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SM Shahin Hossain

Fisheries and Marine Resource
Technology Discipline, Khulna
University, Khulna-9208,
Bangladesh

Shamima Sultana

Assistant Professor, Fisheries
and Marine Resource Technology
Discipline, Khulna University,
Khulna-9208, Bangladesh

Manash Kabiraj

Fisheries and Marine Resource
Technology Discipline, Khulna
University, Khulna-9208,
Bangladesh

Sathi Rani Dey

Fisheries and Marine Resource
Technology Discipline, Khulna
University, Khulna-9208,
Bangladesh

Correspondence

Shamima Sultana

Assistant Professor, Fisheries
and Marine Resource Technology
Discipline, Khulna University,
Khulna-9208, Bangladesh

Recent Scenario of Application of Aqua Drugs and Chemicals in Fish and Shell Fish Health Management in Southwestern Region of Bangladesh

SM Shahin Hossain, Shamima Sultana, Manash Kabiraj and Sathi Rani Dey

Abstract

To investigate present scenario of applied aqua drugs and chemicals in aquatic animal health management in Satkhira district, data were collected through questionnaire interview from eighty fish farms and hatcheries in eight different upazillas of Satkhira district, Bangladesh during May to November 2016. The result showed that sixty-four and aqua drugs and chemicals were used at nine different stages of aquatic animal health management while twelve of those were used by greater percentage due to several reasons like low price, availability, effectiveness etc. Additionally, applied dose of nineteen aqua drugs and chemicals were significantly varied from recommended doses 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.

Keywords: aqua drugs, chemicals, health management, stage, dose

1. Introduction

Bangladesh is one of the world's leading fish producing countries of the world and this sector is contributing significantly in food security through providing safe and quality animal protein as well as contributing foreign incomes and socio-economic improvement (Ali *et al.* 2014) [1].

Application of aqua drugs and chemicals in aquaculture for various purposes is widely recognized as well as beneficial in many ways. The prompt development of aquaculture production in Bangladesh are also influenced by a number of aqua drugs and chemicals. They are not only crucial for health management and treating diseases but also essential for soil and water quality management, enhancing natural productivity, feed formulation, growth promotion and so on.

Satkhira is one of the prominent areas for shrimp and fish culture of Bangladesh. Currently, over 78 percent of the shrimp farms are located in the Satkhira, Khulna, and Bagerhat districts. As aquaculture is expanding in this area, using more drugs and chemicals in aquatic animal health management. It is well established fact that, in aquaculture as in all food production sectors, one of the external inputs required for successful crop production is chemicals (Subasinghe *et al.* 1996) [14]. While use of unapproved drugs or misuse of approved drugs in aquaculture fish and shellfish poses a potential human health hazard. These substances may be toxic, allergenic, or carcinogenic, or may cause antibiotic resistance in pathogens that affect humans. Keeping mind on those issues, the present research was conducted to identify different types of aqua drugs and chemicals used in aquaculture activities in Satkhira district as well as to evaluate whether those items are used appropriately or not.

2. Materials and methods

2.1 Study area and period

Data were collected from eighty different farms and hatcheries of eight upazillas namely Assasuni, Debhata, Symnagar, Kolaroa, Kaligong, Tala, Patkelgata, Satkhira Sadar of Satkhira district during May to November 2016

2.2 Questionnaire preparation and interviews

A set of questionnaire was prepared and pre-tested to verify the relevance of the questions and the nature of the sample producers. The selected areas were visited and primary data was collected by direct questionnaire interview from commercial fish farmers, small scale fish farmers, hatchery owners, hatchery manager and questionnaire forms were filled during the survey period. Besides that, several publications and some unpublished report were collected as secondary data.

2.3 Data Analysis

The collected data were scrutinized and summarized carefully before the actual tabulation. The summary tables were prepared in accordance to 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 analyzed data with Microsoft Excel 2007.

3. Result

3.1 Sources

Nine prominent as well as other small aqua-drug and chemical producing companies were found in Satkhira district (Fig. 1). Additionally, it was observed that most of the local

animal feed and chemical shops are the main sources of such compounds from where farmers usually purchased those products.

3.2 Aqua drugs and chemicals in different purposes

A total 64 chemicals and drugs were found to be used for different purposes (Table 1 to 9) like pond preparation and water quality management, disinfectants, improvement of dissolved oxygen level, antibiotics, probiotics, growth promoter, toxic gas remover, immunity enhancer and treating disease.

Different types of traditional as well as new compounds were found to be used by the fish farmers and hatchery personnel during different stages of aquaculture. About 9, 6, 7, 6, 7, 5, 12, 5 and 7 were found to be used for Pond preparation and water quality management, Disinfectants, Dissolved oxygen, Toxic gas remover, Antibiotics, Probiotics, Growth promoters, Immunity enhancer and stress reducer and Disease treatment. Additionally, result showed that lime and JV Zeolite, Polgard Plus, Timsen, Virex, Pond Safe, Emsen, were used by 73.75, 17.14%, 12%, 17.14%, 20%, 12%, 16.67% and 14.28% farmers respectively (Table 1) and applied dose of those two products significantly varied from recommended dose of application.

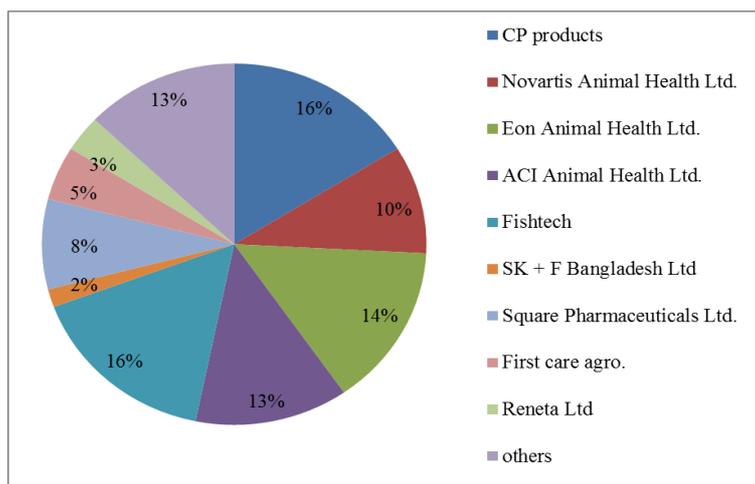


Fig 1: Sources of aqua drugs and chemicals in Satkhira district

3.2.1 Pond preparation and water quality management

Lime is popular because of its low price and effectiveness. Different types of chemical fertilizer were used to improve primary productivity.

3.2.2 Disinfectants

Disinfectants were found to be popular for site and equipment cleaning, maintaining hygiene throughout the production cycle as well as to treat disease or to avoid its occurrence in both hatchery and growout ponds. About six drugs and chemicals were found to be applied as disinfectant at different farms and hatcheries (Table 2). They were 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.

3.2.3 Dissolved oxygen

Seven aqua drugs and chemicals were seen to be used for increasing dissolved oxygen level in farmers' ponds (Table 3). Percarbonate and hydrogen peroxide and was the major

active ingredients of those products. Oxyflow and Oxylife were used to remove poisonous gases and also help to prevent disease. Sea-Freash, Oxylife and Oxy Well, were used at greater percentage by farmers among others. In case of Oxyflow, Oxylife and Oxy-Gold, applied doses were found to be significantly different from recommended dose of application. (Table 3).

3.2.4 Toxic gas remover

Six aqua drugs and chemicals were applied for removal of toxic gas as well as to improving water quality. The major composition of those products are different microorganisms like *Rhodobacter sp.*, *Rhodococcus sp.*, *Paracoccus pantotrophus*, Lactic acid *bacillus*, *Bacillus subtilis*, *Saccharomyces cerevisiae*, *Candida utilis*; Yucca plant extract, saponin steroids and glyco components; K, SO₄, Na, Mg, Ca, Cl and different enzymes. Yucca plant is a rich source of steroidal saponins, and is used commercially as a saponin source. Glyco components are complex bind to ammonia and neutralize it, convert it into a non-toxic

nitrogenous compound; Thus, reducing the high levels of this toxic element. However, applied dose of Bio- Aqua-50 and Pond D tox were found to be different from recommended dose of application. Bio- Aqua-50, Sodamix and Ammonil were most widely used by the farmers. As we know that Genus *Rhodobacter* includes species which possess an extensive range of metabolic capabilities. *Pond Dtox* is composed of the unique and versatile natural microorganism *Paracoccus pantotrophus*. This organism is very effective in oxidizing H₂S. Hydrogen sulfide (H₂S) is highly toxic to shrimp and fish, and can cause rapid and massive mortalities in aquaculture ponds. The result also disclosed that most of the farmers used 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).

3.2.5 Antibiotics

Nine branded antibiotics with different trade name were seen to be applied by the farmers. The active ingredients of such antibiotics are mainly Oxytetracyclin, Doxycycline, Chlortetracycline and Deltametrin. All of the nine branded antibiotics were widely used by the farmers may be due to their affordable price, local availability, effectiveness etc. (Table 5). According to farmers' statement, they applied those antibiotics to the supplementary feed to prevent diseases prior to facing any disease problem. Applied dose of Captor, Renamycin Soluble Powder and Deletrix were found to be different from standard dose of application. In case of applied dose of Renamycin Soluble Powder was found to be greater than standard.

3.2.6 Probiotics

Five probiotics were found to be applied by the farmers to control vibriosis and other luminescent bacteria. The probiotics mentioned in the table contained different beneficial bacteria including *Bacillus sp.*, *Bacillus subtilis*, *Saccharomyces cerevisiae*. 16.66% farmers applied Aqua Photo and Super biotic individually. Applied dose of Megazeo Pro were found to be significantly lower from standard dose of application. Additionally, it was found that, all of those five probiotics were largely used by the shrimp farmers (Table 6).

3.2.7 Growth promoters

Twelve aqua-medicines were used as growth promoter by the

farmers which contained different types of probiotic, anti oxydent, amino acid, amino acid premix, multivitamin, vitamin A, B1, B2, B6, C, D, E, K and minerals like Cu, Co, Mg, Mn, Fe, Zn, I, Ca, Na, P,D, L. Mithiolin, L-lysin, HCl, Niacinamide, Calcium pantothenate, Folic acid, Inositol, Lysine, Methionine, Protein hydrolysate and so on. Zymetin and Eco fish grower is a probiotic and a feed additive which also found to be used as growth promoter by 13.33% and 16% farmers respectively. Ac mix super fish also improve disease prevention capacity of fish while megavit aqua also increase hatching rate and AQ cell and aquamin helpful for fishes' bone development and Aqua savor ensure fast growth. All of those products were found to be followed by the farmers at recommended dose. Moreover, according to opinion of the chemical sellers of the study area, aqua Boost and AC Mix Super-Fish were also used to prevent diseases in fish (Table 7).

3.2.7 Immunity enhancer and stress reducer

Five aqua dugs and chemicals were found to be used as immunity increaser. The price of those items were found to be so high that maximum fish farmer could not able to buy. Those immunity increaser and stress reducer were mostly used in shrimp production. More specifically Cevit- Aqua and Aqua C facilitate to recover malnutrition as well as promote physical condition of fishes. While Uni ecosense is an aqua probiotics also found to be used for this purpose. Applied dose of Vitex C and Aqua C were found to be different from standard dose of application. Vitex C, Aqua C and Ossi-C were widely applied by shrimp farmers (Table 8).

3.2.8 Disease treatment

Besides antibiotic, seven aqua drugs and chemicals were applied for treating different types of disease treatment which caused by different types of pathogen. Farmers used those items at different doses. However, most of the farmers of this present research area did not have adequate knowledge about a specific disease and application of specific aqua chemicals for that, even they applied one after another chemical if previous did not work, sometimes they used those products for pond preparation also. Applied dose of Potash, Methylene Blue and Salt were found to be different from standard dose of application while Potash, Methylene Blue, Salt and Bleaching were largely used may be due to their low price, local availability, effectiveness etc. (Table 9).

Table 1: Aqua drugs and chemicals used for pond preparation and water quality management

Trade Name	Active ingredients	Recommended Dose	Applied dose (Average + Stdv.)	P value	User (%)	Source	Price (Taka)
Lime	CaO, Ca(OH) ₂	100 kg. acre ⁻¹	72.85±7.42 kg. acre ⁻¹	0.0000*	73.75	Chemical seller	15 tk. kg ⁻¹
Calmag	Mg, Ca, SO ₄	20 kg. acre ⁻¹	19.33±1.53 kg. acre ⁻¹	0.3750	13.3	CP products	60 tk. kg ⁻¹
A Soil	N, P, K, SO ₄ , Na, Mg, Si, B, Se	142 kg. acre ⁻¹	135.16±2.75 kg. acre ⁻¹	0.0625	13.33	CP products	85 tk. kg ⁻¹
Dolomite	Ca, Mg, CO ₃ , pH range is 7.5-7.9.	25 kg. acre ⁻¹	23±2.74 kg. acre ⁻¹	0.1250	14	CP Products	28 tk. kg ⁻¹
Geotox	SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ CaO, MgO, Na ₂ O	23 kg. acre ⁻¹	22.25±2.52 kg. acre ⁻¹	0.2187	13.33	Novartis Animal Health Ltd.	55 tk. kg ⁻¹
JV Zeolite	SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ CaO, MgO, Na ₂ O K ₂ O, Mn, P	18 kg. acre ⁻¹	20 kg. acre ⁻¹	0.0039*	13.33	Eon Animal Health Ltd.	35 tk. kg ⁻¹
Mega Zeo Plus	SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ CaO, MgO, Na ₂ O K ₂ O, Mn	20 kg. acre ⁻¹	20 kg. acre ⁻¹	1.0000	17.14	ACI Animal Health Ltd.	34 tk. kg ⁻¹
Zeolite Gold	SiO ₃ , MgO, CaO ₂ etc.	20 kg. acre ⁻¹	20 kg. acre ⁻¹	1.0000	13.33	Fishtech	41 tk. kg ⁻¹
pH fixer		2 kg. acre ⁻¹	2 kg. acre ⁻¹	1.000	13.33	CP Products	450 tk. kg ⁻¹

* Significantly varied at 5% level of significance ($P < 0.05$)

Table 2: Aqua drugs and chemicals used as disinfectant

Trade Name	Active ingredients	Recommended Dose	Applied dose (Average \pm Stdv.)	P value	User (%)	Source	Price (Taka)
Polgard Plus	3-Methyl and 4-Methyl two chain brominated compound	0.5 L. acre ⁻¹	0.59 \pm 0.20 L. acre ⁻¹	0.3750	12	Fishtech	2300 tk. L ⁻¹
Pond Safe	Alkyldimethylbenzylammonium Chloride Solution 80% Inert Ingredients 20%	0.6 L. acre ⁻¹	0.5 L. acre ⁻¹	0.0156*	12	Fish Tech BD.	4000 tk. L ⁻¹
Aquakleen	Tetradesail Tri-methyl Ammonium bromide, BKC	0.8 L. acre ⁻¹	0.51 \pm 0.04 L. acre ⁻¹	0.002*	14.28	Square Pharmaceuticals Ltd.	300 tk. L ⁻¹
Timsen	n-Alkyldimethylbenzyl ammonium chloride and Stabilized urea	0.15 kg. acre ⁻¹	0.19 \pm 0.01 kg. acre ⁻¹	0.0005*	17.14	Eon Animal Health Ltd.	5200 tk. kg ⁻¹
Virex	Potassium Peroxymono sulphate 50%	0.6 kg. acre ⁻¹	0.5 kg. acre ⁻¹	0.0156*	20	ACI Animal Health Ltd.	1000 tk. kg ⁻¹
Emsen	n-Alkyl dimethyl benzyl ammonium chloride stabilized urea	0.25 kg. acre ⁻¹	0.27 \pm 0.04 kg. acre ⁻¹	0.0547	16.67	SK + F Bangladesh Ltd	5000 tk. kg ⁻¹

* Significantly varied at 5% level of significance ($P < 0.05$)**Table 3:** Aqua drugs and chemicals used to increase dissolved oxygen level

Trade Name	Active ingredients	Recommended Dose	Applied dose (Average \pm Stdv.)	P value	User (%)	Source	Price (Taka)
Sea-Freash	Oxygen	8 kg. acre ⁻¹	3.2 \pm 4.16 kg. acre ⁻¹	0.2500	13.33	CP Products	220 tk. kg ⁻¹
Oxyflow	H ₂ O ₂ 10%	0.35 kg. acre ⁻¹	0.5 kg. acre ⁻¹	0.0039*	11.83	Novartis Animal Health Ltd.	800 tk. kg ⁻¹
Oxylife	Oxygen precursors, Probiotics, Detoxificants	0.4 kg. acre ⁻¹	0.47 \pm 0.05 kg. acre ⁻¹	0.0312*	15	Square Pharmaceuticals Ltd.	600 tk. kg ⁻¹
Oxymax	Calcium peroxide	0.25 kg. acre ⁻¹	0.21 \pm 0.01 kg. acre ⁻¹	0.0625	12.5	Eon Animal Health Ltd	720 tk. kg ⁻¹
Bio-Ox	Sodium percarbonate	1 kg. acre ⁻¹	1 kg. acre ⁻¹	1.0000	12.5	ACI Animal Health Ltd.	475 tk. kg ⁻¹
Oxy-Gold	Sodium percarbonate 90%	0.5 kg. acre ⁻¹	1 kg. acre ⁻¹	0.0312*	10	Fishtech	670 tk. kg ⁻¹
Oxywell	Sodium percarbonate,	0.15 kg. acre ⁻¹	0.19 \pm 0.01 kg. acre ⁻¹	0.1250	13.33	First care agro.	500 tk. kg ⁻¹

* Significantly varied at 5% level of significance ($P < 0.05$)**Table 4:** Aqua drugs and chemicals used to remove toxic gases

Trade Name	Active ingredients	Recommended Dose	Applied dose (Average \pm Stdv.)	P value	User (%)	Source	Price (Taka)
Super PS	<i>Rodobacter sp, Rodococcus sp.</i>	1 ppm	1 ppm	1.000	13.33	CP Products	270 tk. kg ⁻¹
Pond D tox	<i>Pracoccus pantotrophus</i>	4 ppm	4 ppm	0.0078*	10	Fish tech BD	2800 tk. kg ⁻¹
Bio-Aqua-50	Yucca plant extract, Saponin Components, Glyco components	0.06 L. acre ⁻¹	0.05 L. acre ⁻¹	0.0001*	17.5	Eon Animal Health Products Ltd.	2900 tk. kg ⁻¹
Sodamix	K, SO ₄ , Na, Mg, Ca, Cl	17 kg. acre ⁻¹	17.5 \pm 2.5 kg. acre ⁻¹	0.2734	14	CP Products	50 tk. kg ⁻¹
Gastrap	Lactic acid <i>bacillus, Bacillus Subtilis, Saccaromyces cerevisiae</i> , Xylogen, Amylase, Protease, Cellulase, Hemicellulase, Phytase, Betaglucanase, Lypase, Aminonitrogen	0.2 kg. acre ⁻¹	0.5 kg. acre ⁻¹	0.125	10	Square Pharmaceuticals Ltd.	3000 tk. kg ⁻¹
Ammonil	Yucca plant extract, <i>B. subtilis, Candida utilis</i>	0.2 kg. acre ⁻¹	0.38 \pm 0.11 kg. acre ⁻¹	0.125	18.33	Novartis Pharmaceuticals Ltd.	2800 tk. kg ⁻¹

* Significantly varied at 5% level of significance ($P < 0.05$)**Table 5:** Antibiotics used for fish disease treatment

Trade Name	Active ingredients	Recommended Dose	Applied dose (Average \pm Stdv.)	P value	User (%)	Source	Price (Taka)
Bactitab	Oxytetracyclin	50 g. kg ⁻¹	50 g. kg ⁻¹	1.000	16	ACI Animal Health	700-800 tk. kg ⁻¹
Ablez	Doxycycline, colistine sulphate+vitamin premix+mineral	25 g. kg ⁻¹	27.5 \pm 3.54 g. kg ⁻¹	0.500	15	Eon Animal Health Products Ltd.	1020 tk. kg ⁻¹
Aquamycine	Oxytetracycline HCL 25%	2 g. kg ⁻¹	2 g. kg ⁻¹	1.000	10	ACI Animal Health Ltd.	700 tk. kg ⁻¹

Captor	Chlorotetracycline HCL 45%	60 g. kg ⁻¹	53.33±5.16 g. kg ⁻¹	0.0156*	10	Novartis Animal Health Ltd.	4050 tk. kg ⁻¹
Oxysentin 20%	Oxytetracycline HCL 200 mg	150 g. kg ⁻¹	193.75±12.5 g. kg ⁻¹	0.0625	12.5	Novartis Animal Health Ltd.	840 tk. kg ⁻¹
Renamycin Soluble Powder	Oxytetracycline 200 mg	0.5 g. kg ⁻¹	1 g. kg ⁻¹	0.0312*	10.25	Reneta Ltd	720 tk. kg ⁻¹
Deletrix	Deltametrin-1.75%	2 g. kg ⁻¹	1 g. kg ⁻¹	0.0078*	17.5	Fishtech (BD) Limited	

* Significantly varied at 5% level of significance ($P < 0.05$)

Table 6: Probiotics used in Satkhira district

Trade Name	Active ingredients	Recommended Dose	Applied dose (Average ± Stdv.)	P value	User (%)	Source	Price (Taka)
Aqua Photo	<i>B. subtilis</i>	5 L. acre ⁻¹	5 L. acre ⁻¹	1.000	16.66	ACI Animal Health Ltd.	300 tk. L ⁻¹
Super biotic	<i>Bacillus sp.</i>	1 kg. acre ⁻¹	1 kg. acre ⁻¹	0.1250	16.66	CP Products	700 tk. kg ⁻¹
Pond Plus	<i>B. subtilis</i>	0.35 kg. acre ⁻¹	0.5 kg. acre ⁻¹	0.0625	10	Fishtech	1230 tk. kg ⁻¹
Biozime	<i>S. cerevisiae</i>	0.05 kg. acre ⁻¹	0.05 kg. acre ⁻¹	1.000	10	Fishtech	1500 tk. kg ⁻¹
Megazeo Pro	<i>B. subtilis</i>	12 kg. acre ⁻¹	9.5±1.22 kg. acre ⁻¹	0.0156*	11.66	ACI Animal Health Ltd.	36 tk. kg ⁻¹

* Significantly varied at 5% level of significance ($P < 0.05$)

Table 7: Growth promoters used in fish farms in Satkhira district

Trade Name	Active ingredients	Recommended Dose	Applied dose (Average ± Stdv.)	P value	% farmers used	Source	Price (Taka)
Zymetin	Beneficial bacteria	8 g. kg ⁻¹	8 g. kg ⁻¹	1.000	13.33	CP Products	1100 tk. kg ⁻¹
Acimix Super-fish	Vitamin, Mineral and Amino acid.	2.5 g. kg ⁻¹	2.33±0.58 g. kg ⁻¹	0.3750	10	ACI Animal Health Ltd.	130 tk. kg ⁻¹
Aqua Savor	Amino acid premix	2 g. kg ⁻¹	2 g. kg ⁻¹	1.000	12	Eon Animal health Products Ltd.	750 tk. kg ⁻¹
Eon Fish Grower	Multivitamin and Minerals	2 g. kg ⁻¹	2 g. kg ⁻¹	1.000	16	Eon Animal health Products Ltd.	150-170 tk. kg ⁻¹
Aqumin	Cu, Co, Mg, Fe, Zn, I, Ca, P,D, L. Mithiolin, L-lysin, HCl	100 g. kg ⁻¹	100 g. kg ⁻¹	1.000	15	ACI Animal Health	150 tk. kg ⁻¹
Megavit-Aqua	Vitamin A, Ca, P, Na etc.	100 g. kg ⁻¹	100 g. kg ⁻¹	1.000	12	Novartis Animal Health Ltd.	360 tk. kg ⁻¹
Rena Fish	Vit A, B, C, D3, E, K, Cu, Mn, Fe, Co etc.	1 g. kg ⁻¹	1 g. kg ⁻¹	1.000	15	Reneta Ltd.	260 tk. kg ⁻¹
C-150	Iron and vitamin C	0.005 kg. acre ⁻¹	0.005 kg. acre ⁻¹	1.000	13.33	CP Products	650 tk. kg ⁻¹
Trade Name	Active ingredients	Recommended Dose	Applied dose (Average ± Stdv.)	P value	User (%)	Source	Price (Taka)
Square Aquamix	Vitamin, Amino acid, Mineral, Probiotic, Anti oxydent etc.	1 g. kg ⁻¹	1 g. kg ⁻¹	1.000	10	Square Pharmaceuticals Ltd.	295 tk. kg ⁻¹
Vitax-C	Vit C BP 100 mg/g powder	2 g. kg ⁻¹	3.33±1.53 g. kg ⁻¹	0.2500	20	Eon Animal Health Ltd.	2000 tk. kg ⁻¹
Provit gel	Vitamin A, Vitamin B1, B2, B6, Vitamin C, Vitamin D, Niacinamide, Calcium pentothinate, Folic acid, Inositol, Lysine, Methionine, Protein hydrolyzate	10 g. kg ⁻¹	10 g. kg ⁻¹	1.000	10	First care Agro. Ltd.	1050 tk. kg ⁻¹
Charger Gel	1-3 D-Glucan, Polysaccharides, Btain, Beta Glucan	7 g Kg ⁻¹	6±1.41 g Kg ⁻¹	0.2500	15	Fishtech	1060 Tk Kg ⁻¹

* Significantly varied at 5% level of significance ($P < 0.05$)

Table 8: Aqua drugs and chemicals used as immunity increaser and stress reducer

Trade Name	Active ingredients	Recommended Dose	Applied dose (Average ± Stdv.)	P value	User (%)	Source	Price (Taka)
Ossi-C	Oxolinic Acid, Beta glucan, Vitamin C	4 g. kg ⁻¹	4 g. kg ⁻¹	1.000	16	Fish tech (BD) Ltd	1800 tk. kg ⁻¹
Vitex C	Vitamin C BP 1-5g/ kg feed	3 g. kg ⁻¹	5 g. kg ⁻¹	0.0312*	16.66	Eon Animal health Products Ltd.	1800 tk. kg ⁻¹

Cevit-Aqua	Ascorbic Acid	2 g. kg ⁻¹	2 g. kg ⁻¹	1.000	10	Square Pharmaceuticals Ltd.	2000 tk. kg ⁻¹
Aqua C	Ascorbic Acid	0.2 g. kg ⁻¹	0.4±0.14 g. kg ⁻¹	0.0312*	16	ACI Animal Health	1700 tk. kg ⁻¹
Uni ecosense	<i>B. subtilis</i> , <i>B. licheniformis</i> , <i>B. polymyxa</i> , <i>B. pumilus</i> , <i>Thiobacillus denitrificans</i> , <i>Aspergillus oryzae</i> , <i>A. niger</i> .	275 g. kg ⁻¹	254.16±53.36 g. kg ⁻¹	0.2734	14	First care	500 tk. kg ⁻¹

* Significantly varied at 5% level of significance ($P < 0.05$)

Table 9: Aqua drugs and chemicals used for disease treatment

Trade Name	Active ingredients	Recommended Dose	Applied dose (Average ± Stdv.)	P value	User (%)	Source	Price (Taka)
Potash	KMnO ₄	3 ppm	3.97±0.72 ppm	.0000*	63.75	Chemical seller	195 tk. kg ⁻¹
Formalin	40% Formaldehyde	20 ppm	18±2.74 ppm	0.2500	12	Chemical seller	80 tk. kg ⁻¹
Bleaching	Chlorine	60 ppm	54.19±4.5 ppm	0.0000*	35.5	Chemical seller	60 tk. kg ⁻¹
Malachite Green	C ₂ H ₂ O ₄	1 ppm	1 ppm	1.000	10	Chemical seller	24000 tk. kg ⁻¹
BKC	Benzalkonium chloride	0.5 ppm	0.5 ppm	1.000	10	Chemical seller	2000 tk. kg ⁻¹
Methylene Blue	C ₁₆ H ₁₄ N ₃ SCI	0.15 ppm	0.4±0.14 ppm	0.001*	14.28	Chemical seller	700 tk. g ⁻¹
Salt	NaCl	100 kg. acre ⁻¹	67.14±14.85 kg. acre ⁻¹	0.000*	30	Chemical seller	8 tk. kg ⁻¹

* Significantly varied at 5% level of significance ($P < 0.05$)

Discussion

In order to achieve research goal, the present study find out total 64 aqua drugs and chemicals and antibiotics marketed by more than nine companies, used for various purposes of aquaculture. This statement was supported by findings of previous researchers (Apud 1984; Faruk *et al.* 2008; Rahman 2011; Monsur 2012; Shamsuzzaman and Biswas 2012; Islam 2013; Alam and Rashid 2014; Anwar 2014; Sarker *et al.* 2014 and Chowdhury *et al.* 2015) [3, 5, 9, 7, 11, 6, 13, 2]

Additionally, it was found that water quality management, growth promotion, health management and disease treatment were the most prominent areas where farmers were seen to use a lot of such compounds.

The most commonly applied traditional chemicals were lime, salt, potash, formalin, bleaching powder, malachite green, methylene blue. Other popular traditional aqua-medicines included zeolite, gypsum, lime were used for pond soil and water quality management. Remaining fifty-four new products with various trade names were present in the market of this district supplied by local animal feed and chemical sellers and company representative. Farmers used those for better health management of aquatic animal. However, Potash, Methylene Blue, Salt and Bleaching were largely used for treating diseases, may be due to their low price, local availability, effectiveness etc. Some previous studies also stated the more or less similar findings about the chemicals used in aquaculture of Bangladesh (Shamsuzzaman and Biswas 2012 and Chowdhury *et al.* 2012) [11, 4].

Farmers used aqua drugs and chemicals at different doses. Moreover, most of the farmers of this present research area did not have adequate knowledge about a specific disease and application of specific aqua chemicals for that, even they applied these chemicals in trial and error basis. Sometimes those products were also seen to use for pond preparation. Disease treatment in aquaculture can be of great value when chemicals used properly while indiscriminant and inappropriate use of those products can cause huge losses of fish. The nature of chemicals reactivity depends on many factors like water quality, the target species the life stages of a certain species and so on. Major responsibility producers were to ensure absence of harmful residues of those chemicals in final product and best way to avoid complications following chemical application is to follow the recommended dosages and using particular chemical methods of application. As we

know the accuracy of determining the dosage and following the best application methods are key to success. However, none of the above measures were found to be followed by the farmers of this district.

On a worldwide basis, only a few number of chemicals are approved for use in aquaculture. But present study showed that most of the farmers did not follow and know any rules and regulation on the use of chemicals in aquaculture in Bangladesh. Now a day some semi intensive shrimp farms were found to following that.

In case of antibiotics, only tetracycline, oxytetracycline, sulfamithoxin, sulfadimethoxine, sulfadiazine, sulfadiazine, amoxicillin, oxilinic acid, difloxin, chlortetracycline, and sulfanilamide and chelinos are approved for use to treat certain diseases in Bangladesh. About 9 trades named antibiotics were found to be used by farmers of this region. The causative agent of a certain disease needs to be identify via a sensitivity test at a diagnostic laboratory to ensure the correct antibiotic (Shamsuzzaman and Biswas 2012) [11]. However, no certain tradition was seen in the study area. Moreover those antibiotics were seen to use indiscriminately in present study without knowing the exact reasons of disease. According to farmers' statement, they applied those antibiotics to the supplementary feed to prevent diseases prior to facing any disease problem. It could be said that those compounds were widely abused in aquaculture in this district without any hesitation. It is well known that excessive use of antibacterial compounds in aquaculture causes toxicity to the host, the develop resistance of aquatic bacteria and sometimes remain aquatic food residues (Selim and Cavit 2011) [10].

Further more, about 19 drugs or chemicals were found to be significantly varied from recommended doses of application. Farmers select doses of a particular chemical on either from previous experiences, or from the suggestion of chemical sellers or company promotion officers. Many pharmaceuticals companies were observed to market their aqua chemicals in which nine were renowned in this district. They supplied attractive leaflet to promote their products to farmers through a number of promotion officers which provide small details about the purpose, dosages, duration and method of application of that chemicals. However, farmers had different opinion about the efficiency of many of the products.

On the other hand, appreciable percentage of farmers were seen to applied aqua drugs and chemicals for increasing

dissolved oxygen level of ponds water as well as immunity enhancer. However, the price of products used as immunity enhancer were found to be so high that maximum fish farmer could not able to buy.

A positive indicative news was, a major percentage of shrimp farmers were using different probiotics contained different beneficial bacteria including *Bacillus subtilis*, *B. Pumilis* and *Saccharomyces cerevisiae* etc. which not only improve disease resistance capacity but also boost up shrimps' growth and ultimately helped to improve production. Sharifuzzaman and Austin (2017) ^[17], Alam (2014) ^[13] and Islam (2013) ^[6] also reported similar findings.

However, the concern sectors should conduct more research towards reducing the harmful impacts of those chemicals in aquaculture systems, they should work to promote public awareness about the pros and cons of chemical use through promotion officers except promoting their products (Shamsuzzaman and Biswas 2012) ^[11]. Some products are useful without any doubt while farmers should work to understand the on-farm management of chemical use in order to increase effectiveness and minimizes adverse impacts (Shamsuzzaman and Biswas 2012) ^[11].

The effects and ultimate fates of those products and their residues in cultured organisms, within the aquaculture system itself is still quite unknown (Weston 2000) ^[16], therefore this practice should be come under scrutiny through department of fisheries and other related organization providing appropriate informational and technical support to the farmers to overcome these problems and should enforce the rules and regulation properly to ensure proper use of these chemicals to get better product through good aquaculture practice

Conclusion

More concisely, most of the farmers of this present research area did not have adequate knowledge about specific function of those individual aqua drugs and chemicals, even though they did not know which drugs should be applied for which species, in which condition and so on. Often they took suggestion of local sellers and company promotional officers for using those products. Farmers and hatcheries personnel were indiscriminately applied those products to increase overall production. Hence, there are some important concerns about this matter such as human health, product quality and environmental concerns. Therefore, those items practice should be taken under scrutiny by the governmental level to get better product through good aquaculture practice.

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