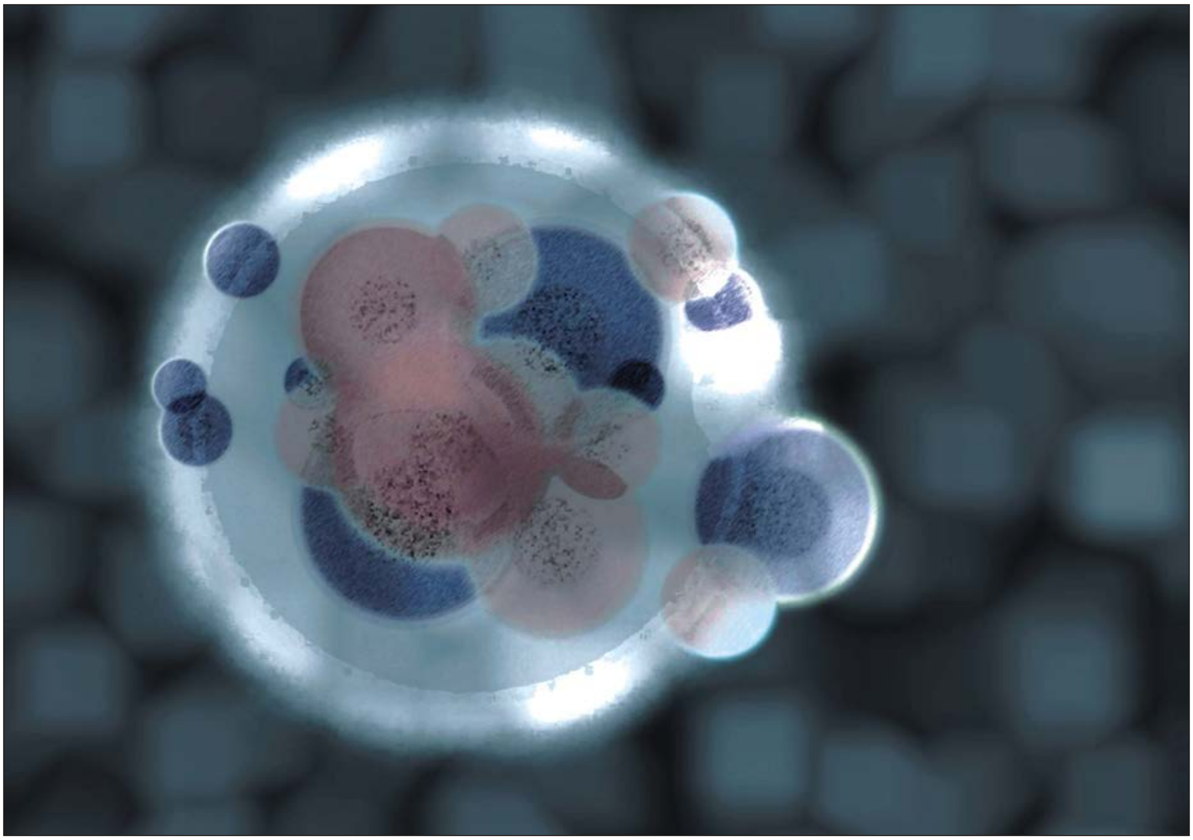

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Effect of Fermented Kitchen Waste on Tilapia (*Oreochromis niloticus*) Growth Performance and Water Quality as a Water Additive

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Abstract: Aquaculture contributes about 20% of domestic fish production in Malaysia. Tilapia has been identified as one of the main species for freshwater aquaculture in the Third National Agriculture Policy (DPN3). However, feed cost and water quality management remain as two major challenges to the industry. This study aim to analyse the effects of Fermented Kitchen Waste (FKW) as water additives on water quality and growth performance of tilapia (*Oreochromis niloticus*). Different concentration (0.05, 0.1 and 0.2%) of FKW were used to treat tilapia in tank culture for a period of twelve weeks. Physico-chemical parameters were also taken every week. Treatment with 0.1% FKW resulted in significant ($p<0.05$) decrease in ammonia, nitrite and nitrate levels. The survival rates of tilapia treated with 0.05 and 0.1% FKW were comparable to the untreated control. Growth performance of the tilapia was measured in term of length and weight. Highest relative growth rate was observed in tilapia treated with 0.05% FKW. However, all the fish died in 0.2% FKW due to severe pH drop. Therefore, low concentration of FKW could severe as a potential water additive to improve water quality and promote growth in tilapia aquaculture.

Key words: Fermented kitchen waste, *Oreochromis niloticus*, relative growth rate, water additive, water quality

INTRODUCTION

Aquaculture sector become the fastest growing food sector in the world food production industry. China contributes the largest production of aquaculture in the world with 51.2% of total production followed by Japan (6.0%), India (4.2%) and Chilie (4.0%) (FAO, 2006). In Malaysia aquaculture sector is still far behind with contribution of 20% fish domestic production (Pawiro, 2008). Main problems that constraints the development of fresh water aquaculture in Malaysia is water quality condition and high price of the feeds. Pour water condition such as ammonia, nitrite and nitrate can lead to the mortality state of the fish. It is important for water management to ensure the survival and growth performance of the fish especially in intensive culture.

Others factor effecting water quality such as dissolved oxygen, pH and temperature. Because of this some research had been done to overcome the problems. One of the studies was using effective microorganisms. Saberi *et al.* (2009) reported that, minimal water change for shrimp culture that applied with effective microorganism. This effective microorganism can be related to the probiotic that was introduced by Parker (1974). The term of probiotic then extended to water additives by Moriarty (1998).

The selection of *Oreochromis niloticus* in this study because the abilities of fish to survive in different culture systems, disease resistant and tolerate unfavorable condition of water (Attalla, 2001). This study also is important for the Malaysian domestic production that increasing every years.

The present study aimed to investigate physico-chemical parameters and growth performance effect of *Oreochromis niloticus* that treated with different concentration of fermented kitchen waste. Study also to determine the suitable concentration of fermented kitchen waste for *Oreochromis niloticus* growth.

MATERIALS AND METHODS

The experiment was conducted at Universiti Putra Malaysia Bintulu Sarawak Campus using 12 glass culture tanks (45×90×45 cm) each containing 20 fries of *O. niloticus* with average total length of 30.88 mm and average weight of 3.0605 g. The

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experimental set up was based on Complete Randomized Designed (CRD) with triplicate for three treatments and a control. The fish were feed twice day at 6% of their body weight. Water in the tanks was changed weekly.

Preparation of fermented kitchen waste (FKW): Fermented kitchen waste was prepared by adding brown sugar, vegetable or fruit waste and water with ratio 1:3:10. This mixture fermented in the air tight plastic container for three month before can be use as treatment. Liquid from the fermentation product filtered and used as treatment.

Treatment detail: The experiment was conducted in 3 regimes consisting of culture treated with 0.05, 0.1 and 0.2% of fermented kitchen waste. Fermented kitchen waste was added to the tanks every week after the water change. The control tank was not treated with any FKW.

Physico-chemical parameters: The temperature and pH were measured using Mettler Toledo, Dissolved Oxygen (DO) using DO meter (Y.S.I. model 550A), nitrite, nitrate and ammonia using hach kit (model DR2400). These parameters were measured once a week.

Growth parameters: Means of length and weight were recorded from ten randomly picked fish for each treatment. Growth performance was calculated according to Daramola *et al.* (2007) as follows:

$$\text{Mean weight gain} = \text{Final weight-Initial weight}$$

$$\text{Relative growth rate} = \frac{\text{Final weight-Initial weight}}{\text{Initial}} \times 100$$

Data on the physico-chemical, relative growth rate and survival rate were analyzed by one way analysis of variance (ANOVA) using Statistical Analysis Software (SAS), version 9.1 (SAS, 2004). Significant difference in mean was compared using Least Significant Difference (LSD).

RESULTS

Tank treated with 0.02% FKW was terminated in the third weak experiment as all the fish died due to high acidity (pH 4.61-4.75).

Growth performance: Treatment 0.1% concentration of FKW had the highest mean weight gain 23.850±3.223 g and control had the lowest mean weight gain 21.718±1.199 g (Table 1). Result shows significant higher relative growth rate for treatment 0.05% of FKW with 999.4%. Present study was demonstrate the lowest growth rate was control, with value 576.6% but there no significant difference between control and treatment 0.1% of FKW.

Physico-chemical parameters: Ammonia nitrogen parameters for treatment 0.1% of FKW showed significant lower (0.82±0.28 mg L^{-1}) at 0.05 level compared to control (1.39±0.13 mg L^{-1}) (Table 2). Treatment 0.05% of FKW showed no significant difference with treatment 0.1% of FKW. Even with the high stocking density treatments 0.1 and 0.05% of FKW showed significant difference low of ammonia nitrogen compared to control. Nitrite parameters showed treatment 0.1% of FKW had the lowest value (2.539±0.267 mg L^{-1}) at 0.05 level compared to control (3.585±0.18 mg L^{-1}) and there is no significant differences to control and treatment 0.1% of FKW shows by treatment 0.05% of FKW. Nitrate level showed treatment 0.1% of FKW the lowest (12.3±3.1 mg L^{-1}) compared to control (20.5±3.7 mg L^{-1}). Treatment 0.05% showed no significant difference with treatment 0.1% but significant lower than control. Application of fermented

Table 1: Growth performance of *Oreochromis niloticus* in different concentration of fermented kitchen waste

Treatments	Initial weight (g)	Final weight (g)	Mean weight gain (g)	Relative growth rate (%)	Survival rate (%)
Control	3.825±0.505	25.543±0.776	21.718±1.199	576.6[b]	88.333[a]
0.1%	3.741±0.226	27.590±2.999	23.850±3.223	642.6[b]	91.667[a]
0.05%	2.296±0.404	24.731±2.328	22.435±2.286	999.4[a]	88.333[a]

Means with different letter indicate significant difference at p<0.05 using LSD±Mean comparison

Table 2: Physico-Chemical parameters for water quality applied differences concentration of fermented kitchen waste

	Treatments			
Parameters	Control	0.1% FKW	0.05% FKW	Accepted range
Ammonia (mg L^{-1})	1.390±0.13[a]	0.820±0.280[b]	0.930±0.02[b]	<2.0 mg L^{-1} (Rakocy, 1989)
Nitrite (mg L^{-1})	3.585±0.18[a]	2.539±0.267[b]	3.323±0.67[ab]	<5.0 mg L^{-1} (Rakocy, 1989)
Nitrate (mg L^{-1})	20.500±3.70[a]	12.300±3.100[b]	13.300±1.50[b]	<90 mg L^{-1} (Stone and Thomforde, 2003)
DO (mg L^{-1})	5.040±0.15[a]	4.510±0.180[b]	4.700±0.22[ab]	>2.0 mg L^{-1} (Stickney, 2005)
pH	5.560±0.08[c]	6.490±0.130[a]	6.190±0.07[b]	6-9 (Buttner *et al.*, 1993)
Temperature (°C)	26.800±0.10[a]	26.700±0.100[a]	26.800±0.20[a]	30°C (Rakocy, 1989)

Means with differences letter indicate significant different at p<0.05 using LSD±Mean comparison, DO: Dissolved oxygen kitchen waste in treatments showed decreasing value of dissolved oxygen in water. Statistical analysis for dissolved oxygen showed control had the significant highest (5.04±0.15 mg L^{-1}) compared to treatment 0.1% of FKW and treatment 0.05% of FKW. Parameter for pH showed control had the lowest pH value (5.56±0.08) followed by treatment 0.05% of FKW (6.19±0.07) and treatment 0.1% of FKW (6.49±0.13).

DISCUSSION

Relative growth rate for *Oreochromis niloticus* was shown the best result when treated with fermented kitchen waste. According to Waseef (2005) by using acid fermented silage the highest relative growth rate for *O. niloticus* was 834% still less compared to this study. Present study was demonstrated b value was ranged from 3.018-3.173 which high when compared to Zafar (2008) study with only varies between 2.45-2.73. However, r^2 (0.993) for present study more high compared to Zafar (2008) which only 0.966. Base on r^2 value for present study growth rate for *O. niloticus* can be predict with increasing length in 1 mm will increasing in weight for 9.993 g.

Present study on water quality treated with FKW was demonstrated improvement for ammonia nitrogen, nitrite, nitrate and pH level. However, the result for dissolved oxygen was contrast with other parameters. Most important component in water quality for fish rearing is ammonia concentration which high ammonia level will cause growth performance decrease in tilapia (Riche and Garling, 2003). High ammonia level also related to high stock density of reared fish (D'Silva and Maughan, 1995). Improvement water quality for nitrite, nitrate and pH level in present study was better when compared with other previous study by using alcohol yeast (Medri *et al*., 2000) and sun flower as replacement in fish meal Zafar (2008). Even three water quality indicator showed improvement; dissolved oxygen for treated tank was significant lower compared to control. This might occurred due to the high stock density of tilapia in each treatment. Low dissolved oxygen level in water will limit respiration, growth and other metabolic activities of fish (Tsadik and Kutty, 1987). Present study was indicated fermented kitchen waste as alternative water additive to improve water quality and corresponding to the tilapia growth performance.

CONCLUSION

From the experiment suggest that FKW is able to improve water quality and growth performance of *Oreochromis niloticus*. It is recommended to use not exceed than 0.1% of FKW concentration for water quality improvement and low concentration of fermented kitchen waste for the best growth performance of *O. niloticus*. There is need for further study in lower concentration of FKW on *O. niloticus* or other fish species. Besides that it is recommended in the future to use specific bacteria strain density in fermented kitchen waste to replace the different concentration in the present study for treatment.

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