Sapronegnia Fungus Species: A THREAT TO SUSTAINABLE FISH PRODUCTION IN NIGERIA

[1]B.T., ADESINA,[2]B.O., OMITOYIN,[2]O.A., ADESINA,[3]A.O., LADOKUN ,[4]F.I., ADEOSUN[1]J.L., AFOLAYAN,[5]A.A., ADEYEMO, [1]W.C., IWEBEMA,[1]A., IGA, [1]E.O., ONI, AND [1]A.O., ADEBIYI

[1]Department of Animal Science, College of Agricultural Sciences, Landmark University P.M.B. 1001, Km4 Ipetu Road, Omu-Aran, Kwara State, Nigeria, [2]Department Aquaculture and Fisheries Management, Faculty of Agriculture, University of Ibadan, Ibadan, Nigeria; [3]Department of Animal Physiology, College of Animal Science and Livestock Production, Federal University of Agriculture, Abeokuta, Nigeria; [4]Department of Aquaculture and Fisheries Management, College of Environmental Resources Management, Federal University of Agriculture, Abeokuta, Nigeria; [5]Depatment of Agricultural Education, School of Vocational and Technical, P.M.B. 206, Ila-Orangun, Osun State, Nigeria; Corresponding E-mail:isajin1999@yahoo.com;adesina.babatunde@lmu.edu.ng

ABSTRACT

In the hatchery, where primary production of fries and fingerlings were the key to sustainable fish production is currently faced with obnoxious problem caused from infection on the hatchling eggs of freshwater fish by the Sapronegnia Fungus Species (SFS) at the hatchery production units of every aquaculture outfits in Nigeria and elsewhere in the tropics. In an attempt to control SFS in the hatchery, fish farmers regularly make used of synthetic chemicals are used to control fish eggs infection in the hatchery. Currently, world is tending towards the campaign on the use of organic fungicides application in aquaculture sector as a results of their cost effectiveness and eco-friendly nature. Searching for the most effective organic fungicides is unabated. The paper therefore reviewed on causes of *saprolegniasis* in fish, mode of *Saprolegniasis* infection on freshwater fish and eggs,effects of *Saprolegnia* on aquatic organisms and their biosafety, synthetic fungicides treatment of *Saprolegnia*, organic fungicides treatment of *Saprolegnia*: medicinal plants to the rescue, benefit of organic fungicides application in sustainable fish production in Nigeria and elsewhere in the tropics. Some safety recommendations were proposed for proper usage of organic fungicides in sustainable aquaculture production in the hatchery operations in Nigeria.

Keywords: *Saprolegnia*, synthetic fungicides, organic fungicides, Freshwater fish

INTRODUCTION

Water moulds of the genus ''*Saprolegnia*'' are common in most if not a freshwater ecosystems around the world. They are occasionally seen on the skin of wild, hatchery-reared or aquarium fish, especially during spawning or times of stress. Infection can be fatal (Government of Alberta.Ca, 2010). Outbreaks of waterborne fungal infections (Saprolegniasis) on fish and fish eggs continue to cause problems among cultured fish (Schreier *et al.*,1996), and the huge losses to the fish farmers at the hatchery unit of aquaculture production. Aquaculture operations have been intensified to meet the growing market for fish products which may result in crowded conditions promoting fungal infections (Schreier *etal.*, 1996).Almost every freshwater fish is exposed to at least one species of fungus during its lifetime (Mayer, 2005; Noga, 1996), especially from the egg stage through smortification (Bruno and Wood, 1999; Pickering, 1994). Cotton wool fungus refers to as 'pseudo fungi' of the genus'' *Saprolegnia*'' is a threat and of economic malady to sustainable fish production in the hatchery operations in most of the aquaculture enterprises as a social business that enhances sustainable livelihood activities in urban and rural areas in Nigeria. In the hatchery, where primary production of fries and fingerlings were the key to sustainable fish production is currently faced with obnoxious problem caused from infection on the hatchling eggs of freshwater fish by the SFS at the hatchery production units of every aquaculture outfits in Nigeria and elsewhere in the tropics. The SFS have drastically reduced the supply of catfish and other freshwater fish species from aquaculture production in Nigeria. Some of the hatchery managers could hardly boast of raising over ten thousand (10,000) hatchlings eggs successfully to fingerlings and juveniles stages respectively. Fish as protein source has tremendously assisted in solving food security challenges at every household in Nigeria. However, sustainable fish production should be encouraged at all time, and this will pave way to meeting up with fish demands in Nigeria. In an attempt to control SFS in the hatchery, fish farmers regularly make used of synthetic chemicals such as malachite green, hydrogen peroxide, potassium permanganate, formalin, iodine, and sodium chloride to control fish eggs infection in the hatchery. The used of synthetic fungicides are known to be of public health concern in aquatic environment in Nigeria. This is due to their bioaccumulation effects on tissues

and reproductive dysfunction in freshwater fish species exposed to such synthetic chemical fungicides application. Currently, world is tending towards the campaign on the use of organic fungicides application in aquaculture sector due to their cost effectiveness and eco-friendly nature .Organic fungicides application are of medicinal plants origin. Searching for the most effective organic fungicides is unabated, but must the phytochemically screened to ascertain effective anti-fungal properties before final consideration is put on them to be used in aquaculture as organic fungicides. The paper therefore reviewed on causes of *saprolegniasis*in fish, mode of *saprolegniasis* infection on freshwater fish and eggs, effects of *saprolegnia* on aquatic organisms and their biosafety, synthetic fungicides treatment of *saprolegnia*, organic fungicides treatment of *saprolegnia:* medicinal plants to the rescue, benefit of organic fungicides application in sustainable fish production in Nigeria and elsewhere in the tropics. Some safety recommendations were proposed for proper usage of organic fungicides in sustainable aquaculture production in the hatchery operations in Nigeria.

Causes of Saprolegniasis in fish

In Salmonids, and other freshwater fish species, the physiological state of the fish generally determines if a fungal infection will be successfully established (Mayer, 2005). *Saprolegnia* generally invades fish that have been stressed or otherwise have a weakened immune systems (Bruno and Wood, 1999; Pickering, 1994). There are certain conditions that normally rendered fish to be susceptible to *saprolegniasis*as reported by Mayer (2005) and references by other researchers that have worked on the *Saprolegniasis* infections on fish. Below is table 1 for further information on their activities on fish species. Mode of *Saprolegniasis* Infection on Freshwater Fish and Eggs: On Fish, saprolegnia invades epidermal tissues, generally beginning on the head or fins (Willoughby, 1994; Mayer, 2005) and can spread over the entire surface of the body. Visible as white or grey patches of filamentous mycelium (Bruno and Wood, 1999; Beakes *et al.*,1994). The fungus also can infect dead fish eggs and spread to nearby live eggs. The filaments pierce the egg membrane and the eggs dies. This can be a significant problem in fish hatcheries where large numbers of eggs are held in close quarters (Government of Alberta.Ca, 2010).

Effects of Saprolegniaon Aquatic Organisms and their Biosafety

We don't know how damaging *sapro* infections are for wild fish. Infected fish are seen occasionally, and they are lethargic and don't swim properly. Severely infected fish usually die. However, Brewin (1994) documented that some infected Brown Trout survive and are not infected in subsequent spawning seasons .Fortunately fish have built-in defences against fungal infections. Similarly, fish scales and skin cells make it difficult for spores to establish. Stress and injury can weaken these defences, allowing the spores to quickly latch on and establish a new colony Government of Alberta.Ca, 2010). Handling can increase chances of infection, likely due to removal of mucous. Synthetic Fungicides Treatment of *Saprolegnia.* The use of malachite green began in 1933 and was if one of the cornerstones used in treatment of fish against a range of parasites (Agbebi *et al.*, 2012). Malachite green is known to kill fungal growth on catfish eggs; this chemical is no longer approved for use with food fish due to its teratogenic properties (Alderman, 1985). Additional fungicides for use in aquaculture are needed. In addition the use of formalin has increased causing more awareness about users safety and the chemical's impact on the environment (Schreier *et al.*,1996). Among other alternative compounds tested for antifungal activity are formalin, sodium chloride, potassium permanganate, aquatol, herbicides diquat, simazine, hydrothol, iodine, hydrogen peroxide and copper sulphate(Marking *et al.*,1994; Fitzpatrick *et al.*,1995; Pottinger and Day, 1999), but all requires further toxicological and efficacy studies to validate its use at the concentrations found to be most effective(Pottinger and Day,1999).

Over the last two decades the search for new and effective substances against *saprognia* infection has been intensified, but still no appropriate substitute to malachite green has been found (Svein, 2009). The loss of this effective substance in the fish-farming industry has driven scientists to look for a less hazardous substance which is as effective as malachite green (Agbebi *et al.*, 2012).

Organic Fungicides Treatment of Saprolegnia: Medicinal Plants to the Rescue

The search for alternative anti-fungal agents for use in fish hatchery has intensified in recent years. The search has been extended to medicinal plants that possess fungicidal

properties (Agbebi*et al.*, 2012). Mori *et al.*(2002) reported that some plant extracts possesses anti-fungal properties which inhibits the growth of aquatic fungi such as *Saprolegnia* species. Medicinal plants as the alternative agents are effective to treat the infectious diseases and mitigate many of side effects that are associated with synthetic antimicrobials(Madhuri *et al.*, 2012),and other anti-fungal treatment in aquaculture. Additionally, the plant-derive phyto-medicines provide a cheaper source for treatment and greater accuracy than chemotherapeutic agents in this field (Punitha *et al.*, 2008).

Benefits of Organic Fungicides Application in Sustainable Fish Production in Nigeria and elsewhere in the tropics

The world -wide campaign on organic aquaculture in food security as a means of sustainable human health and its biosafety application in animal production of aquatic source should be of public health concern at every household in Nigeria and other tropical regions of the world. Whatever aquatic products as source of protein at every household in Nigeria should regularly undergo screening for biosafety sake. In an attempt to screen the aquatic food from chemicals, pollutants and pesticides residue will go a long way to increase life span of every Nigerians and in other tropical regions of the world. Organic fungicides will not bio-accumulates in the tissues of aquatic organisms as well as in human tissues consuming such fish treated with organic fungicides. It's also known to be cost effective, and eco-friendly in aquatic environment where they might be applied.

Safety recommendations proposed for proper usage of organic fungicides in sustainable aquaculture production in the hatchery operations in Nigeria

- Hatchery managers should ensure that eggs are free from *saprolegnia* infections by regularly cleaning the hatchery equipment and materials by applying organic fungicides;
- Fries and fingerlings in the hatchery should be carefully handled during the rearing stage by applying organic fungicides;
- Water quality should be properly and regularly checked when organic fungicides are applied;
- Hatchery managers should not give room for overcrowding of fish and fish eggs in the during hatchling process;
- Regular checked for temperature changes to discourage growth of *saprolegnia*when organic fungicides are applied; and
- Effective concentrations and non-toxic to fish and fish eggs must be established before the application of organic fungicides in aquaculture.

Acknowledgement

The authors would like to appreciate those whose contributions, comments and proof-reading added to the final review of this paper ; and the suggestions on the experimental design on the on-going research on *Saprolegnia* infections on fish at Landmark University, Omu-Aran, Kwara State, Nigeria.

REFERENCES

Agbebi O. T., Oyeleke G.O. and Agbon O. A. (2012).Use of *Euphorbia Kamerunica* (Spurge) Extract in the Control of Saprolegnia species Growth in Incubated Eggs of *Clarias gariepinus. G. J. Sci. F. Res. Bio. Sci.* 12(8), 27-30.

Alderman, D.J.(1985): Malachite Green: A Review. *J. Fish. Dis.*, 8:289-298.

Beakes, G. W., Wood, S.E., and Burr, A.W. (1994). Features which characterize Saprolegnia isolates from salmonid fish lesions – A review. In *Salmon Saprolegniasis*. Edited by G. J. Mueller. U.S. department of Energy, Bonneville power Administration, Portland, Oregon. Pp. 33-66.

Bly, J.E., Quiniou, S.M.A., Lawson, L.A., and Clem, L.W. (1996): Therapeutic and prophylactic measures for winter saprolegniosis in channel catfish. Dis. Aquati.Org, 24:25-33.

Brewin, K.M.,(1994). Reproductive ecology of Brown Trout and Brook Trout in Alberta's Upper Bow River and Tributaries. MSc thesis, University of Alberta, Canada.

Bruno, D. W., and Wood, B.P. (1994). *Saprolegnia* and other Oomycetes. In fish Diseases and Disorders, Volume 3, Viral, Bacterial and Fungal Infections. Edited by P.T.K. Wood and D.W. Bruno. CABI Publishing, Wallingford, Oxon, Unites Kingdom. Pp. 599-659.

Fitzpatrick,M.S.,Schreck,C.B.,Chitwood,R.L.,andMarking,L.L.(1995): Evaluation of three candidate fungicides for treatment of adult spring Chinook Salmon. Prog. Fish. Culture, 57:153-155.

Government of Alberta. Ca (2010). Saprolegniosis in Alberta (*Saprolegnia parasitica*).Wildlife Diseases in Alberta:

http:// srd.alberta.ca/BioDiversity Stewardship/ Wildlife Diseases/.Pub. No. I/426.IssN: 1710-4327,ISBN Print:0-7785-8917-4,ISBN Online:0-7785-9013-2,april edition downloaded on 25th November 2014 at 7;15 p.m.

Hatai, K., and Hoshiai, G.,I. (1994):Pathogenicity of *Saprolegni aparasitica coker. In Salmon Saprolegniasis.* Edited by Mueller, G.J. U.S Department of Energy, Bonneville Power Administration, Portland, Oregon. pp.87-98.

Madhuri, S., Mandloi, A.K., Govid, P. and Sahni,Y.P.,(2012).Antimicrobial activity of some medicinal plants against fish pathogens.*IRJP*,3(4): 28-30.

Making, L.L., Rach, J.J., Scheier, T.M., (1994): Evaluation of Antifungal agents for fish culture. Prog. Fish .Culture, 56:225-231.

Mayer, K., (2005): *Saprolegnia:* There's a Fungus among us. 10pp. downloaded from http://hmsc.oregonstate.edu/classes/MB492/saprokent/saprolegnia.htm.

Meyer, F.P. (1991). Aquaculture disease and health management. *J. Anim. Sci.* 69: 4201 - 4208.

Mori, T., Hirose, H., Hanjavant, C., and Hatai, K., (2002): Anti-fungicidal Activities of plant extracts against some aquatic fungi.*Biocont.Sci.*7:187-191.

Noga, E.J. (1996). Fish Disease Diagnosis and Treatment. Mosby-Year Book, Inc. St. Louis, MO.367 p.

Pickering, A.D., (1994): Factors which predisposed Salmonid fish to Saprolegniasis. Edited by Mueller, G.J.U.S. Department of Energy, Bonneville Power Administration, Portland, Oregon. pp. 67-84.

Pottinger, T.G., and Day, J.G.(1999): A *Saprolegnia parasitica* challenge system for rainbow trout: assessment of Pyceze as an anti-fungal agent for both fish and ova.*Dis.Aqua.Org*,36:129-141.

Punitha, S.M.J., Babu, M.M., Sivaram, V., Shankar,V.S., Dhas, S.A., Mahesh, T.C., Immanuel, G., and Citarasu, T., (2008): Immuno stimulating influence of herbal biomedicines on non-specific immunity in Grouper *Epinephelus tauvina* juvenile against *vibrio harveyi* infection. *Aquaculture Int., 16:511-523.*

Svein S. (2009). *Saprolegnia* infections in salmonids Characterization of *Saprolegnia* species and search for new treatment of *Saprolegnia* infections, Norwegian School of Veterinary Science.

Whisler, H.C. (1996) : Identification of Saprolegnia spp. Pathogenic in Chinook Salmon. Final Report, DE-AC 79-90BP02836, US Department of Energy, Washington, D.C., 43p.

Willoughby, l.G .(1994): Fungi and Fish Diseases. Pisces Press, Stirling, Scotland. 57p.

Table 1: Conditions for *Saprolegniasis* to occur in Fishes

S/N	Conditions for Saprolegniasis	References from several researchers on their activities
1	Broodstock	Meyer 1991
2	Crowded hatchery conditions	Beakes*et al.*,1994; Whisler,1996
3	Epidermal integrity	Hatai and Hoshiai,1994; Pickering ,1994
4	Poor Handling	Bruno and Wood ,1999; Hatai and Hoshiai,1994; Government of Alberta.Ca,2010
5	Water Quality	Government Alberta.Ca,2010
6	Sudden Temperature Changes	Government Alberta .Ca,2010
7	Stress in Fish	Government Alberta.Ca,2010

Sources: (Modified after Mayer, 2005 and Government of Alberta.Ca, 2010)