total weight gain of the fishes in control group was only 21.03±1.34 g. Same results were also reflected in specific growth rate whereby SGR of the fishes in the treatment group 96.86% while only 60.10% in the control group (p-value = 0.01). As for feed conversion ratio, feed supplemented with kombucha tea had a significantly lower conversion ratio indicated less feed is being required to obtain a require weight gain (p = 0.02).

Table 1: Comparison of growth performance parameters of treatment and control groups

Parameters	Control	Treatment	Statistical significance
Weight gain	21.03±1.34 g	32.50±0.53 g	p = 0.010
Specific growth rate	60.10%	96.86%	p = 0.010
Feed conversion ratio	0.003±0.002	0.002±0.000	p = 0.016

DISCUSSION

Based on the results obtained, the dietary feed supplement consisting of kombucha tea promoted the growth of African catfish fingerlings. These results showed that kombucha improves nutrient utilization. Kombucha tea is known to regulate gastric functions, mainly intestinal activities. Kombucha tea treatment has been proven to increase the height of villous within the small intestine especially the duodenum and jejunum[7]. The increase in height of the villous can increase the available surface for nutrient absorption. This can then improve the efficiency of gastrointestinal system in nutrient absorption. The positive effects of kombucha can also be associated with the increase in feed, protein and energy consumption. The increase of dietary protein absorption may lead to an improvement in the appetite of the fishes, which results in increased feed consumption[8].

Besides, the protective effect of kombucha due to the presence of tea polyphenols and hepatoprotective effects which are produced during the fermentation period has been associated with the antioxidant properties or free radical scavenging ability[9]. Fish are very susceptible to oxidative stress. Stress from a variety of sources such as poor water quality, pathogens, parasites, management and handling of fish which in turn jeopardize the growth performance of the fish. Oxidative stress can affect the DNA, protein and lipid components within the body[10]. The antioxidant in kombucha tea is thus believed helps in preventing the harmful effects of oxidative stress by reducing the free radical that stimulated by various stress factors in the surrounding.

CONCLUSION

Kombucha tea-infused diet improves weight gain, specific growth rate and feed conversion efficacy of African catfish.

The cocktail effect due to the presence of tea polyphenols, ascorbic acid and DSL within kombucha are the important factors that are correlated with its many beneficial effects such as growth improvement, antioxidant properties, immunity enhancement and alleviation of inflammation.

SIGNIFICANCE STATEMENT

This study discovers the use of kombucha tea that can be beneficial for fish feed supplement. This study will help the researcher to uncover the critical areas of natural resources to improve the overall fish well-being and increase production in aquaculture industry. Thus a new theory on using kombucha as fish feed supplement may be arrived at.

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