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Article

Study on the effect of aquaculture-drugs and chemicals on health and production of prawn (*Macrobrachium rosenbergii*) in Narail, Bangladesh

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Abstract: The present study was carried out to evaluate the effect of aquaculture-drugs and chemicals on health and production of prawn in Narail district. Data were collected through questionnaire interview, market survey and focus group discussion from June to December 2014. Six categories and 28 types of chemicals were found in the chemical shops as well as used by the farmers. Chemicals used in pond preparation, equipments disinfection, oxygen supplementation, growth promotion, antibiotics and disease treatment. Eco-solution, malachite green and melathion were used in the treatment of viral diseases having 85%, 70% and 65% recovery respectively. Potassium permanganate, oxytetracycline and renamycine had 86%, 80% and 75% recovery respectively against protozoan and bacterial diseases. Clinically prawn appeared normal greenish in control ponds, whereas, in chemical treated prawn appeared yellowish brown and grayish color. Histology of muscle of control prawn were almost normal except some vacuums, however, chemical treated prawn muscle had remarkable pathological changes like necrosis, vacuums and pyknotic cells. Prawn production was 85 kg/acre in control ponds, 150 kg/ acre in lime-urea treated ponds and 450 kg/ acre in chemical treated ponds.

Keywords: aquaculture- drugs; chemicals; effect; production; recovery

1. Introduction

Aquaculture in Bangladesh has achieved the second largest export industry after garments. Agricultural sector contributes 4.43% to the national GDP among fisheries sector contributes 23.37% (DoF, 2014). Bangladesh is considered one of the most suitable countries in the world for freshwater prawn (*Macrobrachium rosenbergii*) farming in southwestern region having favorable agro-climatic condition. Over the last decade the rapid expansion of shrimp and prawn culture in coastal areas has been drawn an outstanding development in the country's fisheries sector. In recent years most of the farmers in coastal areas culture both shrimp and prawn having new aquaculture techniques with improved extensive and semi intensive culture systems. For the successful aquaculture, technology is most needed as well as the application of different aquaculture-drugs and chemicals which improves the production and disease resistance capacity (Subasinghe *et al.*, 1996; GESAMP, 1997 and Ahmed *et al.*, 2014).

Farmers of Bangladesh use both traditional and commercial aquaculture-drugs and chemicals during pond preparation, water quality management, growth promotion and disease treatment. Traditionally farmers use drugs including lime, urea and TSP for pond preparation and potassium permanganate, tetracycline, oxytetracycline, formalin, salt and lime for health management and disease treatment (Hasan and Ahmed, 2002 and Plumb, 1992). Recently various types of commercial aquaculture-drugs such as geolite, JVgeolite, mega zeo, benzo, aquazet are using for pond preparation, oxy-flow, oxymax, biocare, quick oxygen, oxy-plus use for

oxygen supply (Faruk *et al*., 2008). Several types of antibiotics and probiotics are used for health management. The common ingredients of antibiotics are oxytetracycline, chlorotetracycline, amoxicilin, co-trimoxazoie, sulphadiazine and sulphamethoxozole (Plumb, 1992).

The impact of using chemicals and drugs, improves the growth and disease resistance capacity of fish and shrimp (Ahmed *et al.,* 2014). The production of Thai pangus in chemically treated ponds is 8100 kg/acre and the non-treated pond is 4800 kg/acre (Ahmed *et al.,* 2012). Histology of fish skin-muscle, gill, liver and kidney and shrimp muscles differentiates the chemically treated and non-treated through the remarkable pathological changes like necrosis, vacuums, pyknotic cell (Ahmed *et al.,* 2014). The negative impacts of using chemicals roughly, often leads to problems like drug resistance, tissue residue, and adverse effect on species biodiversity (Spanggaard *et al.,* 1993 and Herwing and Gray, 1997). So, the present study highlights the actual impact of aquaculture-drugs and chemicals on prawn health and production through clinical, histopathological and overall field observations.

2. Materials and Methods

The present study was carried out in 10 villages of Narail Sadar upazilla namely Gobra, Khalishakhali, Barcula, Arpara, Mirjapur, Tularampur, Shitarampur, Chandirpur, Mulia and Bicali from June to December 2014. Data were collected through questionnaire interview, personal contact, participatory rural appraisal (PRA) and focus group discussion (FGD) with fish farmers, drug sellers and different fisheries associations. For questionnaire interview a set of questionnaire was prepared of both closed and open form. Three types of questionnaires were prepared. The effect of different aquaculture-drugs and chemicals were measured through the farmer's opinion and the production was compared between culture systems using chemicals and without chemicals.

Health status was verified through laboratory analysis in addition with the field observations. Prawn was examined clinically through observation of gross signs, abnormality, lesion, erosion, erratic movement, color and spots on body. Samples for histological examination were taken from muscle and cuticle and fixed in 10% neutral buffer formalin. The samples were then arranged in steel rack and dehydrated, cleared and infiltrated in an automatic tissue processor (SHADON, Citadel 1000). The samples were then embedded with molten wax, steel mold and perforated plastic holder. Trimming were done from side and surface of the blocks with the help of scalpel and a microtome respectively. The blocks were then sectioned at 5-7 micrometer by the microtome machine (Leica JUNG RM 2035). The sections were then stained with haematoxylin and eosin stains. After staining the sections were mounted with Canada balsam and covered by cover slips. Photomicrographs of the stained sections were done by using photomicroscope.

3. Results and Discussion

3.1. Present status of aquaculture-drugs and chemicals used in the study area

From the present investigation 6 categories and 28 types of chemicals were found in the chemical shops as well as used by the farmers (Table 1). From the research findings of Hasan (2014) and Ahmed *et al.* (2014) in Bangladesh there 7 categories and 34 types of chemicals used in aquaculture. Chemicals were used as pond preparation, disinfection, oxygen supplement, growth promotion, antibiotics and disease treatment which were nearly similar to the findings of Faruk *et al.* (2008), Hasan (2014) and Ahmed *et al.* (2014). In the present investigation it was recorded that 82% farmers used chemicals during pond preparation, 32% farmers used oxygen supplier, 55% farmers used growth promoters and 58% used chemicals for disease treatment (Figure 1). According to Hasan (2014) the percent of using chemicals in coastal regions were almost similar.

3.2. Effect of aquaculture-drugs and chemicals in the study area

During pond preparation and water quality management farmers traditionally used lime, urea and TSP which enhanced the proliferation of algae and the positive effect of using that chemicals were observed as 97%, 96% and 94% respectively (Table 1). According to Faruk *et al. (*2008) and Subasinghe *et al. (*1996) lime, urea and TSP were important for the proliferation of algae. In the present study, farmers also used some commercial drugs for gas removal such as geotox and zeolite having positive effect of 80% and 85% respectively (Table 1).

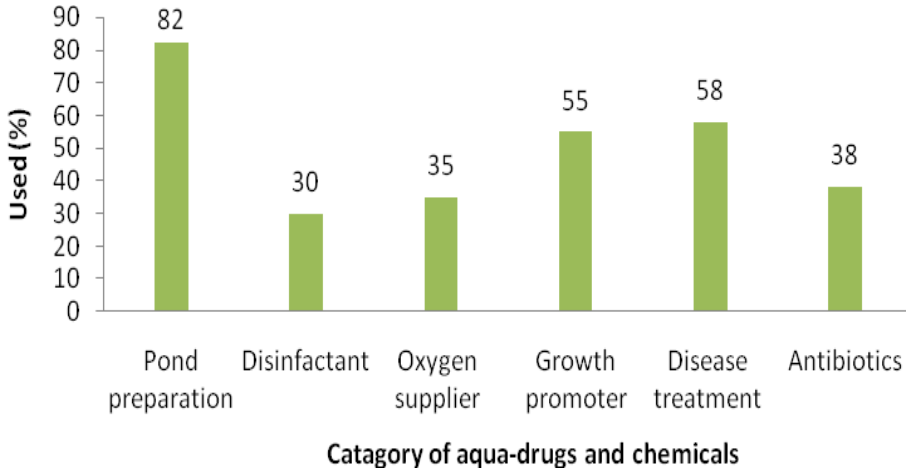

Figure 1. Percent drug used by farmers in Narail Sadar upazilla.

From the research findings of Hasan (2014) farmers used zeolite and zeocare which had the effect of 80% and 70% on gas removal. It was observed that sometimes the dissolved oxygen decreased rapidly and farmers used several chemicals to increase DO immediately. Commonly used chemicals were listed as bio-ox, oxy-flow and oxymax having positive effect of 83%, 88% and 85% respectively which was almost similar to the findings of Hasan (2014). For killing microbes and equipment disinfectants farmers used bleaching powder, timsen and lime which was also reported by Islam *et al.* (2014) and Faruk *et al.* (2008). The highest disinfecting capacity was timsen as 97% (Table1). From the present study it was recorded that 4 types of growth promoters were used by the farmers such as aqua boost, aquamin, panvit aqua and megavit aqua having positive effect on growth such as 80%, 82%, 86% and 82% (Table 1). According to Faruk *et al.* (2008), Shamsuzzaman and Biswas (2012) and Islam *et al.* (2014) farmers of both inland and coastal regions used megavit aqua, panvit aqua, vitamin, civet vet, aquasavor and aqua boost to increase growth and production of fish and shrimp.
It was observed that drugs and antibiotics used in aquaculture for treating bacterial and fungal infection in prawn culture. Common diseases were recorded as viral, bacterial, protozoan and external parasitic infections. For treating protozoan and external bacterial diseases farmers used $KMnO_4$ which had 86% recovery, although salt, lime and formalin were also used in same purpose having 82%, 78%, and 82% recovery respectively (Table 1). Eco-solution, malachite green and melathion had 85%, 70% and 65% recovery against viral diseases but not active in case of WSSV. From the research findings of Islam (2013) there were no treatment for WSSV. Oxytetracycline and renamycine were widely used as antibiotics for the treatment of bacterial and fungal diseases having 80% and 75% recovery respectively (Table 1). According to Hasan (2014) farmers of coastal regions used oxytetracycline and renamycine for the treatment of bacterial and fungal diseases.

3.3. Clinical appearance of prawn in the study area

Clinically prawn appeared normal, greenish and healthy but light yellowish color in control ponds (Figure 2A). In chemical treated ponds, prawn appeared yellowish brown, grayish, and sometimes normal in color (Figure 2B). Disease affected prawn observed abnormal in movement with deep yellowish and darker color. Form the research findings of Hasan (2014) and Islam (2013) in drug treated ghers shrimp were slight yellowish and darker in color, whereas, in control ghers shrimp were normal.

Table 1. Effect of aquaculture chemicals in the study area.

Category of drugs	Drugs/Chemicals/ Trade name	Dose	Purpose of use	Effect (%)
Pond preparatory & water quality management	Geotox	20-25kg/100dec	To remove gas	80
	Lime	1-1.5 kg/dec	Disinfectant, pH maintenance	97
	Rotenone	40g/dec	Predator killer	98
	TSP	100-150 g/dec	Proliferation of algae	96
	Urea	100-150g/dec	Proliferation of algae	94
	Zeocare	20-30 kg/acre	To improve water quality	82
	Zeolite	20-30 kg/acre	To remove gas & improve water quality	85
Oxygen supplimentory	Bio- Ox	2.50-5g/acre	To increase DO	83
	Oxyflow	250-350g/acre	Oxygen supplement	88
	Oxymax	250-500g/acre	To increase DO	85
Disinfectants	Bleaching	250-350g/acre	Disinfectant	98
	Lime	1 kg/dec	Disinfectant	97
	Timsen	20g/33 dec	Killing microbes	97
Growth promoter	Aqua boost	500g/mt feed	To increase organic acid in feed composition, β-glucan	80
	Aquamin	200g/100kg feed	Used in vitamin deficiency	82
	Panvit aqua	1-2mg/kg feed	Vitamin, mineral & protein supplement	86
	Megavit aqua	100g/100kg feed	Vitamin, mineral & protein supplement	82
Disease treatment	Eco-solution	0.1-0.2 ppm	To prevent viral disease	85
	Formalin	1-3 ppm	To control protozoan disease & improve water quality	82
	$KMnO_4$	0.1-0.2 ppm	Prevent bacterial disease & disinfectant	86
	Lime	1 kg/dec	Improve water quality	78
	Melathion	10g/dec	Bacterial & viral treatment	65
	Salt	0.5-1 kg/ dec	Control protozoan & fungal disease	82
Antibiotics	Oxytetracycline	1g/kg feed	Bacterial & viral treatment	78
	Renamox		Antibiotic	75
	Renamycine	1g/kg feed	Antibiotic	80

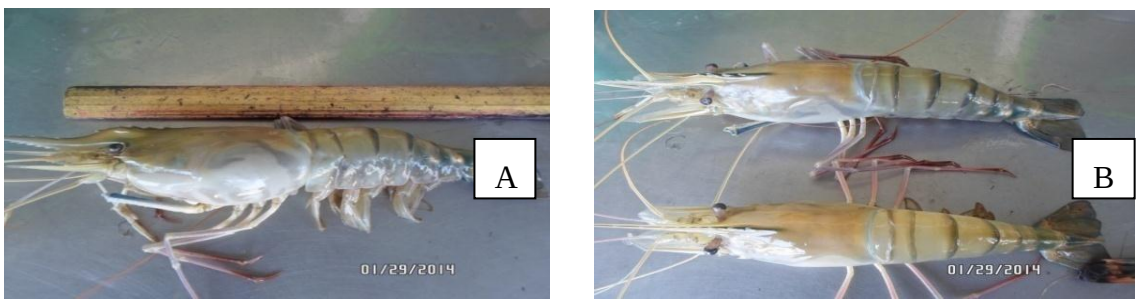

Figure 2. Clinical appearance of shrimp in the study area.

3.4. Histological observations

Cross section of muscle of control prawn (without drug treated) in Narail were almost normal (Figure 3A) except there were some vacuums in control shrimp muscle (Figure 3C). However, in the drug treated ponds photomicrograph of prawn muscle showed remarkable pathological changes like necrosis, vacuums and pyknosis (Figure 3B and 3D). From the research findings of Islam (2013) section muscle of shrimp were almost normal in control ponds, whereas, some vacuums, necrosis and pyknotic cells were observed in treated ponds. Cress section of cuticle of pawn having normal structure in control ponds (Figure 3E). Section of cuticle of prawn also showed viral inclusion body in treated ponds (Figure 3F). According to Hasan (2014) photomicrograph of hepatopancreas of shrimp having necrosis, inclusion bodies, pyknotic cells and vacuums in treaded ponds.

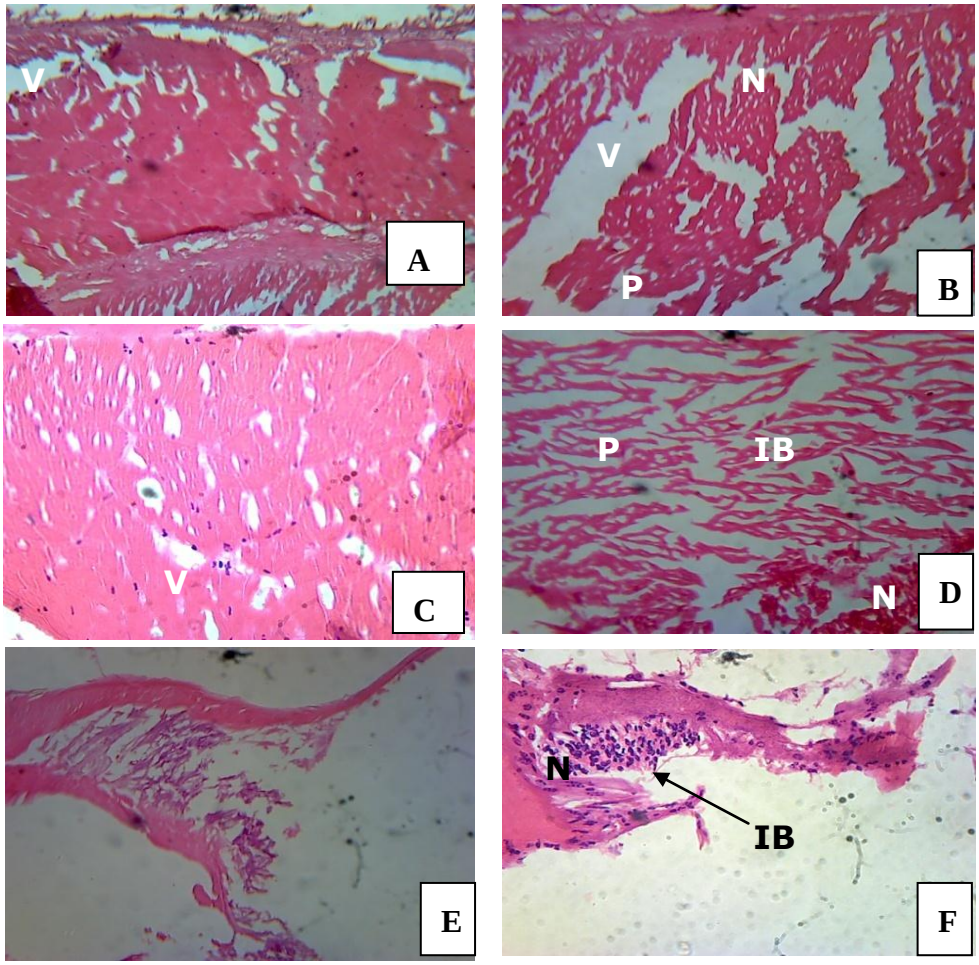

Figure 3. A. Section of the normal muscle of prawn from control pond having only vaccum (V). H & E x 125. B. Photomicrograph of affected prawn muscle from a drug treated pond showing vaccum (V), necrosis (N) and pyknotic cell (P) H & E x 125. C. Cross section of normal muscle of prawn of control pond having vaccum (V) H & E x 215. D. Photomicrograph of affected muscle of prawn collected from drug treated ponds showing necrosis (N) and pyknotic cell (P) and inclusion body (IB) H & E x 215. E. Cross section of normal cuticle of prawn from control ponds H& E x 125. F. Section of the affected muscle of prawn from treaded pond having iclusion body (IB) H & E x 125.

3.5. Effect of aquaculture-drugs and chemicals on prawn production

In the present investigation it was found that aquaculture-drugs and chemicals had tremendous impact on prawn production. Production varied from treated and control systems. Prawn production was recorded as 85 kg/acre in control ponds and 150 kg/ acre in lime and urea treated ponds similar as the previous study. According to Islam (2013) shrimp production was 100-120 kg/acre in control ghers. However, production of prawn in aquaculture-drugs and chemicals treated ponds was 450 kg/ acre. From the research findings of Hasan (2014) in drugs treated ghers shrimp production was 550 kg/acre.

4. Conclusions

Farmers used different types of aquaculture-drugs and chemicals for prawn health and production. Farmers used eco-solution, malachite green and melathion for the treatment of viral diseases which had 85%, 70% and 65% recovery respectively. Potassium permanganate, oxytetracycline and renamycine having 86%, 80% and 75% recovery respectively against protozoan and bacterial diseases. From histological section of prawn muscle there were found some remarkable pathological changes like necrosis, hemorrhage, pyknotic cell and viral inclusion bodies in chemical treated ponds, whereas, some vacuums were observed in control ones. Prawn production was 85 kg/acre in control ponds, 150 kg/ acre in lime-urea treated ponds and 450 kg/ acre in chemical treated ponds. Bangladesh aquaculture has been influenced by aquaculture-drugs and chemicals which had positive effect on prawn production and disease recovery, on the other hand, some remarkable pathological changes were observed in prawn organs from chemical treated ponds. So the use of aquaculture-drugs and chemicals in ponds and ghers should be reduced in order to overcome adverse pathologies in shrimp organs.

Conflict of interest

None to declare.

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