

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/305913868>

Parasites Of African Catfish *Clarias Gariepinus* Cultured In Homestead Ponds

Article · December 2015

CITATIONS

0

READS

1,381

1 author:



[Uchechukwu Enyidi](#)

Michael Okpara University of Agriculture, Umudike

15 PUBLICATIONS 12 CITATIONS

SEE PROFILE

Some of the authors of this publication are also working on these related projects:



I am working on the effects of provitamin A cassava a genetically modified cassava on the nutrient utilization body composition of African catfish and tilapia [View project](#)

Parasites Of African
Catfish *Clarias Gariepinus*
Cultured In Homestead
Ponds

U.D. Enyidi

*Department of Fisheries and Aquatic Resources
Management, Michael Okpara University of
Agriculture, Umudike Umuahia Abia State, Nigeria*

U.L. Eneje

*Department of Biological Sciences Godfrey Okoye
University, Thinkers Corner Emene Enugu, Enugu
State, Nigeria*

ABSTRACT

There is current boom in the culture of African catfish *Clarias gariepinus* due to profitability and public acceptance. The boom in catfish culture has also lead to increased homestead farming, poor management and parasitism. There is need therefore to survey the prevalence of parasites of African catfish cultured in homestead ponds. To this end mature African catfish were obtained from four homestead fish farms, each with an average of four ponds making 16 ponds. The catfish were transported to wet lab of Godfrey Okoye University Enugu. The fish were sexed and separated according to their farms till analyzed for parasites. Analyses were done for ecto and endoparasites. There was also an analysis on the prevalence of microbial parasites. Parasitic helminths *Procamallanus laevioncus*, had the highest prevalence rate 47.62% followed by necrotic bacteria *Flavobacterium columnare* (38.10%). *Alloglossidium corti* species and *Polyonchobothrium clariae* species were least endemic with prevalence rate of 9.52% and 4.76% respectively. The helminth parasites were more endemic in the intestine of most female than male catfish. *Flavobacterium columnare* was notably causing fin rot and fin erosion. There parasites seems to be reducing in prevalence as the fish increases in weight. Stress and poor knowledge of fish welfare seems to account for prevalence of parasites in the homestead ponds.

Keywords: parasites, flavobacterium, homestead fish ponds, helminth parasites, fish welfare

1. INTRODUCTION

There has not been much work done on the effects of parasites on homestead ponds in Nigeria. Parasites have been said to have little consequences on small scale fish farming in Sub-Saharan Africa (Hecht and Endemann 1998). However there is current increase in fish farming in Sub-Saharan Africa especially Nigeria. Most of the increase in fish farming is due to increase in small scale homestead fish farming. Homestead fish farming is profitable (Obiekezie 2000; Olagunju et al. 2007), and has been posited to have potential of increasing fish production in Nigeria by 500,000 t (Obiekezie 2000). The increase in homestead fish farming leads to increase in number of untrained farmers. There is need to train fish farmers on better farming techniques (Ibrahim and Yahaya 2011).

Poor home stead fish farming techniques results in stress, diseases and eventually death of fish. *Aeromonas* and *Pseudomonas* infections have been noted to be most serious bacteria infection on African fish farms (Hecht and Endemann 1988). African catfish have been noted to be infected with *I. multifiliis*, *Cryptobia iubilans* and *Ichthyobodo* sp. (Omeji et al. 2011). Fin and gill rot disease caused by myxobacteria infection has been reported on African catfish *C. gariepinus*, (Roberts and Summerville 1982, Paperna 1996). Platyhelminths like *Diplostomum spathaceum* (eye fluke) cause blindness when fish is infected. Cercariae penetrates the fish and metacercariae forms in the eyes causing blindness. Parasites of catfish are affected by

pollution. Prevalence of catfish parasites have been used as indicator of pollution (Madanire-Moyo and Bason 2010, Bason et al. 2014). There was reduced prevalence of nematode *Paracamallanus cyathopharynx* and also *Procamallanus laevionchus* as pollutants increased (Madanire-Moyo and Bason 2010). There was prevalence of *Diplostomum* sp and *Polyonchobothrium clarias* in both polluted and unpolluted waters. Among the parasites of fresh water fish is the *Flavobacterium columnare* (Eissa et al. 2010). Nevertheless the absence of parasites in polluted water may be due to effects of pollutants on the fish and parasites as well. Pollution will reduce food availability to the parasite therefore causing death.

Microbial parasites can affect fish and can be very dangerous, mortality and damaging aesthetic values example *Flavobacterium comunare*. The infections of *F. columnare* could be causes acute to chronic. It mainly affects the gills, fins and skin. The pathology of *F. columnaris* disease is dependent on the particular strain and its virulence(Declercq et al. 2013). Parasitic infections are also affected by temperature (Decostere et al. 1998). Prevalence and epizootics of *F. columnare* are associated with rising water temperature, high water turbidity as a result of uneaten food, poor rearing conditions and high stocking density or poor conditions (Wakabayashi, 1991; Kinnunen et al., 1997 and Decostere et al. 1998). Homestead fish farms do not require heavy investment and are operated by the owner and members of house hold (Faphohunds 2005, Olawumi et al. 2010 and Ibrahim and Yahaya 2011). Consequently homestead fish pond maybe subject to enabling environments in favor of parasitic infection example, poor water management and rearing conditions. This research is aimed at achieving the following objectives: (A) to the analyses of parasites of African catfish that are cultured in homestead ponds. (B) to find out the types most rampant or prevalent and their prevalent rate (C) to find out if there is any relationship between sex, weight or age and parasitic infection of African catfish *C.gariepinus* cultured in homestead ponds.

2. MATERIALS AND METHODS

2.1 EXPERIMENTAL FISH

Mature Africa catfish *Clarias gariepinus* were obtained from four homestead fish farms using a net. A total of four fish farms with at least four homestead ponds were visited and sixteen (16) catfish were collected from each farm. The fish were transported back to the wet lab of Godfrey Okoye University Enugu. The catfish were sorted according to their origin of source, sex and stocked in concrete pond till used. Fish were fed with 32% protein diets for two days before the experiment started.

2.2 EXPERIMENTAL PROCEDURE

Water parameters analysis

The water parameters of the rearing ponds were analyzed. Parameters analyzed were pH, dissolved oxygen (DO₂), ammonia and temperatures. The pH was measured using pH meter. Ammonia was measured using

Tetra ammonium kit. Temperature was measured with mercury in glass thermometer. Water chemistry parameters were generally measured according to methods stipulated in Enyidi and Agi (2015).

Ectoparasites examination

African catfish is a scales fish and the presence of ectoparasite was done by examining the whole body of the fish. We looked for presence of necrosis on the fins, spots on the body or sores that could indicate microbial parasite.

Examination of the gills for parasites

Live catfish were seined from the water and taken to the lab for examination. The catfish operculum was cut off with a scissors and examined for any attaching parasite. The exposed gill was cut off at the point of attachment to the body. The entire gill arch was removed and placed on a petri dish containing 3ml of normal saline solution. The cartilaginous arches were cut using scissors. Using 2 inch needle the gill lamellae were separated and cut in 4 cm pieces. The cut lamellae were placed on a glass slide and two drops of normal saline water was placed on the top. The slide was examined under a microscope starting with lowest of 5x, till a clear picture was seen with a total magnification of 100X.

Examination of internal organs

The catfish were placed on a table with their back and cut open with a scissors on the ventral side. The dissection was carefully done and exposed the whole internal organs of the fish. Careful examination of the whole internal organ system was made to identify presence of any parasite. Specific internal organs like the stomach, intestine and the liver were cut off and placed on petri dishes containing 6mls of normal saline water and examined. The stomach, intestine and liver were carefully cut open along the whole length.

Examination of stomach contents

Stomach contents were carefully teased out and examined. The stomach contents were removed and placed inside a petri dish with 4ls of saline water. The stomach contents were carefully examined for possible parasite.

Examination of intestine and liver

The intestinal and liver contents were careful examined under luminous environment for parasites. Scissors was used in cutting 4cm of the intestine and this was placed on a slide and 3 drops of normal saline was added on top and it was examined under the microscope. Furthermore, the cut intestines together with 1ml of water were put into sterile test tube and 2mls of normal saline water was added making 3mls. The mixture were loaded on a centrifuge and centrifuged for 30 mins. The supernatant were collected and placed on a slide and examined under the microscope. Extracted helminthes were identified and preserved in 70% ethanol solution.

Microbial parasite examination

The prevalence of microbial parasites on the catfish was analyzed. Catfish samples externally were examined for possible presence of microbial parasite by close look at their fins and body. Those catfish with notable erosion of their fins and gill were used for analyses. Sterile swabs sticks were used in collecting fluids from the eroding portions of the catfish fins. The fluid were cultured and examined.

Preparation of blood agar

We weighed 2.3g of nutrient agar into a conical flask using an electronic balance and it was mixed with 100mls of water. The mixture was agitated for 8mins and the solution was autoclaved for 30mins. Autoclaved agar was cooled for 10mins at room temperature in the lab. The cooled agar was mixed with 5mls of blood and shake very well. The mixed nutrient blood agar was poured into petri dishes and allowed to solidify and gell before it was inverted. Streaks were made on the agar and it was placed in incubator to incubate for 24hrs.

Gram Staining of microbes

The microbial cultures in the petri dishes were picked with sterile wire loop. The wire loop was passed through naked flame from a Bunsen burner. Each colony was picked and smeared on a glass slide. The smear was flooded with methylene blue for 30 sec. Acetone was used in flooding after the methylene blue and water was finally used in flooding the same slide. The slide was flooded with methyl red and allowed to stand for 1min, then water was flooded and the slide placed under oil immersion and viewed under the microscope.

Isolation of *F. columnare*

The isolation was done according to methods stated in Pilarski et al. (2006). We observed the Gram stained bacteria under the microscope (magnification, x 100) coupled with observation of the typical flexing movements of the bacteria by means of hanging drop and light microscope at x 40 magnification. We made serial dilution of each culture in phosphate buffered saline. There was 0.1 ml taken from each dilution and inoculated onto five separate Anacker and Ordal plates. They plates were incubated under temperature of 25 °C for 48 hrs. Incubation of the plates yielded viable counts to be identified. The isolated Flavobacterium strains were identified based on their pedigree yellow-green colonies, with rhizoid edges. *F. columnare* are rod shaped with gliding motility.

2.3 STATISTICAL ANALYSIS

Prevalence rate was calculated by dividing occurrence of the parasite /total infestation*100. One way ANOVA was used in calculating the statistical differences in the weight affects on parasite prevalence. Fishers least significant difference was used in separating means. SPSS statistical package was in the statistical analyses.

3. RESULTS

Ectoparasites: There were no ectoparasites detected on the body of the African catfish *C. gariepinus*. Although there were presences of eroding fin rays on some of the fish this prompted microbiological analyses for microbial parasites.

Stomach contents: The stomachs of the fish were filled with some digested feed obviously from our feed. However there were much trash like wood debris, bark of some fruits and poorly digestible dried fruit. The non conventional food items found in the stomach were definitely from the farmer's pond, since our concrete tank had no such things.

Intestinal parasites: There were two major types of helminth parasites extracted alive from the catfish intestine. The parasites were of nematodes and the platyhelminths. The most abundant of the nematodes were the *Procamallanus laevioncus* a round worm known to be parasitic to African catfish *C.gariepinus*. The nematodes were recovered mainly from catfish of weight between 520-540g, 580-600g and 600-700g (Table 1). There were significant differences in the prevalence of the parasite on catfish of weight 520-540g and those of 580-600 and 600-700g ($P<0.05$). There was however no significant difference between prevalence of parasite on fishes of 580-600 and those of 600-600g ($P>0.05$). The parasites were also recovered majorly from the female catfish. The next abundant helminth parasite were they digenetic trematode *Alloglosidium corti*. The *alloglosidium* sp. was more prevalent in catfish of average weight 1.5kg (table 1). . *A. corti* were also recovered from few catfish of weight 520-540g and 540-580g. There was no significant differences between the prevalence of parasites on these weight groups of catfish ($P>0.05$) (Table 1). The least prevalent parasite of the catfish was the trematode *Polygonchobothrium clariae*. Male catfish of weight range 500-542g and 540-580g were found to be more susceptible to helminth parasite *P. clariae*. However the infestation of this parasite was not much among the catfish.

Bacteriological analyses result showed presence of rod-like yellow –ve gram staining fin rot causing bacteria *Flavobacterium columnare* in the infected African catfish. The infected fish had different degrees of erosion of fins and showed pathological signs of lethargic behaviors. Bacterial infections were recovered mostly from female African catfish of weight range 600-700g. The infected fish had barbells that were whitish and the fishes were slow in swimming.

The prevalence of rate of the parasites is shown in fig.1. *Procamallanus laevioncus* had the highest prevalence rate 47.62% which was significantly different ($P<0.05$) from that of bacteria parasite *Flavobacterium columnare* with prevalence rate of 38.10%. Helminth parasite *Alloglosidium corti* and *Polygonchobothrium clariae* had lowest prevalence rate of 9.5% and 4.7% respectively. There was no significant differences between the prevalence rate *A. corti* and that of *P. clariae* ($P>0.05$). There was higher rate of infection found on the female parasites than the males Table 1.

The water parameters measured for the culture water was within acceptable range. The pH of the water was normal and the work was done in the dry season period (Table 2). Temperature was up to 30°C and was normal in tropical dry seasons. Ammonia content of the ponds were high in homestead ponds B and C. >1.8ppm.

4. DISCUSSIONS

African catfish cultured in homestead ponds are exposed to parasitic infections. The infection rates seem to be as results of management practices of the farms. The high prevalence rate of *Procamallanus laevioncus* suggests that there was poor management of the surveyed farms. The nematode *P. laevioncus* is an ovoviviparous parasite found in many siluriids (Boomker 1994, Khalil & Polling 1997). Low prevalence rate of *P. laevioncus* (19.17%) had been previously reported in gravid cultured African catfish *C. gariepinus* (Anosike et al. 1992). The authors noted that gravid fish may not have been foraging much for food leading to low parasitism. There was higher prevalence rate of *P. laevioncus* in this research. We noted higher infestation rate for female African catfish than males. However *P. laevioncus* has been identified in series of other African freshwater fishes including the African catfish *C. gariepinus* (Oniye et al. 2004, Barson and Avenant-Oldewage 2006, Hassan et al. 2010). At high infestation of *P. laevioncus* African catfish can have serious pathological effects leading to reduced feeding rate. Many of the parasite can attached to intestinal mucosa, however we only isolated maximum of two worms from each fish. This could be because our sample fish were from homestead ponds.

Infestation with *Flavobacterium columnare* was severe and spread fast on the body of the catfish. There is global infestation spread of *F. columnare* in tropical, temperate and polar climate world (Bullock et al. 1986). The infestation with *F. columnare* we noted in our samples could have been enhance and proliferated due to high temperature as the time of the research. High temperature has been noted in the proliferation of *F. columnare* infection (Kinnunen et al. 1997, Decostere et al. 1998), management as some of the farmers were feeding their fish with poultry waste and other natural food sources obtained from the wild. The analyses of stomach content of some of the fish revealed that fish fed on waste materials of aquatic sources like wood pebbles, dried fruits and non-conventional food sources. *F. columnare* is highly contagious and transmitted through bruised skin and orofecal routes (Welker et al. 2005). The infection of *F. columnare* can be opportunistic or in symbiosis with *Ichthyofiliis multifiliis*. The bacteria has been noted to adhere to the ciliae of *I. multifiliis* and from that route attack the skin of the fish (Sun et al. 2009). Poor water management could also have accounted for the infestation of the bacteria on catfish cultured in homestead pond. Most ponds do not exchange water and the fish are reared in stagnant water for over two weeks before water change. Meanwhile feeding would continue and waster products would accumulate, depleting dissolved oxygen. High biological oxygen demand and stress factor could reduce fish immunity and cause susceptibility to *F.*

columnare. Reduced dissolved oxygen and elevated temperature (Eisa et al. 2010) has been reported to reduce fish immunity making them vulnerable to *F. columnare* infection (Bullock et al. 1986, Suomalainen et al. 2005). *Alloglossidium corti* had low prevalence rate of 9.5%. This may be an opportunistic parasite due to sourcing of feed and poor management of homestead ponds.

5. CONCLUSIONS

The growth of aquaculture calls for greater care and fish welfare. Parasites can be source of the downwards trend in growth if unchecked. The proliferation of parasites can easily be stopped by proper hygiene, good feeding and water quality management. Homestead ponds operators should constantly resort for training to ensure updating of knowledge in fish culture. These would reduce incidence of parasitic infection and possible financial loss and poor aesthetic value of parasitized fish.

6. REFERENCES

- Anosike J.C., Omoregie E., Ofojekwu P.C. and Nweke I.E. (1992). A survey of helminth parasites of *Clarias gariepinus* in Plateau state Nigeria. *Journal of Aquatic Sciences* 7: 39-43.
- Barson, M., Mabika, N., Cooper, R. G. and Nhiwatiwa, T. (2014). Histopathology and helminth parasites of African catfish *Clarias gariepinus* (Burchell, 1822) in relation to heavy metal pollution in a subtropical river system. *Journal of Applied Ichthyology*, 30: 923-929. doi: 10.1111/jai.
- Barson, M. and Avenant-Oldewage, A. (2006). Nematode parasites of *Clarias gariepinus* (Burchell,1822) from the Rietvlei Dam, South Africa. *Onderstepoort Journal of Veterinary Research*, 73:87-94.
- Boomker, J. (1994). Parasites of South African freshwater fish.VI. Nematode parasites of some fish species in the Kruger National Park. *Onderstepoort Journal of Veterinary Research*, 61:35-43.
- Bullock GL, Hsu TC, Shotts EB. (1986). Columnaris disease of fishes. USFWS Fish Disease Leaflet 1986, 1986:1-9.
- Declercq A.M., Haesebrouck, F., Van den Broeck, W., Peter Bossier, W.P, and Decostere A. (2013). Columnaris disease in fish: a review with emphasis on bacterium-host interactions. *Veterinary Research*: 44:2-17.
- Decostere A., Haesebrouck F., Turnbull J., Charlier G. (1999): Influence of water quality and temperature on adhesion of high and low virulence *Flavobacterium columnare* strains to isolated gill arches. *Journal Fish Diseases*, 22, 1-11.
- Eissa, A.E., Zaki, M.M., Abdel Aziz A. (2010). *Flavobacterium columnare* / *Myxobolus tilapiae* concurrent infection in the earthen pond reared Nile tilapia (*Oreochromis niloticus*) during the early summer. *Interdisciplinary Bio center*
- Fapohunda O.O. (2005). Profitability of homestead fish farming in Ondo State Nigeria *Journal of Animal and Veterinary Advances* 4. (6): 598-602
- Hassan, A.A, Akinsanya B & Adegaju, W. A. (2010). Impacts Of Helminth Parasites On *Clarias gariepinus* And *Synodontis clarias* From Lekki Lagoon, Lagos, Nigeria. *Report and Opinion*. 2(11):42-48]. (ISSN: 1553-9873).
- Hecht T. and F. Endemann (1998). The impact of parasites, infections and diseases on the development of aquaculture in sub-Saharan Africa. *J. Appl. Ichthyol.* 14: 213-221.
- Ibrahim H.Y., Yahaya H. (2011). Women participation in homestead fish farming in North central Nigeria. *Livestock Research for Rural Development*. 23: Article no 35.
- Khalil L.F. and L. Polling. (1997). Check list of the helminth parasites of African freshwater fishes. University of the North Republic of South Africa. 161 pp

- Kinnunen, P.R., Bernardet, J.F. and Bloigu, A. (1997). Yellow pigmented filamentous bacteria connected with farmed salmonid fish mortality. *Aquaculture*, vol. 149, no. 1, p. 1-14.
- Madanire-Moyo G. and Barson M. (2010). Diversity of metazoan parasites of the African catfish *Clarias gariepinus* (Burchell, 1822) as indicators of pollution in a subtropical African river system. *Journal of Helminthology*, 84, pp 216-227. doi:10.1017/S0022149X09990563.
- Morris JM, Snyder-Conn E, Foott JS, Holt RA, Suedkamp MJ, Lease HM, Clearwater SJ, Meyer JS. (2006). Survival of lost river suckers (*Deltistes luxatus*) challenged with *Flavobacterium columnare* during exposure to sublethal ammonia concentrations at pH 9.5. *Arch Environ Contam Toxicol*. 50:256–263.
- Obiekezie A. I. (2000) "Poverty Alleviation through Fisheries Production: The way Forward". Proceedings of the 14th Annual Farming Systems Research and Extension workshop in Southeastern Nigeria. Edited by Enyinnia, NRCRI, Umudike, Nigeria.
- Olagunju, F. I., I. O. Adesiyun, and A. A. Ezekiel (2007). Economic Viability of Catfish Production in Oyo State, Nigeria. *J. Hum. Ecol*. 21(2): 121 – 124.
- Olawumi A.T., Dipeolu A.O., Bamiro, O.M. (2010). Economic Analysis of homestead fish production in Ogun State Nigeria. *J. Hum Ecol*. 31 (1) 13-17.
- Omeji, S., Solomon, S.G. and Idoga, E.S. (2011). "A Comparative Study of the Common Protozoan Parasites of *Clarias gariepinus* from the Wild and Cultured Environments in Benue State, Nigeria," *Journal of Parasitology Research*, vol. 2011, Article ID 916489, 8 pages, 2011. doi:10.1155/2011/916489
- Oniye S.J., Adebote D.A., Ayanda O.I. (2004). Helminth parasites of *Clarias gariepinus* (Teugels) In Zaria Nigeria. *Journal of Aquatic Sciences* 19 (2): 71-75.
- Pilarski, F, Rossini, A.J. and Ceccarelli, P.S. (2008). Isolation and characterization of *Flavobacterium columnare* (Bernardet et al. 2002) from four tropical fish species in Brazil. *Braz. J. Biol.*, 68(2): 409-414.
- Roberts R.J. and Sommerville C. (1982). Diseases of tilapias. In R.S.V. Pullin and R. H. Lowe-McConnel (Eds.), *The biology and culture of tilapias* (pp 247-263). Manila, Philippines: ICLARM Conference Proceedings 7.
- Suomalainen L-R., Tiirola M., Valtonen E.T. (2005): Influence of rearing conditions on *Flavobacterium columnare* infection of rainbow trout, *Oncorhynchus mykiss* (Walbaum). *Journal of Fish Diseases*, 28(5), 271-277.
- Suomalainen L-R, Reunanen H, Ijäs R, Valtonen ET, Tiirola M. (2006). Freezing induces biased results in the molecular detection of *Flavobacterium columnare*. *Appl Environ Microbiol* 2006, 72:1702–1704.
- Sun H. Y., Noe J., Barber J., Coyne R.S., Cassidy-Hanley D., Clark T.G., Findly R.C., Dickerson H.W. (2009). Endosymbiotic Bacteria in the Parasitic Ciliate *Ichthyophthirius multifiliis*. *Applied and Environmental Microbiology*, 75 (23), 7445-7452.
- Wakabayashi, H., (1991). Effects of environmental conditions on the infectivity of *Flexibacter columnaris* to fish. *J. Fish Diseases*, vol. 14, no. 3, p. 279-290.
- Welker T.L, Shoemaker C.A, Arias C.R, Klesius, P.H. (2005). Transmission and detection of *Flavobacterium columnare* in channel catfish *Ictalurus punctatus*. *Dis Aquat Organ* 2005, 63:129–138.

Table 1: Infection of African catfish *C.gariepinus* in homestead ponds according to weight and sex of the catfish

Species	Weight	<i>P.laevioncus</i>	<i>F. columnare</i>	<i>A. corti</i>	<i>P. clariae</i>	Male	Female
<i>C.gariepinus</i>	500-520		10 ^a			X	
	520-540	34 ^a	12 ^a	1 ^a			X
	540-580		4 ^b	2 ^a	2 ^{ns}	X	X
	580-600	4 ^b			2 ^{ns}		X
	600-700	2 ^b	6 ^b				X
	700-1.5kg			5 ^b		X	

The prevalence of parasites is read per column. Parasites occurring in both male and female have both stars (X), those occurring singly have a star of the sex (example 600-700g with *P. laevioncus* are all females). Figures in same vertical column not followed by same superscript are significantly different.

Table 2: Water quality parameters of the homestead fish ponds culturing African catfish *Clarias gariepinus*

Farms	pH	DO _{2mg/l}	Ammonia ppm	Temp °C
A	7.5±0.2	3.7±0.3	0.34±0.5	30±0.3°C
B	6.8±0.1	3.0±0.4	2.4±0.6	31±0.3°C
C	7.1±0.3	3.0±0.5	1.8±0.2	30±0.6°C
D	6.9±0.2	2.9±0.3	0.9±0.6	28±0.5°C

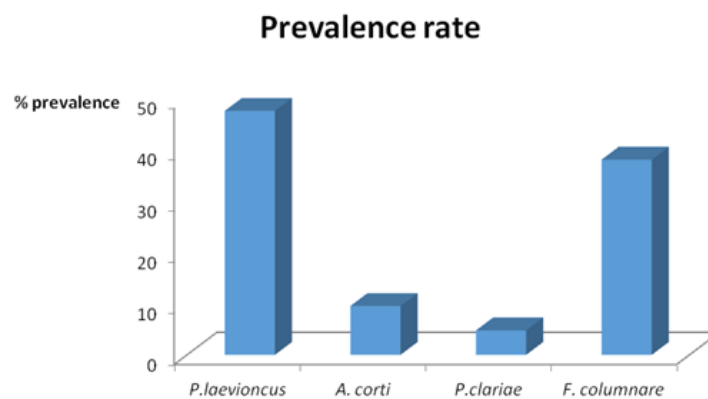


Figure 1. Prevalence rate of parasites of African catfish *C. gariepinus* cultured in homestead ponds