



UNIVERSITI PUTRA MALAYSIA

**ENDOPARASITES OF SILVER CATFISH (*Pangasius sutchi*) CULTURED
IN RECIRCULATING AQUACULTURE SYSTEM**

USAMAH BIN NURDENG DEURASEH

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USAMAH BIN NURDENG DEURASEH

**FACULTY OF VETERINARY MEDICINE,
UNIVERSITI PUTRA MALAYSIA,
SERDANG, SELANGOR.**

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USAMAH BIN NURDENG DEURASEH

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CERTIFICATION

It is hereby certified that we have read this project paper entitled “Endoparasites of Silver Catfish (*Pangsius sutchi*)”, by Usamah bin Nurdeng Deuraseh and in our opinion it is satisfactory in terms of scope, quality, and presentation as partial fulfilment of the requirement for the course VPD 4999 – Final Year Project.

Prof Madya Dr. Mohd Hezmee B. Mohd Noor

**Department of Veterinary Preclinical Science
Faculty of Veterinary Medicine, Universiti Putra Malaysia, 43400 UPM,
Serdang,
Selangor Darul Ehsan.**

Prof Madya Dr Hassan Hj Mohd Daud

**Department of Clinical Studies
Faculty of Veterinary Medicine, Universiti Putra Malaysia, 43400 UPM,
Serdang,
Selangor Darul Ehsan**

DEDICATIONS

To those who encouraged me until the very end.



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CONTENTS

TITLE.....	i
DEDICATION.....	iii
ACKNOWLEDGEMENTS.....	iv
CONTENTS.....	v
LIST OF TABLES.....	vi
LIST OF ABBREVIATIONS.....	vii
ABSTRAK.....	vii
ABSTRACT.....	x
1.0 INTRODUCTION.....	1
2.0 LITERATURE REVIEW.....	3
2.1 Silver Catfish.....	3
2.2 Endoparasites of Freshwater Fishes.....	5
2.3 Aquaculture system.....	7
3.0 MATERIALS AND METHODS.....	9
3.1 Fish Sample.....	9
3.2 Examination of the Specimens.....	9
4.0 RESULTS.....	11
5.0 DISCUSSION.....	13
6.0 CONCLUSION.....	16
7.0 REFERENCES.....	17

LIST OF TABLES

- Table 1 Presence of endoparasites in Silver Catfish from fibreglass tank
- Table 2 Water quality analysis of fibreglass tank



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LIST OF ABBREVIATIONS

FAO	Food and Agriculture Organization of United Nations
RAS	Recirculating Aquaculture System
MyGAP	Malaysian Good Agriculture Practice
Sp.	Species
mg/L	Milligram per Litre



ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4999 – Projek Ilmiah Tahun Akhir.

ENDOPARASIT DALAM IKAN PATIN (*Pangasius sutchi*)

Oleh

Usamah bin Nurdeng Deuraseh**No. Matrik: 190667****Penyelia:** Associate Professor Dr. Mohd Hezmee bin Mohd Noor**Penyelia bersama:** Associate Professor Dr. Hassan bin Haji Mohd Daud

Ikan Patin (*Pangasius sutchi*) merupakan makanan ruji masyarakat negara Asia Tenggara tetapi kelaziman endoparasit dalam sistem akuakultur untuk spesies ini kurang dikaji. Tujuan kajian ini dijalankan adalah untuk menentukan kehadiran dan identifikasi endoparasit dalam ikan patin yang dibela dalam tanki gentian kaca. Dalam kajian ini, sejumlah 12 ekor ikan patin berjisim dalam lingkungan 400 ke 500 gram telah disampel dari ladang akuakultur intensif di Universiti Putra Malaysia dan organ dalaman mereka telah diteliti. Ladang tersebut menjaga dengan teliti keselamatan biosek dan pengurusan air selari dengan pematuhan Skim Amalan Ladang Baik Malaysia (SALM) dalam bidang akuakultur. Hasil daripada kajian ini menunjukkan bahawa tiada ikan yang disampel mempunyai endoparasit yang biasa di darah, laluan gastrousus, buah pinggang dan limpa. Dengan demikian, perkara ini dapat disimpulkan bahawa dengan pengurusan makanan dan persekitaran yang baik serta penggunaan sistem kitar

semula air pintar, kelaziman endoparasit dapat dikurangkan dengan ketara. Walau bagaimanapun, faktor risiko spesifik yang mempengaruhi hasil daripada kajian ini tidak dapat ditentukan dengan tepat.

Kata kunci: ikan patin, akuakultur intensif, endoparasit, sistem kitaran air semula pintar



ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfilment of the course VPD4999 – Final Year Project.

ENDOPARASITES OF SILVER CATFISH (*Pangasius sutchi*)

By

USAMAH BIN NURDENG DEURASEH**Matric No.: 190667****Supervisor:** Associate Professor Dr. Mohd Hezme bin Mohd Noor**Co-supervisor:** Associate Professor Dr. Hassan bin Haji Mohd Daud

Silver catfish (*Pangasius sutchi*) is a staple food source for Southeast Asian countries but the prevalence of endoparasites in aquaculture system of this species has not been widely documented. The purpose of this study is to determine the presence and identification of endoparasites in silver catfish cultured in fibreglass tank. In this study, a total of 12 silver catfish weighing around 400 to 500 grams were collected from intensive aquaculture farming in Universiti Putra Malaysia and their internal organs were examined. The farm maintains proper biosecurity and water management in compliance with the Malaysian Good Agricultural Practice (MyGAP) in Aquaculture. The result of the study shows that none of the sampled fish contain any common endoparasites in the blood, gastrointestinal tract, kidney, and spleen. Thus, it can be concluded that with proper management of feed and environment of the fish stock in

addition to using a smart recirculating aquaculture system, prevalence of endoparasites can be significantly reduced. However, the specific risk factors that influence the result of the study has not been properly determined.

Keywords: silver catfish, intensive aquaculture, endoparasites, smart recirculating aquaculture system



1.0 INTRODUCTION

The striped catfish, *Pangasius sutchi* is a fast growing omnivorous fish, highly popular as a food fish and a valuable species in Asian aquaculture. In Malaysia, catfish is the largest freshwater aquaculture species being cultured which includes *Pangasius spp.*, *Clarias spp.* and *Mystus numerus*. *Pangasius spp.* is one of the largest and most important freshwater fish species in the world and Vietnam producing more than 1.1 million tons in 2008. Other producers are Thailand, Cambodia, Laos People's Democratic Republic, Myanmar, Malaysia, Bangladesh, and China (FAO, 2009).

The presence of parasites is, to a large extent, detrimental for a fish population and consequently, imposes high losses in the fish industry. Parasitic invasion on fishes may cause high mortality, weight losses and reduced fecundity (Grabda et al., 1991). Parasitic diseases, either alone or in conjunction with other environmental stresses, may influence weight or reproduction of the host, alter its population characteristics, or affect its economic importance (Rhode et al., 1993). Parasites are normally found in wild fish populations, and in most cases may also be responsible for diseases in aquaculture (Scholz et al., 1999). Conditions associated with intensive aquaculture such as confinement, overpopulation and stress may facilitate the transmission of parasites and increase parasite intensity in farmed fish (Ogawa et al., 1995). Such diseases restrict the development and sustainability of the aquaculture industry and lead to direct production losses.

In today's industry, open pond culture has become the dominant practice in freshwater aquaculture industry. Although development in the aquaculture industry is beneficial to promote the social and economic growth, it also causes detrimental effect on the surrounding water environment (Cao et al., 2007). In recent years, pond water purification and remediation

technology such as physical filtration, chemical treatment and biological treatment technology have been the interest of newer studies. A multistage water treatment system has been developed to regulate and maintain the balance and stability of pond ecological environment (Crab et al., 2012). Therefore, the reuse and purification of wastewater from the fisheries has become one of the key technologies for the sustainable development of aquaculture.

Despite the considerable progress in fish parasitology in recent decades, there are still major gaps in knowledge of taxonomy, biology, epizootiology and parasites control especially in an intensive aquaculture system. In addition, studies on the parasitology of Malaysian aquaculture fish can be considered as an emerging area of interest and has been gaining popularity for the past decades. Therefore, the present study aimed to analyse the parasitic fauna in cultured silver catfish in fibreglass cage environment of a recirculating aquaculture system.

2.0 LITERATURE REVIEW

2.1 SILVER CATFISH

Pangasius sutchi (Fowler, 1937), or also known as *Pangasius hypophthalmus* (Sauvage, 1878), is one of the major freshwater fish natives to the Mekong River of Vietnam and is considered one of the largest and most important inland fisheries in the world. Traditional aquaculture production for this species particularly in Vietnam probably started because it is a prolific spawner, producing relatively large numbers of larvae that are readily harvested from the flowing river (FAO, 2010).

P. sutchi are omnivorous, feeding on algae, higher plants, zooplankton, and insects, while adult fish can feed on fruits, crustaceans, and other smaller fishes. Mature fish can achieve a maximum standard total length of 130 cm and up to 44 kg in weight. This species is benthopelagic, normally living within the pH range of 6.5-7.5 and temperature range of 22-30 °C. In captivity, females take at least three years to attain sexual maturity (being over 3 kg in weight) while males often mature in their second year.

Silver catfish farming has emerged as a commercial freshwater species that is now a vital component for the supply of global whitefish. Although trade in frozen products generally stagnated in 2007 and 2008, the exception was *P. sutchi*, with trade growing by 311%, mainly traded as frozen fillets (Van et al., 2007). This species is now regarded as a highly competitive, high-value white fish commodity in many markets. To meet the growing demands, aquaculture introductions of this species have taken place to several other Asian countries including Bangladesh, China, India, Indonesia, Malaysia, and Myanmar.

Traditional pangasius fish farms normally operate multiple fishponds with depth range between 3 to 5 metres, a drainage system, and a feed storage. It was common practice for the farmers to apply chlorine, lime, benzalkonium chloride and salt for water purification. Stocking

densities vary from 5 to 31 fish/m³, depending on the size of market fish, availability of fingerlings and the amount of feed the farmer can afford (Phan et al., 2009). Most farms use river water to fill the fishponds and release the wastewater from the ponds directly into the nearby river.



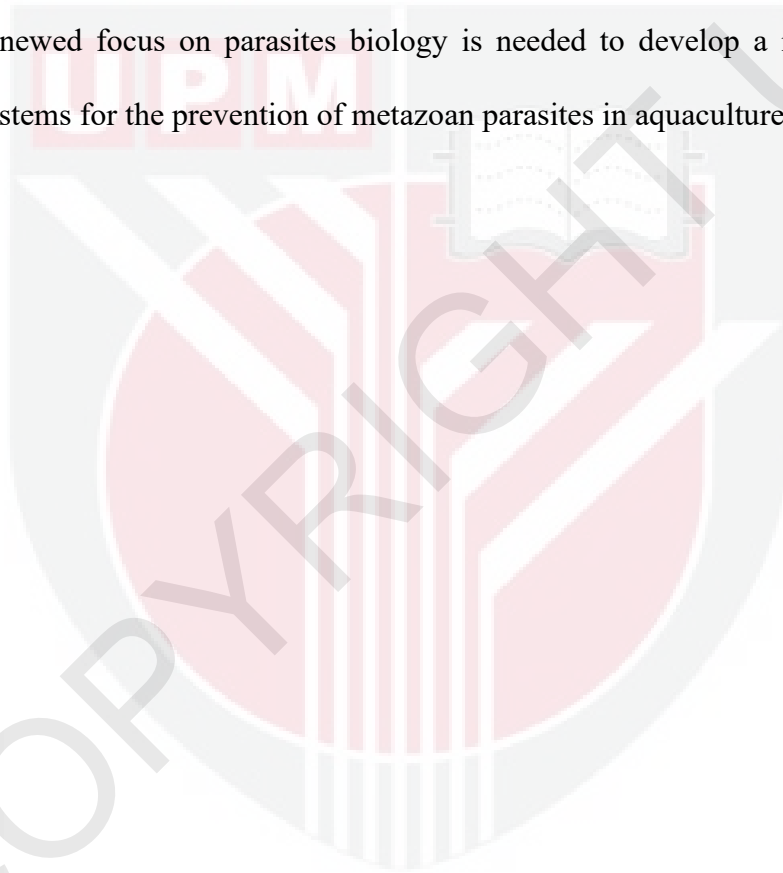
2.2 ENDOPARASITES OF FRESHWATER FISHES

Parasites are known to infect freshwater fish because they, especially carnivores and omnivores, consumed other smaller animals that may have been previously fed on parasite eggs or larvae (Hilderbrand et al., 2003). In aquatic ecosystems, fish are a particularly important hosts for parasites, harbouring a wide variety of adult and juvenile forms and acting either as the sole host in the life cycle of a parasite or as one in a series of hosts. Protozoans, trematodes, nematodes, cestodes, acanthocephalans, copepods and hirudineans are some of the common parasites known to infect freshwater fishes (Iyaji et al., 2008). In marine and freshwater aquaculture, metazoan parasites are among the most economically important in terms of effecting production output and animal welfare concern (Hoai, 2020). The negative effects of these parasites on cultured fish farms range from decreased growth to mass mortality (Liu et al., 2018).

Parasites can cause mechanical damage to the gills of fish, such as tissue discoloration and fusion of gill lamellae. Infected fish will become lethargic, appears visibly pale or anaemic, develop white spots and in chronic cases will increase mucous secretion (Toksen, 2007). In addition, parasites may cause physiological damage, such as cell proliferation, which has been found to be comparable to human diseases and may act as a causative agent for carcinogenesis in fish species (Iwanowicz et al., 2016). Damage to the reproductive capacity of fish due to parasites is also a concern. Parasitic infections have been reported to decrease female fertility by decreasing the development of embryos (Deaton, 2009) and male fishes often avoid mating with parasitized females (Richards et al., 2010).

Variations in the mechanism of parasitic infections in fish could be attributed to the abiotic and biotic aspect of environmental conditions. Unfavourable environmental conditions, such as extreme temperatures or low dissolved oxygen level, may cause detrimental effect on the fish physiology and thus lead to parasitic infection (Ejere et al., 2014).

Current methods for controlling parasites in aquaculture are mainly conservative, which most farmers rely on the use of chemical treatment that focuses on removing parasites infestation present on the fish. Such treatments are expensive, must be repeated regularly, and, in fish cages that uses net pen systems, are subject to significant environmental pollution (Olaussen, 2018). Most of these treatments are unsustainable in the long term as the rapid proliferation of parasites will likely lead to the emergence of resistant strains (Mennerat, 2010). Currently there are no commercial vaccines available against any parasitic diseases in fish. Therefore, a renewed focus on parasites biology is needed to develop a more sustainable management systems for the prevention of metazoan parasites in aquaculture.



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2.3 AQUACULTURE SYSTEM

Aquaculture is defined as the production of aquatic animals and plants using ponds, reservoirs, lakes, rivers, and other inland waterways, including brackish water sources, under controlled or partially controlled conditions. The most widely cultivated aquaculture fish species are the carp species, but tilapia, catfish, and a few other species are also produced in large quantities. As a consequence of overharvesting and water contamination, the reduction of wild fish stocks has encouraged the development of aquaculture industry that commercially produce fish in a healthy and regulated environment.

The most popular aquaculture systems practiced today are fish rearing in ponds due to its relatively cheap capital investment, but other flowing water systems, such as cages, and net pens have become increasingly common. In conventional raceway systems used to grow fishes, they are called as "open" or "flow through" systems since all the water only makes one pass through the tank and is then discarded after usage.

In recent years, Recirculation Aquaculture System (RAS) has been practiced more commonly as new knowledge and improved technologies have been developed. This system rears fish at high densities, in indoor tanks with an artificially controlled environment, instead of the conventional method of growing fish outdoors in open ponds and raceways. Recirculating water systems filter and cleans the used water and recycles them back through the fish culture tanks. Fresh water is only added to the tanks to compensate for spillage and evaporation or to wash out waste materials. This minimizes the use of water resources which contributes positively towards the natural environment.

In this system, RAS filters out the solids from the bio-filter into septic tanks, which improves the water quality inside the ponds and reduce waste discharge, while providing additional oxygen for the fish inside the cage. An airlift pump is used to get the water flowing

inside the pond thus keeping solid materials moving towards a storage zone below the bio-filter. The solids are then pumped to a separate septic tank for denitrification process. The use of efficient RAS can increase the stocking densities up to 76 fish/m³ but only extruded pellet feeds can be used in this system (Nhut et al., 2013).

Potential advantages in using RAS in aquaculture is the reduced rate of diseases and usage of less antibiotics and chemicals (Gutierrez-Wing et al., 2006). However, there are limits and constraints in the adoption of RAS in the current aquaculture industry due to the relatively high initial investment costs. Additionally, the cost of maintaining the system requires the constant use of water pumps and filters which leads to high energy utilization in the form of electricity in order to maintain circulation in pond water (d'Orbcastel et al., 2009). Furthermore, the potential yields, profit range and operating costs for RAS still cannot be properly determined. This uncertainty together with the high starting investment and maintenance costs means that the economic practicability is also uncertain which will hinder the implementation of these innovative production systems (Ngoc et al., 2016).

3.0 MATERIALS AND METHODS

3.1 FISH SAMPLE

A total of 12 silver catfish (*Pangsius sutchi*) were collected for this study. The specimen was obtained from Taman Pertanian Universiti, Puchong, Universiti Putra Malaysia. The fish was reared in a fibreglass tank and fed with a commercial diet made from grains and plant-based materials. The farm implemented a Recirculating Aquaculture System (RAS) that recycles most the water used inside the tank by filtering solids using a sand-based filter and resupply the water with oxygen.

The fish was caught using a fish net and transported via an oxygen-filled sealed water bag. The fish was later kept alive in a fibreglass tank at the aquatic lab until they were dissected under IACUC approval (UPM/IACUC/AUP-U043/2020). The water quality was determined from the records of water quality test result that was recorded by the fisheries worker.

3.2 EXAMINATION OF THE SPECIMENS

The fish was handled cautiously using a damp cloth to reduce stress and injuries to the skin surface and prevent the skin from drying out. The blood was collected from the caudal peduncle vessels. The fish were then immobilized by decapitation and pithing of the central nervous system of the fish prior to further examination. The standard body length and total body length was measured and recorded. The endoparasite presence was then examined by dissection of the fish internal organs for direct observation under the light microscope. The dissection was done by piercing the abdominal cavity using a pair of iris scissors at the ventral midline just behind and between the pectoral fins and cutting along the ventral midline towards the anal region. The abdominal flap was removed to expose the internal organs of the abdominal cavity. The stomach, intestines, spleen and kidney were carefully taken out and put on a petri dish. Any white spots found on the surface of the organs was

carefully examined to check on the possibilities of a parasite infestation. The intestine was incised into 3 different portions namely the anterior, middle and posterior part and was put on a different petri dish for easier identification and examination of the entire gastrointestinal tract. The 3 parts of the intestine was dissected carefully, and the intestinal walls were scrapped. The scrapings were placed onto a clear glass slide and diluted with a few drops of normal saline. These were carefully examined under a microscope for the attachment of the parasites using 10x and 40x magnification.



4.0 RESULTS

4.1 ENDOPARASITES FOUND IN SILVER CATFISH (*Pangasius sutchi*)

Common Parasites	Sampled Organ				
	Blood	Stomach	Intestines	Kidney	Spleen
Myxosporea (Myxobolus)	-	-	-	-	-
Cestodes (Tapesworms)	-	-	-	-	-
Trematodes (Flukes)	-	-	-	-	-
Nematodes (Roundworms)	-	-	-	-	-
Acanthocephala (Thorny-headed worms)	-	-	-	-	-
No. of fish sampled			12		
% of fish infected			0.00		
Total no. of parasites			0		

Table 1: Presence of endoparasites in Silver Catfish from fibreglass tank

A total of 12 silver catfish was examined for the presence of endoparasites. All the sampled fish were adult weighing around 400 to 500 grams cultured in fibreglass tank that uses a recirculating aquaculture system. It was found that none of the fish sampled from the fibreglass tank harbour any common endoparasites in the blood, kidney, spleen, stomach, and intestinal content.

4.2 WATER QUALITY ANALYSIS

The water quality analysis shows that all parameters as listed below [Table 2] for the water used in the fibreglass tank were all within normal range and is optimal for the rearing of silver catfish intensively based on the recommendation set by FAO (2010).

Parameter	Fibreglass Tank	Reference range
pH	7.1	6.5 – 7.5
Temperature	28.5°C	22 – 30 °C
Dissolved Oxygen (DO)	6.0 mg/L	2.5 – 7.5 mg/L
Ammonia	0.0 mg/L	< 1.0 mg/L

Table 2: Water quality analysis of fibreglass tank

5.0 DISCUSSIONS

The factors contributing to the prevalence of parasites in the natural environment that leads to the development of various parasitic fauna within fish hosts are complex, but they are largely dependent on the geographic range, diet, local habitat use and size of the host fish (Barber et al., 2008). Recent studies have shown that parasite abundance can increase where the conditions of the local environment are suitable for parasite development but will decrease when there are high levels of environmental contaminants which are harmful to the parasites (Pilosof et al., 2012). In this study, the negative findings of endoparasites inside the sampled silver catfish can attributed to 2 main reasons; the dietary content of feed given to the fish and the environmental management in which the fishes are reared.

For parasites transmitted via the food chain, dietary component is an important determinant of the types of parasites that infect fish hosts. Fish species that are considered pelagic morph, which are top and middle dwellers that feed on planktonic prey, were found to be dominated by cestodes transmitted by copepods, while fish considered to be benthic morph, which are bottom dwellers, are dominated by acanthocephalans, transmitted via bottom-dwelling prey, and diplostomatid trematodes, the cercaria of which are released from benthic snails (Dorucu et al. 1995). In an intensive farming scenario, the utilization of proper feed management can minimize the likelihood of parasite infection and transmission. By controlling the feed requirements and intake, traumatic stressors in captive-reared populations, which can predispose the fish to parasitic as well as bacterial infection, can be minimized. Thus, it is important to evaluate the quality of the feed given to stock. Trash fish should not be fed, and the food must be processed and stored properly so that it is free from contamination that could lead to disease outbreak.

The next aspect we could look at when considering parasitic presence in fish is the environment in which the fish are cultured. Water quality plays a major role in determining the

health status of fish and organisms that are in the aquatic environment. Poor water quality can cause detrimental effect as a result from the interactions between the host fish and the disease-causing situation or stressors (Winton, 2001). The causative factor for parasitic diseases has often been linked to contaminated diets (Sherif et al. 2013) or pollutants such as nitrogenous compounds, ammonia, and nitrites (Xiao et al. 2018), hydrocarbons (Noreña-Barroso et al. 2004), heavy metals (Abedi et al. 2012) and sewage water (Maceda-Veiga et al. 2013). The pollutants may disrupt the metabolism and immune system of the fish and thus lead to parasitic infestation and clinical disease development.

Certain parasites have complex life cycles which involves intermediate host, thus understanding the parasites biology can allow for the strategic application of effective control measures in order to break its life cycle. Examples of such interventions can include the elimination of the intermediate hosts, such as the use of molluscicides to control snail population, the removal of vegetation to eliminate the habitat and feed sources for snails and preventing direct or indirect contact with wild birds which might otherwise transmit parasites through the release of parasite eggs during feeding or defecation.

One of the ways to combat the issues concerning poor water qualities while performing intervention strategy management in fish farms is the implementation of the Recirculating Aquaculture system (RAS). The efficiency of the RAS technology can be evaluated by assessing various water quality parameters such as the total nitrogen, total phosphorus, ammonia nitrogen, and nitrite nitrogen. Several reports have found that a well operated RAS technology are able to control the water quality parameters and its environments through the use of many different components, thus maintaining optimal conditions for fish farming. (Pham et al., 2016; Zhang et al., 2016; Liu et al., 2014).

The RAS technology were designed to a conserve the usage of land and water while maintaining high production-yield fish culture, which have the advantage of reducing resource demand, protecting the ecological environment and maximizes production capacity. With the continuous destruction of the natural environment due to agriculture development and more restriction in farm operation from government environmental policy, the recirculating aquaculture will become the future progression of aquaculture development.

However, presently there are very few farmers that uses the RAS technology in actual production, because of the specialization and training needed to improve their current management. The application of RAS in fish farms involves additional investment in a moving bed bio-filter, filter media, septic tank, pumps and pipes for water treatment and aeration. In order to apply the RAS technological model to the actual production, it is necessary to develop alternatives and variations of this system that could ease the transition from the current production practice of rearing in ponds and open bodies of water towards the intensive production using RAS technology.

6.0 CONCLUSIONS

From this research, we can see that the implementation of Recirculating Aquaculture System (RAS) in an intensive fish farm plays a major role in the presence of endoparasites in Silver Catfish cultured in fibreglass tank. An aquaculture system that practices good biosecurity prevents the introduction of endoparasites in the fish farm populations which reflects on the negative result of this study. This observation shows that it is possible for an intensive fish farm to completely eradicate the presence of endoparasites that are associated with disease outbreak that leads to poor growth and reduce production.

It is noted that the data presented here only serves as a preliminary result since it was generated from a small sample size within a short sampling period and using only samples from a single fish farmhouse. It is recommended to increase the sample size with different sampling sites so that more reliable data can be obtained with different parameters to observe and study. To provide a better insight into the mechanisms of parasitic infestation in RAS intensive farming, fish samples should be obtained throughout the production stages, starting from the juvenile nursing stages to the adult grower stages. The data obtained in this study may serve as a baseline study on parasitic infections of intensively cultured fish and how the environment and management play a role in the presence of endoparasites.

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