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# CURRENT SCENARIO OF APPLICATION OF AQUA DRUGS AND CHEMICALS IN FISH AND SHELL FISH HEALTH MANAGEMENT OF KHULNA DISTRICT IN BANGLADESH

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**Abstract**: To find out the present picture of applied aqua drugs and chemicals in aquatic animal health management in Khulna district, data were collected through questionnaire interview from ninety fish farms and hatcheries in nine different upazillas of Khulna district, Bangladesh during May to November 2016. The result revealed that fifty seven aqua drugs and chemicals were used at nine different stages of aquatic animal health management whereas Lime (71.1%), Bioaqua (10.0%), Aquanone (10.0%), Bleaching Chlorine (16.7%), Oxy Well (6.7%), Gas Check Plus (8.9%), Oxygen plus (6.7%), Zeolite (21.1%), Gastrap (12.2%), AC mix super fish (7.8%), Rapid Grow (7.8%), Bio-Permix (gold) (7.8%), Charger Gel (6.7%), Potash (21.1%) and Salt (32.2%) were used by greater percentage of farmers among others due to several reasons like low price, availability, effectiveness and so on. Additionally, applied dose of twelve aqua drugs and chemicals significantly varied from recommended dose of application as well as greater than standard dose of application. However, it pointed out some major problems associated with topic like lack of knowledge of farmers and hatchery owners about the application of such products, appropriate dose, ultimate fate etc. as well as involvement of different local aqua drug and chemical sellers. The effects and fates of chemicals and their residues in cultured organisms and within the aquaculture system itself are still quite unknown. So, this practice should be under scrutiny for the purpose of getting better product through good aquaculture practice.

**Keywords:** Aqua drugs, chemicals, dose, interview, farmers, chemical sellers

## Introduction

Aquaculture production is increasing day by day in Bangladesh. It plays an important role in the national economy to fulfill the animal protein demand, creates new employment opportunity, helps poverty alleviation and improvement of socio-economic condition of people (Islam *et al.*, 2014). With the expansion of aquaculture, there has been increasing trend in using more chemicals in aquatic animal health management. The chemicals and drugs are recently used to fulfill the demand of protein in Bangladesh. Department of Fisheries (DoF) (2013) reported that aquaculture contributes 4.43% to national GDP, 2.73% of export earnings and 60% of the total protein supply in the diet of the people of Bangladesh. According to Supriyadi and Rukyani (2000) and Shamsuzzaman and Biswas (2013) aqua drugs and chemicals used in aquaculture for various purposes are widely recognized and beneficial in many ways. The rapid development of aquaculture production in Bangladesh is also influenced by a number of aqua drugs and chemicals. They are not only vital for

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health management and treating diseases but also crucial for soil and water quality management, enhancing natural productivity, feed formulation, growth promotion and so on. Dipu *et al.,* (2014) stated that in most of the developed countries in Europe as well as USA use of drugs is controlled by drug licensing supported by a surveillance program to monitor the active ingredient and the recommended dose and dosage. Since these are relatively new controls, their level of enforcement may vary in different regions, but proper enforcement should be the basis of consumer protection. Where regulations are lacking or weak like Bangladesh, the drug of choice is determined by cost, availability and efficacy. Khulna is the southern part of Bangladesh. Most of the people in this region depend on aquaculture. Aquaculture in this area is expanding and using more drugs and chemicals in aqua-health management are increasing. For this reason, the production of aquaculture in this region is increasing day by day. Most of the farmers in this region are less educated and not expert in this aquaculture. They have lack of knowledge about adverse effect of aqua drugs and chemicals. So, they apply different types of aqua drugs and chemicals to promote production. Very limited research in this regard was conducted in the area. Adoption of many of these aqua drugs and chemicals by the aquaculture industry is a relatively new phenomenon. The effects and fates of chemicals and their residues in cultured organisms and within the aquaculture system itself as well as the actions and fate of chemicals used in aquaculture in the aquatic environment in general are still quite unknown. So, there are some important concerns about this matter such as human health concerns, product quality concerns, environmental concerns and so on. Therefore, this practice should be under scrutiny for the purpose of getting better product through good aquaculture practice.

Therefore, the aims of the present research were to search for the applied available aqua drugs and chemicals in aquatic animal health management in Khulna district as well as to assess whether the farmers applied those aqua drugs and chemicals in recommended dose or not.

## Materials and methods

***Study area and period:*** The present study was carried out to collect data from fields' level of nine different upazillas namely Rupsha, Dumuria, Phultola, Batiaghata, Koyra, Dacope, Paikgacha, Terokhada and Digholia in Khulna district during May 2016 to November 2016.

***Data collection:*** Data were collected from ninety different fish farms and hatcheries through questionnaire interview from target group. Both primary and secondary data were collected for the study and for that a detailed questionnaire was developed. Several publications and some unpublished reports were collected through personal communication. During the survey period the selected area was visited and data were collected by direct questionnaire interview from commercial fish farmers, small scale fish farmers, hatchery owners and hatchery managers. Primary data were collected from different target groups such as commercial fish farmers, small scale fish farmers and hatchery owners by questionnaire interview. During the questionnaire, survey questions were asked on the used aqua drugs and chemicals, their active ingredients, purpose of application, applied doses, source and price of those aqua drugs and chemicals. Primary data were categorized in to seven categories according to farmers use at different stages of aquatic animal health management which were practiced aquaculture system like pond preparation and water quality management, disinfectant, to increase dissolve oxygen level, toxic gas removal, growth promotion, antibiotic used for disease treatment and different disease treatment. Whereas secondary data were collected from different books, thesis papers, published research papers etc.

***Statistical Analysis:*** The collected data were scrutinized and summarized carefully before the actual tabulation. The summary tables were prepared in accordance with the aim of the study. The technique of analysis included the classification of tables into meaningful result by arithmetic mean,

percentage and ratios. Normality test, Z test and Sign test for median were performed to analyze data with Microsoft Excel 2007.

**Result and Discussion**

***Aqua drugs and chemicals: Sources and usages:*** Products of different renowned companies i.e. ACI Animal Health Limited, Square Pharmaceuticals Limited, Fish Tech BD Limited, SK+F, Eon Animal Health Products Limited, First Care Agro Limited, Novartis Animal Health as well as products of chemical sellers which were available mainly used by farmers in Khulna district. Fifty-seven aqua drugs and chemicals were found to be used by farmers at different stages of aquatic animal health management like pond preparation and water quality management, disinfectant, supply of oxygen, toxic gas removal, growth promotion, antibiotic used for disease treatment, and different disease treatment in aquaculture sector of Khulna district. The applied aqua drugs and chemicals in aquaculture sector in Khluna district with their active ingredients, standard dose, applied dose, percentage of farmers used, source and approximate price are shown in Tables 1 to 7. Wide varieties of traditional as well as new compounds were found to be used by the fish farmers during pond preparation and water quality management. Eight aqua drugs and chemicals were found to be applied for pond preparation and water quality management in Khulna district (Table 1). Chemicals like Rotenone were seen to be used for removing unwanted predatory fin fish species while different types of chemical fertilizer were used to improve primary productivity. The result of the present study showed that applied dose of lime, Bio Aqua and Bioplus significantly varied from recommended dose of application.

Table 1. Pond preparation and water quality management

| Trade Name | Active Ingredients | Standard Dose (per acre) | Farmer's Applied Dose (Average ± Stdv.) | P value | User (%) | Source | Price (Taka) |
|---|---|---|---|---|---|---|---|
| Lime | CaO, $Ca(OH)_2$ | 100 kg | 106±5.0 kg | 0.000* | 71.1 | Chemical Seller | 8–15/kg |
| Aqua lime | CaO | 38 kg | 37±2.3 kg | 0.25 | 6.7 | ACI Animal Health Ltd. | 10-20/kg |
| Blue mix | Cu, Mn, Zn, Vitamin A,B,D,E | 8 kg | 8.4±0.4 kg | 0.375 | 5.6 | Fish Tech BD Ltd. | 600/kg |
| Bio Aqua | Yucca extract | 280 kg | 299±15.7 kg | 0.0156* | 10.0 | Eon Animal Health Products Ltd | 330/100 ml |
| Vita plankton | Nitrogen, potassium, phosphoru, magnesium | 1.5 kg | 1.5 kg | 1.000 | 5.6 | ACI Animal Health Ltd. | 550/kg |
| Bioplus | Cu, Mn, Zn, Aspertic acid | 2L | 2.2±0.1L | 0.0312* | 6.7 | ACI Animal Health Ltd. | 675/L |
| Aquanone | Rotenone | 6 kg | 5.9±0.3 kg | 0.25 | 10.0 | SQUARE Pharmaceuticals Ltd. | 50 / kg |
| Rota Plus | Rotenone | 2.5 kg | 2.6±0.1 kg | 0.25 | 4.4 | ACI Animal Health Ltd. | 80/kg |

*Indicates significantly difference ($p<0.05$)

***Pond preparation and water quality management:*** Bio aqua and Bioplus were applied to increase the soil and water quality. Besides, results also revealed that Lime, Bioaqua, Aquanone were used by farmers in great percentage. Most of the people were found to use lime during pond preparation and water quality management as it is cheap and effective. Farmer preferred Bio Aqua for producing

natural food and useful bacteria. Faruk *et al.* (2008) found drugs like Geotox, Lime, Bio Aqua, Aquanone, Aqua lime were used by the farmers for the pond preparation and water quality management while Lime was mostly used during pond preparation and water quality management. Sharkar *et al.* (2014) found that 37% farmers used lime due to its low price and effectiveness. Yucca extracts are degraded by bacteria and no food safety hazards or environmental threats result from their use. According to Shamsuzzaman and Biswas (2013) and Sharkar *et al.* (2014) Aquanone and Rotenone were used for controlling unwanted fishes as well as other harmful aquatic animal. Above mentioned researchers' findings were similar to the findings of the present study.

Table 2. Disinfectant

| Trade Name | Active Ingredients | Standard Dose (per acre) | Farmer's Applied Dose (average±Stdv.) | P value | User (%) | Source | Price (Taka) |
|---|---|---|---|---|---|---|---|
| EDTA | Sodium thio sulphate | 0.6 ppm | 0.6 ppm | 1.000 | 8.9 | Chemical Seller | 40/kg |
| Bleaching Chlorine | Chlorine | 60 ppm | 63±2.7 ppm | 0.001* | 16.7 | Chemical Seller | 50/kg |
| Aquakleen | Tetradesile Aminonitrogen | 24 L | 23.6±1.4 L | 0.25 | 8.9 | SQUARE Pharmaceuticals Ltd. | 432/L |
| Timsen | n-alkyl dimethyl benzyl ammonium chloride+ stabilized urea | 60 g | 63±3.0 g | 0.0625 | 7.8 | Eon Animal Health Products Ltd. | 260/50 g |
| Emsen | n-alkyl dimethyl benzyl ammonium chloride+stabilize stabilized urea | 240 g | 264±17.0 g | 0.0625 | 4.4 | SK+F | 250/50g |
| Virex | Potassium Peroxymono sulphate 50% | 600 g | 626±27.0 g | 0.0625 | 7.8 | ACI Animal Health Ltd. | 100/100 g |
| Ossi C | Oxilinicacid, Betaglucan,Vitamin-C | 5 g | 5.4±0.1 g | 0.125 | 3.3 | Fish Tech BD Ltd. | 380/100 g |
| Polgard Plus | 3-Methyl, 4-Methyl | 500 ml | 486±24.4 ml | 0.25 | 7.8 | Fish Tech BD Ltd. | 460/200 ml |
| Bactisal-80 | n-alkyl dimethyl benzyl ammonium chloride 80% | 350 ml | 333±22.1 ml | 0.1562 | 6.7 | First Care Agro Ltd. | 250/100ml |

*Indicates significantly difference ($p<0.05$)

***Disinfectant:*** The results of this study exposed that nine disinfectants were found to be used to disinfect hatchery and farm equipment. Besides, some farmers mentioned that in some cases those were also applied for disease treatment though farmers did not know about proper application (Table 2). It also showed that applied dose of Bleaching Chlorine only significantly varied from recommended dose of application among all others. Most of the disinfectants contain chlorine so chlorinated tanks were drained, freshwater rinsed, and allowed to dry before being used. Before water discharge from culture operations, the chlorine was neutralized through dechlorination. Rahman (2011) mentioned that Polgard Plus, Bactisal, Virex, Lenocide, Timsen, Emsen, Aqua Cleaner Plus, Formalin and Bleaching Powder were most widely used disinfectants in fish farms. Apud (1984) also said that Emsen (Table 2) was very effective in prevention of some bacterial fungal infection and viruses while Formalin was used to control protozoan disease and Efinol was used for stress resistance. The fish farmers used a variety of chemicals in the treatment of disease or to avoid its occurrence. More or less similar results were found in this study. The results of the present study also revealed that though farmers did not know about the proper use of these chemicals, some farmers treated those in disease treatment without knowing its ultimate effect.

***Dissolved oxygen level:*** Ten aqua drugs and chemicals with very similar names were seen to be used for increasing dissolved oxygen level in farmers' ponds in the present study area (Table 3). Hydrogen peroxide was the major active ingredient of such chemical. Peroxide compounds are powerful oxidizing agents, and they are strong irritants when highly concentrated. Applied dose of Oxymax, Oxy Well and Gas Check Plus by farmers were found to be significantly different from recommended dose of application. Oxy Well, Gas Check Plus and Oxygen plus were largely used by farmers among others.

More or less similar results were found to be stated by Rahman (2011) and Chowdhury (2015). In addition to the above results, the present study also found that farmers of this region applied those aqua drugs and chemicals in their ponds with not enough knowledge about those products and their applications.

Table 3. Increasing dissolved oxygen level

| Trade Name | Active Ingredients | Standard Dose (per acre) | Farmer's Applied Dose (average±Stdv.) | P value | User (%) | Source | Price (Taka) |
|---|---|---|---|---|---|---|---|
| Oxyflow | $H_2O_2$10% | 300 g | 326±7.5 g | 0.0625 | 4.4 | Novartis Animal Health Ltd. | 800/kg |
| Oxymax | $H_2O_2$10% | 375 g | 409±24.4 g | 0.0312* | 5.6 | Eon Animal Health Products Ltd | 360/500 g |
| Bio-ox | Sodium carbonat, $H_2O_2$10% | 4 g | 4 g | 1.000 | 5.6 | ACI Animal Health Ltd. | 475/kg |
| Oxyplus | $Na_2O_2$+AlOH, $Na_2O_2$-90% | 500 g | 525±25.0 g | 0.25 | 3.3 | Navana Animal Health | 750/kg |
| Oxygen plus | $O_2$ Promoter ($H_2O_2$/$Ca_2O_2$) | 375 g | 378±7.7 g | 0.5 | 6.7 | Acon Animal Health | 690/kg |
| Oxymore | Sodium carbonat peroxyhydrat | 375 g | 413 g | 1.000 | 4.4 | SK+F | 650/kg |
| Oxylife | Oxygen precursors | 400 g | 420±20.0 g | 0.25 | 3.3 | SQUARE Pharmaceuticals Ltd. | 610/ kg |
| Oxy-Gold | Sodium percarbonate 90% | 375 g | 389±18.0 g | 0.25 | 4.4 | Fish Tech BD Ltd. | 670/kg |
| Oxy Well | Tetradesile ethiline diamine Sodium percarbonate | 175 g | 188±9.2 g | 0.0312* | 6.7 | First care agro Ltd. | 500/kg |
| Gas Check Plus | Tetradesile ethiline diamine Sodium percarbonate | 200 g | 213±13.9 g | 0.0312* | 8.9 | First Care agro Ltd. | 600/kg |

*Indicates significantly difference ($p$<0.05)

***Toxic gas:*** Eight aqua drugs and chemicals were found to be applied for removal of toxic gas as well as for improving water quality (Table 4). Applied dose of Zeo prime and Zeolite were found to be different from standard dose of application. Zeolite is an aluminosilicate clay of high cation exchange capacity. It was used by the farmers to maintain the pH of the water body and reduce the toxic gas. It was applied to ensure the minerals in the water body. Zeolite and Gastrap were found largely used by the farmers.

Sharker (2014) also mentioned Zeolite, Zeo prime, Zeocare, Mega Zeo Plus, Gastrap, Geotox, Bacto gro were used to remove toxic gas which was more or less similar to the recent findings. Zeolite does not cause food safety problems or environmental threats. The result of the present study also brought out that most of the farmers applied those products according to the advice of aqua drug sellers when they smelt bad odor from the cultured water body without following proper testing procedure or knowing anything.

Table 4. Toxic gas remover

| Trade Name | Active Ingredients | Standard Dose (per acre) | Farmer's Applied Dose (average±Stdv.) | P value | User (%) | Source | Price (Taka) |
|---|---|---|---|---|---|---|---|
| Zeolite | $SiO_2$, $Al_2O_3$, $Fe_2O_3$ CaO, MgO, $Na_2O$ | 25 g | 26±1.4 g | 0.0095* | 21.1 | Reneta Limited | 400 /10 kg |
| Zeo prime | $SiO_2$, $Al_2O_3$, $Fe_2O_3$, CaO, MgO, LoI, $K_2O$ | 22 g | 25±1.3 g | 0.0312* | 5.6 | SK+F | 450/10 kg |
| JV Zeolite | $SiO_2$, $Al_2O_3$, $Fe_2O_3$ CaO, MgO, $Na_2O$, $K_2O$, Mn, P | 21 g | 20±1.3 g | 0.1562 | 6.7 | Eon Animal Health Products Ltd. | 350 /10 kg |
| Zeolite Gold | $SiO_3$, MgO, $CaO_2$ etc. | 25 g | 26±1.4 g | 0.25 | 5.6 | Fish Tech BD Ltd. | 410/10 kg |
| Mega Zeo Plus | $SiO_2$, $A1_2O_3$, $Fe_2O_3$ CaO, MgO, $Na_2O$ $K_2O$ and Mn | 20 g | 22±0.9 g | 0.0625 | 5.6 | ACI Animal Health Ltd. | 340/10 kg |
| Gastrap | Lactic acid, Bacelassubtiles, amyles, proteas etc. | 0.3 g | 0.3 g | 1.000 | 12.2 | SQUARE Pharmaceuticals Ltd. | 300/100 g |
| Geotox | $SiO_2$, $A1_2O_3$, $Fe_2O_3$ CaO, MgO, $Na_2O$ | 10 g | 11±0.5 g | 0.25 | 3.3 | Novartis Animal Health Ltd. | 55/kg |
| Bactogro | Lactic acid, Bacelassubtiles, amyles, proteas etc | 0.1 g | 0.1 g | 1.000 | 5.6 | Fish Tech BD Ltd. | 250/100 g |

*Indicates significantly difference ($p<0.05$)

***Growth of fish:*** Eleven aqua drugs and chemicals were recorded to be used as growth promoter as well as to increase fish production (Table 5). Charger Gel was found to be different from standard dose of application. AC mix super fish, Rapid Grow, Bio-Permix (gold) and Charger Gel were largely used by the farmers. But most of the farmers of the research area were found to be unknown about the function of those products. Without having any knowledge about the effect, specific function to specific species, recommended dose etc, they just used those products to promote growth according to different sellers' recommendation. Rahman (2011) and Alam (2014) observed that aqua drugs used as growth promoter were charger Gel, Rapid Grow, AC mix super fish, Vitax-C and Charger Gel. Growth promoters play a vital role for rapid growth of fish. Panvit-Aqua, Vitax-C, Vitax-ES, Vita Power and Ac mix super fish improve disease preventing ability of fish.

Table 5. Growth Promoters

| Trade Name | Active Ingredients | Standard Dose (per kg feed) | Farmer's Applied Dose (average ±Stdv.) | P value | User (%) | Source | Price (Taka) |
|---|---|---|---|---|---|---|---|
| Aquamin | Methionin, Lysin | 3 g | 3.1±0.2 g | 0.5 | 3.3 | ACI Animal Health Ltd. | 140/kg |
| Aqua-C | Vitamin C BP 50 g | 3 g | 3.2±0.1 g | 0.125 | 4.4 | ACI Animal Health Ltd. | 100/100 g |
| Panvit-Aqua | Vitamin A, B, D, Ascorbic acid etc. | 8 ml | 9±0.2 ml | 0.125 | 3.3 | SQUARE Pharmaceuticals Ltd. | 125/100 ml |
| Vitax-C | VitC BP 100 mg/g powder | 1 g | 1.0 g | 1.000 | 3.3 | Eon Animal Health Products Ltd | 200/100 g |
| Vitax-ES | Vitamin E Acetate + Selenium | 0.3 g | 0.3 g | 1.000 | 3.3 | Eon Pharmaceuticals Limited | 256/100 g |
| Charger Gel | 1-3 D-Glucan, Polysaccharides | 7 g | 8±0.3 g | 0.0156 * | 6.7 | Fish Tech BD Ltd. | 1060/kg |
| Bio-Permix (gold) | Vit A, B, D, E, C, K Niacin | 2.5 g | 2.5 g | 1.000 | 7.8 | Fish Tech BD Ltd. | 360/kg |
| Rapid Grow | Selected organic acid and their salt, beta-glucan, mannan oligosaccharide, essential oil | 0.5 g | 0.5 g | 1.000 | 7.8 | Fish Tech BD Ltd. | 670/kg |
| Provit Gel | Vitamin A, B, D, E, Ascorbic acid, Folic acid, Biotin | 10 g | 11±0.5 g | 0.25 | 3.3 | First Care Agro Ltd | 1050/kg |
| Vita Power | Vitamin A, B, D, E, Ascorbic acid, Folic acid, Biotin | 90 g | 85±4.9 g | 0.125 | 5.6 | Fish Tech BD Ltd. | 790/kg |
| AC mix super fish | Vitamin, Mineral, Amino acid | 2 g | 2.0 g | 1.000 | 7.8 | ACI Animal Health Ltd. | 325/2.5 kg |

*Indicates significantly difference (P<0.05)

***Antibiotics:*** Result of this study also revealed that use of antibiotics was limited in this region though the amounts of antibiotic mixed in supplementary feed were not taken under consideration. The present investigation showed that five antibiotics with different trade names were seen to be applied by the fish farmers (Table 6). Antibiotic users mentioned that they applied antibiotic to the supplementary feed to prevent diseases prior to facing any disease problem. The different training programs provided by different nongovernmental organizations at farmers level might be the reasons behind this limited use of antibiotics in this district. Shamsuzzaman and Biswas (2013) observed that the active ingredients of such antibiotics are mainly oxytetracyclin, chloro tetracycline amoxicillin, co-trimoxa zole, sulphadiazine and sulphamethaoxazole. Antibiotics were effective against bacterial disease. Monsur (2012) found that Oxysentin 20%, Aquamycine, Captor and Acimox powder are active as antibiotics. Ablez, Aquamycine and fish cure played vital role in growth promotion as well as effective against some of disease like dropsy, tail and fin rot, gill rot of fish, etc. Most of the antibiotics were effective against bacterial disease. These findings by Monsur (2012) were found to be matched with the findings of the present study.

Table 6. Antibiotics

| Trade Name | Active Ingredients | Standard Dose (per acre) | Farmer's Applied Dose (average± Stdv.) | P value | User (%) | Source | Price (Taka) |
|---|---|---|---|---|---|---|---|
| Aquamycine | Oxytetracyclin HCL 25% | 1.5 g | 1.5 g | 1.000 | 4.4 | ACI Animal Health Ltd. | 70/100 g |
| Oxy-Dox-F 100 | Oxytetracyclin HCL20%+Doxycycling | 1.5 g | 1.5 g | 1.000 | 3.3 | ACI Animal Health Ltd. | 150/100 g |
| Renamycin Soluble Powder | Oxytetracycline USP 200mg per g | 50 mg | 53±2.9 mg | 0.25 | 4.4 | Renata Limited | 72/100 g |
| Oxy-D Vet | Oxytetracyclin 20% Doxycyclin 10% | 8 g | 7±0.2 g | 0.5 | 3.3 | Eon Animal Health Products Ltd | 172/100 g |
| Bactitab | Oxytetracyclin | 50 g | 53±2.9 g | 0.25 | 3.3 | ACI Animal Health Ltd. | 70-80/kg |

*Indicates significantly difference ($p<0.05$)

***Disease Treatment:*** Eleven aqua drugs and chemicals were found to be used for treating a variety of fish diseases with different doses (Table 7). Applied dose of potash was found to be significantly different from recommended dose of application. From the survey it was found that fish diseases were treated by the application of potassium permanganate to fish in holding tanks or in ponds. Potash and salt were largely used by the farmers. Salt was found to be mainly used for parasitic diseases. The study showed that formalin was applied to remove the external parasite. Alam (2014) and Sharker *et al.* (2014) observed that Potash, Salt, Formalin, Malachite Green, Methylene Blue and Eco-solution were used regularly for disease treatment. Potassium permanganate is toxic to phytoplankton and reduced the production of dissolved oxygen by photosynthesis. Potassium permanganate is highly explosive when in direct contact with organic substances, and it can cause irritation to the skin. Care should be taken when handling it. There is a potential risk from spills into water because potassium permanganate can cause massive mortality of aquatic organisms. Shamsuzzaman and Biswas (2013) observed that salt was useful for eradication of external parasites as well as fungal diseases. Timsen was used for treatment of various diseases and act as a disinfectant. Lime and potash were widely used to control the dactylogyrosis, gyrodectylosis and argulosis. Above findings were more or less similar to the present study. However, most of the farmers of this present research area did not have adequate knowledge about application of specific aqua drugs for specific disease, even though they did not know which drugs should be applied for which species.

Table 7. Disease treatment

| Trade Name | Active Ingredients | Standard Dose (per acre) | Farmer's Applied Dose (average±Stdv.) | P value | User (%) | Source | Price (Taka) |
|---|---|---|---|---|---|---|---|
| Potash | $KMnO_4$ | 3 ppm | 3.2±0.2 ppm | 0.0002* | 21.1 | Chemical Seller | 185/kg |
| Salt | NaCl Spread with water | 8 ppm | 9±0.4 ppm | 1.000 | 32.2 | Chemical Seller | 10/kg |
| Methylene Blue | $C_{10}H_{18}CIN_3S$ $xH_2O$ | 0.1 ppm | 0.2 ppm | 1.000 | 3.3 | Chemical Seller | 450/25 kg |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Malachite Green | $C_2H_2O_4$ | 1 ppm | 1.0 ppm | 1.000 | 4.4 | Chemical Seller | 550/25 kg |
| Eco-solution | Eco-solution | 225 g | 236±11.3 g | 0.125 | 3.3 | Fish tech BD Ltd | 100/l |
| Formalin | 40 % Formaldehyde | 2 ppm | 19±1.2 ppm | 0.25 | 6.7 | Chemical Seller | 80/kg |

*Indicates significantly difference ($p<0.05$)

## Conclusion

In conclusion, farmers used those chemicals comprehensively and did not maintain proper instruction because of lack of their consciousness and knowledge as well. Less use of these aqua drugs and chemicals is the best alternative to minimize the adverse effects of chemicals in aquaculture because the effects and fates of chemicals and their residues in cultured organisms and within the aquaculture system itself as well as the actions and fate of chemicals used in aquaculture in the aquatic environment in general are still quite unknown. Further research should be expanded on the applications of these drugs and chemicals for the appropriate use of these materials in aquatic environment and human health.

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