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EFFECTS OF HONEY ON SURVIVAL AND GROWTH PERFORMANCE OF *Clarias gariepinus* (BURCHELL, 1822) FINGERLINGS

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Abstract

Effects of honey on survival and growth performance of C. gariepinus (Burchell, 1822) fingerlings were investigated. The experiment constituted of T1 (0ml/g): Control; T2 0.1ml of honey/g of feed); T3 0.2ml of honey/g of feed; T4 0.3ml of honey/g of feed; T5 0.4ml of honey/g of feed and three replicates using complete randomized design (CRD). Data collected analyzed using one-way analysis of variance to test for significant difference (P<0.05) on survival and growth performance, means separation was done by Duncan's Multiple Range Test. The results showed that treatment T2 (0.1ml/g) had the highest mean survival rate (95.33 %) and was significantly different (P<0.05) compared to control (T1). Similarly, T2 (0.1ml/g) was significantly different (P<0.05) from T4 (0.3ml/g) and T5 (0.4ml/g) at (P<0.05). Survival rate of fingerlings decreased with increased honey concentrations. Growth parameters such as weight gain (2.26g), percentage weight gain (80.74%), specific growth rate (1.01%), SLI (6.38cm) showed that treatment T2 (0.1ml/g) had the highest growth performance and was significantly higher than that of control (T1) (0ml/g) at (P<0.05). This study showed that honey in fish diets improved survival and growth performance of C. gariepinus fingerlings. Therefore, recommended that honey can be incorporated in fish diets in aquaculture.

Keywords: African Catfish, Diets, Feed additive, Growth performance, Honey, and Survival rate

INTRODUCTION

The application of honey as feed additive in aquaculture has been rather limited but holds considerable potential (Gary, 2007). The application of honey in a diet of fish have been observed to have positive effects on growth performance, immune system, disease resistance, maintenance of intestine function, and microbial activity in the intestinal tract of Salmonids (Merrifield *et al.*, 2010). According to Arawwawala and Hewageegana (2017) honey is accepted as a food source and medicine by both modern and ancient generations, traditions and civilizations. Several researchers also reported that honey is universally utilized (Crane, 1975; Allsop and Miller, 1996; Crane, 1999; Jones, 2001). Honey affect the microbiota of the host in numerous processes including growth, digestion, immunity and disease resistance of the host organism as demonstrated in poultry (Patterson and Burkholder, 2003), other terrestrial livestock and companion animals (Flickinger *et al.*, 2003), as well as in humans (Gibson and Roberfroid, 1995). Components of honey act as prebiotics to increases resistance against diseases by increasing immunity of the organism's digestive tract resulting in low mortality and also enhance growth performance (Raja *et al.*, 2015).

Gary (2007) suggested that prebiotics have the potential to enhance numerous biological responses while lowering mortality due to microbial pathogens. The use of honey as prebiotics may offer a better, safer, and preventive alternative to antibiotics used in fish treatments and disease control. The application of honey as feed additive in fish hatcheries in aquaculture may be highly effective in improving digestibility of nutrients, survival and growth performance of fry (Daniels *et al.*, 2010). Honey is also environmental-friendly and used as bioindicators to enhance the health of fish (Ponokvar *et al.*, 2005). Honey incorporated into diet at 2.5% improved growth of Tilapia (*Oreochromis niloticus*) (El-Asely *et al.*, 2014). Daily supplied drinking water with 20 ml (20H), 40 ml (40H) and 60 ml (60H) of honey per liter of water to assess the effect of different levels of honey on physiological, growth and carcass traits of broiler chickens during dry season (Oke *et al.*, 2016) showed that the 60 ml of honey liter per day has the highest in terms of weight gain and spleen weight, and found to reduce stress. The use of antibiotics in fish treatments inhibit or kill both harmful and beneficial microorganisms in the gut and disturb the natural ecosystem that affects fish nutrient absorption, physiology and immunity (Song *et al.*, 2014). The application of honey as a prebiotics feed additive in aquaculture has been rather limited but holds considerable potential (Gary, 2007). Therefore, there is sparse or little information on the effects of honey on survival and growth performance of African catfish *(C. gariepinus)* fingerlings.

MATERIALS AND METHODS

The experiment was carried out at the Aquaculture Production Technology Unit, National Agricultural Extension and Research Liaison Services, Ahmadu Bello University, Zaria, Kaduna State Nigeria. It is located at latitude 11º4' N and 7º58 E. The average annual rainfall is approximately 107.5cm. The average daily temperature recorded maximally 36.6ºC around April and falls to 23.3ºCaround October. The relative humidity ranged between 70% and 80% in August and minimum around 15 – 20% in December (Hore, 1970).

Fry of four-week-old were obtained from Bal & Kol Global Concepts Fish Farm (Hatchery), Grace-Land, Zaria, Kaduna State Nigeria. The fingerlings were acclimatized for two weeks. The initial total weight and standard length (cm) of the fngerlings of each experimental unit was taken using electronic weighing balance (Camry Model EK5350: max-5kg) and a measuring board for length (cm) respectively. The fingerlings were siphoned in a small bowl and were counted directly using a plastic strainer and transferred into each experimental unit.

Skretting fish feed was purchased Kaduna Central Market, fish diet size of 0.5 – 0.8mm. Undiluted honey was obtained from a Beekeeper in Ribah, Wasagu-Danko Local Government Area of Kebbi State Nigeria and transported to Zaria, Kaduna State Nigeria. The dosage/concentration of honey per gram of feed added to diets in Treatments (T2-T5), except Treatment 1 (T1) (0ml/g) control; Treatment 2 (T2) (0.1ml/g); Treatment 3 (T3) (0.2ml/g); Treatment 4 (T4) (0.3ml/g); Treatment 5 (T5) (0.4ml/g).

The experimental layout constituted five (5) treatments and three replications, and were arranged in Complete Randomized Design (CRD), which made a total of fifteen (15) experimental units in fifteen bowls (70liter capacity) for the experiment. Each experimental unit was stocked with 10 fingerlings in each experimental unit. Each experimental bowl was filled up to 30-liter capacity.

Fingerlings were fed *ad libitum* in each experimental unit. Feeding frequency was twice daily between 9.00am - 10.00am and 3.00pm - 4.00pm due to cold season. Uneaten feeds were siphoned out every morning before first feeding daily and the water volume was replaced to about 50 - 70% every morning. Total renewal of water and washing of the experimental units was on weekly basis. The experiment lasted for twelve weeks.

Mortality rate was recorded on weekly basis. Weight gain (g) and length (cm) increase were measured twice in a month using sensitive weighing balance (Camry Model EK5350) and measuring board, respectively. The water quality parameters were recorded on monthly basis at about 8.00am - 9.00am before feeding the fingerlings. The data recorded from each experimental unit such as mortality (survival), standard length, weight gained, and condition factor were analyzed to determine the general performance of the fingerlings.

Survival and Growth Performance of *C. gariepinus* Fingerlings

Survival Rate:

Survival Rate (%) = $\frac{Ni-Nf}{\mathrm{Ni}}$ × 100 (Achionye-Nzeh *et al.*, 2012).

Where Ni and Nf is initial stocking and final number of fingerlings survived at the end of the experiment respectively.

Weight gain (WG)

Weight gain (g) recorded was computed according to (Adebayo and Popoola, 2008)

Weight gain (WG) = $WGf - WGi$

Where WGf and WGi is the final and initial weight gain in grams

Percentage Weight Gain (PWG)

This was calculated according to the method described by Owodeinde and Ndimele (2011).

PWG (%) = $\frac{MWGf-MWGi}{MWGi}$ × 100

Where mWGf and mWGi is final and initial mean weight gain, respectively

Specific Growth Rate (SGR)

According to (Adebayo and Popoola, 2008), specific growth rate was computed thus:

SGR (%) = $\frac{LogeWf-LogeWi}{Time\ (Days)}$ × 100

Where Loge = Natural logarithm, Wf and Wi is final and initial weight fingerlings during the Experiment.

Mean Standard Length Increase (MLI)

The Mean Length Increase (MLI) was calculated by adopting the method by (Adebayo and Popoola, 2008)

MLI (mm) =$MLf - MLi$

Where mLf and mLi is mean final and initial length of the fingerlings

Data Analyses

Data collected were subjected to one-way analysis of variance (ANOVA) to test for significant difference (P<0.05) among treatments on survival and growth performance indices using IBM SPSS 2013 version 22. Mean separation were by using Duncan's Multiple Range Test (DMRT) where differences exist (Adebayo and Popoola, 2008).

RESUILTS

Table 1: Survival and growth performance of *C. gariepinus* fry fed honey as a prebiotic feed additive

Treatments	SR (%)	WG (g)	PWG (%)	SGR (%)	MSLI (cm)	K
T1 (0ml/g)	50.33 ± 0.33^{bc}	1.64 ± 0.02^{d}	58.57 ± 0.12^{b}	0.85 ± 0.23^{b}	3.29 ± 0.01^{c}	0.64 ± 0.00^{a}
T2 (0.1ml/g)	95.33 ± 0.33^{a}	2.26 ± 0.01^{a}	80.74 ± 0.02^{a}	1.01 ± 0.11^{a}	6.38 ± 0.02^{a}	0.44 ± 0.00^{b}
T3 (0.2ml/g)	70.33 ± 0.33^{ab}	2.10 ± 0.01^{b}	75.00 ± 0.22^{ab}	0.97 ± 0.43^{ab}	5.33 ± 0.01^{ab}	0.44 ± 0.00^{b}
T4 (0.3ml/g)	60.00 ± 1.00^{cd}	2.09 ± 0.00^{bc}	74.64 ± 0.13^{ab}	0.97 ± 0.23^{ab}	4.81 ± 0.01^{b}	0.44 ± 0.00^{b}
T5 (0.4ml/g)	40.67 ± 0.33^{d}	2.03 ± 0.00^{bc}	72.50 ± 0.42^{ab}	0.95 ± 0.64^{ab}	4.4 ± 0.01^{bc}	0.44 ± 0.00^{b}
P Value	0.001	0.001	0.001	0.001	0.001	0.000

Means with the same superscripts are not significantly different (P>0.05). SR% = Survival rate, WG = Weight gain, PWG = Percentage weight gain, SGR% = Specific growth rate, MSLI = Mean standard length increase, K = Condition factor

The results in Table 1: showed that treatment T2 (0.1ml/g) had the highest mean survival rate (%) 95.33±0.33 among the treatments while treatment T5 (0.4ml/g) had the lowest mean survival rate (%) 40.67±0.33 and was significantly different (P<0.05) and higher than the control treatment T1 (0ml/g) in terms of survival rate (%) in this study. Mean weight gain (g) treatment T1 (0ml/g) had the lowest 1.64±0.02 which served as the control while treatment T2 (0.1ml/g) had the highest mean weight gain (2.26±0.01g), however it was statistically different (P<0.05) for other treatments. There was significant difference (P<0.05) in mean percentage weight gain (PWG) among the treatments, although treatment T1 (0ml/g) had 58.57±0.12% which was the lowest and treatment T2 (0.1ml/g) had the highest 80.74±0.02% in the study. In terms of mean specific growth rate (%) treatment T2 (0.1ml/g) had 1.01±0.11 which was the highest and was statistically different (P<0.05) from the other treatments while treatment T1 (0ml/g) had the lowest 0.85±0.23. There was significant difference (P>0.05) in mean standard length increase (MSLI) (cm) among the treatments though treatment T1 (0ml/g) had the lowest value 3.29±0.01 while treatment T2 (0.1ml/g) had 6.38±0.02 which was the highest.

DISCUSSION

The results showed that treatment T2 (0.1ml/g) had the highest mean survival rate (%) of 95.33 ± 0.33^{a} among the treatments. This was higher than the findings of Sanaye *et al.* (2014) and (Ayinla, 1988) who observed higher mean survival rate of 95.23% for *C. anguillaris* fingerlings fed with commercial feed and mixed additives (zooplankton). Treatment T2 (0.1ml/g) had the highest mean survival rate (95.33 %) and was significantly different (P<0.05) when compared to control (T1). Similarly, T2 (0.1ml/g) was significantly different (P<0.05) with T4 (0.3mg/l) and T5 (0.4mg/l) at (P<0.05). It was observed that survival rate of the fish fingerlings decreases with increased in the concentrations of honey. Mean survival rate (%) in this study was higher than the findings of El-Asely *et al.* (2014) and (Ayinla and Nwadukwe, 1988) who recorded survival rate (SR) of 50% of *O. niloticus*, this could be attributed to higher doses of honey in fish diets added externally made the nutrients accessible to the fingerlings (Ayinla, 1988) and (Ayinla and Nwadukwe, 1988).

The result on growth performance of *C. gariepinus* mean weight gain (g) treatment T2 (0.1ml/g) had the highest 2.26 ± 0.01^{a}, mean percentage weight gain (PWG) 80.74±0.02%, mean specific growth rate (%) treatment T2 (0.1ml/g) 1.01±0.11, mean standard length increase (MSLI) (cm) 6.38±0.02, which was in line with the findings of El-Asely *et al.* (2014) and (Ayinla and Nwadukwe, 1990) who reported significant increase in growth performance parameters [body weight, length, average daily gain (ADG), specific growth rate (SGR), and feed efficiency ratio (FER)] of Tilapia (*O. niloticus*) using honey as an additive. However, Oke *et al.* (2016) reported that daily supply of drinking water with honey at 20 ml (20H), 40 ml (40H) and 60 ml (60H) of honey per liter of water to assess the effect of different levels of honey on physiological, growth and carcass traits of broiler chickens during dry season showed that the 60 ml of honey liter per day has the highest in terms of weight gain and spleen weight, and found to reduce stress.

CONCLUSION AND RECOMMENDATION

Honey in fish diets to improve survival and growth performance of *C. gariepinus* fry at T2 (0.1ml/g) gave the highest mean survival rate (95.33 %) and growth parameters of mean weight gain (2.26g), mean percentage weight gain (80.74%), mean specific growth rate (1.01%), and mean standard length increase (MSLI) (6.38cm) had the highest growth performance. Therefore, honey should be incorporated in fish diets in small quantity to improve survival and growth performance in the aquaculture.

Honey should be incorporated in fish diets in small quantity to ensure optimal survival rate and growth performance in fish hatchery management and aquaculture. Further research should be conducted to ascertain the dose or concentration or level of inclusion in fish diet.

REFERENCES:

Achionye-Nzeh, G. C, Olumuji, K., Bello, N (2012). Effects of *artemianauplii* and formulated diets on growth and survival of larvae and post-larvae of *C. gariepinus* (L.). *International Journal of Life Science and Pharmacology Research, 2(2): 29 -34.*

Adebayo O.T, Popoola O.M (2008) Comparative evaluation and efficacy and cost of synthetic and non-synthetic hormones for artificial breeding of African catfish *(Clarias gariepinus*). *Journal of Fish Aquatic Science* 3: 66-71.

Allsop, K. A. and Miller, J. B. (1996). Honey revisited: A reappraisal of honey in pre-industrial diets. *British Journal of Nutrition; 75: 513-520.*

Arawwawala, L. D. A. M. and Hewageegana, H. G. S. P. (2017). Health benefits and traditional uses of honey: A review.*Journal of Apitherapy; 2(1): 1-14*

Ayinla, A. O. (1988). 'Nutrition and Reproductive Performance of *C. gariepinus* (Burchell, 1822)'. Ph.D Thesis, University of Ibadan. 500p

Ayinla, A. O., and F. O. Nwadukwe (1988). Preliminary studies on early rearing of *C. gariepinus* fry in plastic ponds. *Nigeria Institute for Oceanography and Marine Research Technical Paper, 30: 1-10.*

Ayinla, A. O., and F. O. Nwadukwe (1990). Effects of Season on Controlled Propagation of African Catfish, *C. gariepinus (*Burchell, 1822*). NIFFR Research Technical Paper, 62:15pp*

Crane, E. (1975). '*History of honey'*. In: Honey a Comprehensive Survey. London: William, Heinemann; Editted, *15-27pp*.

Crane, E. (1999). '*The World History of Beekeeping and Honey Hunting'*. London: Gerald Duckworth & Co.; *12-34pp.*

Daniels, C. L., Merrifield, D. L., Boothroyd, D. P., Davies, S. J., Factor, J. R., Arnold, K. E. (2010). Effect of dietary *Bacillus spp.* and mannan oligosaccharides (MOS) on European lobster *(Homarus gammarus* L.) larvae growth performance, gut morphology and gut microbiota. *Aquaculture 304:49-57*.

El-Asely, A. M., Abbass, A. A. and Austin, B. (2014). Honey bee pollen improves growth, immunity and protection of Nile tilapia (*Oreochromis niloticus*) against infection with *Aeromonas hydrophila. British Journal of Nutrition; 77: 1-50*

Flickinger, E.A., J. van Loo, and G.C. Fahey, Jr. (2003). Nutritional Responses to the presence of inulin and oligofructose in the diets of domesticated animals: a review. *Clinical Reviews of Food Science and Nutrition 43:19-60.*

Gary, S. B. (2007). "Effects of Prebiotics on Growth Performance, Nutrient Utilization and the Gastrointestinal Tract Microbial Community of Hybrid Striped Bass *(Morone chrysops x M. saxatilis)* and Red Drum *(Sciaenops ocellatus)*". A Ph.D. Dissertation, Graduate Studies of Texas A&M University. Pp 12-78.

Gibson, G.R. and M.B. Roberfroid. (1995). Dietary modulation of the human colonic microbiota: introducing the concept of prebiotics. *Journal of Nutrition 125:1401-1412.*

Hore, P. N. (1970). Weather and Climate of Zaria. In: *Zaria and its Region* (Ed, Mortimore) Occasional Papers 4. Department of Geography, A. B. U. Zaria 41-48p.

Jones, R. (2001). Honey and healing through the ages. In: Munn P, Jones R, editors. 'Honey and Healing'. Cardiff: *International Bee Research Association IBRA; 201pp.*

Merrifield, D. L., Arkadios-Dimitroglou, A., Foey, A., Davies, S. J., Baker R. T. M., Bøgwald J., Castex, M., Ringø, E., (2010). The current status and future focus of probiotic and prebiotic applications for salmonids. *Aquaculture 302:1–18.*

Oke,O. E., F. O. Sorungbe, M. O. Abioja, O. Oyetunji, A. O., Onabajo (2016).Effect of Different Levels of Honey on Physiological, Growth and Carcass Traits of Broiler Chickens during Dry Season .*Acta Agriculturae Slovenica,* 108(1): 1-5.

Owodeinde, F.G and P.E Ndimele, (2011). Survival, growth and feed utilization of two Clariid catfish (*Clarias gariepinus* (Burchell 1822) and *Heterobranchus bidorsalis,* (Geoffroy, 1809) and their reciprocal hybrids. *Journal of Applied Ichthyology, 1249-1253*.

Patterson, J.A., and K.M. Burkholder (2003). Application of prebiotics and probiotics in poultry production. *Journal of Poultry Science. 82:627–631.*

Ponokvar, M., J. Šnajder, and B. Sedej (2005). Honey as a Bioindicator for Environmental Pollution with SO_2.*Apidologie,* 36: 403–409

Raja, S., Nandhini, N., Sahana, K., and Dhanakkodi, B (2015). A Review on Beneficial and Destructive Effects of Probiotics in Aquaculture System. *International Journal of Fisheries and Aquaculture Studies; 2 (3): 153 - 159*

Sanaye, S. V., Dhaker, H.S., Tibile, R.M., and Mhatre, V. M. (2014). Effects of green water and mixed zooplankton on the survival and growth performance of neon tetra, *Paracheirodon insnensi* (Myers, 1936) during larval and early fry rearing. *International Journal of Biology, Food, Veterinary, and Agricultural Engineering*, 8(2):1-5.

Song, S. K., Beck, B. R., Kim, D., Park, J., Kim, J., Kim, H. D. (2014). Prebiotics as immunostimulants in aquaculture: A review. *Fish Shellfish Immunology. 40:40-48.*