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SEASONAL VARIATIONS OF PHYSICOCHEMICAL PARAMETERS AND INCIDENCE OF FISH DISEASES IN FRESHWATER AQUACULTURE OF BANGLADESH

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ABSTRACT

Monir MS, Bagum N, Khan MH, Haque MR (2013) Seasonal variations of physicochemical parameters and incidence of fish diseases in freshwater aquaculture of Bangladesh. *J. Innov. Dev. Strategy*. 7(3), 67-74.

The monthly variations of physicochemical parameters and incidence of fish diseases in some selected freshwater cultured ponds were studied in three zones (Mymensingh, Rajshahi and Sylhet) of Bangladesh during July 2010 to June 2013. The highest values for water temperature, pH, dissolved oxygen (DO), alkalinity, total hardness and ammonia in fish cultured ponds were 30.7°C (August '10) in Mymensingh, 8.8 (July '11) in Rajshahi, 6.6 ppm (August '12) in Sylhet, 170 ppm (January '11) in Mymensingh, 120 ppm (January '11) in Mymensingh and 0.065 ppm (February '12) in Rajshahi, respectively. In the study area, the physicochemical parameters have more or less significant combined effect on the deterioration of water quality as well as outbreak of fish diseases. The highest incidence of fish diseases was found 44.36% (January' 11) in Rajshahi followed by 41.82% (December '12) in Sylhet and 41.00% (February' 11) in Mymensingh zone. The lowest incidence of fish diseases was 4.64% (June' 13) in Sylhet, 5.55% (July' 11) in Rajshahi and 7.10% (July' 10) in Mymensingh zone. Among the diseases, Trichodiniasis and Dactylogyrosis were the most prevalent diseases recorded throughout the year following Dropsy, Whirling and Mouth fungus were found as least dominant diseases in the study areas.

Key words: *physicochemical parameters, fish diseases, freshwater, Bangladesh*

INTRODUCTION

The environmental stress of fish is related to some biological, ecological and management aspects. Poor condition of physicochemical properties of water is O_2 depletion, excess ammonia, low or high pH, excess CO_2 in water and temperature change. The important physicochemical parameters influencing the aquatic environment and these parameters are the limiting factors for the survival of aquatic organisms (Lawson 2011). The physicochemical factors have strong influence on fish health and their resistance against the disease causing agents (Welch 1941; Snieszko 1974; Plumb *et al.* 1988; Shresta 1994). Healthy of any population depends on the control of disease and maintenance of a healthy relationship between living creatures and their environment (Snieszko 1983). The physiological and biological features of the host affect the composition of parasites (Dogiel 1961). Srivastava (1975) stated that the characteristic of any water body can influence and determine its parasitic fauna and when environmental conditions, such as water, food and temperature become favourable for mass reproduction of parasites, the disease may spread very quickly. Early identification of environmental problems prevents cumulative environmental degradation which may save the life of cultured organisms. When degradation reaches an extreme level, cultured organisms experience depressed growth rates, increased disease conditions and even death. The success of fish culture depends on its proper management, which is related with understanding the biology of fish and the aquatic environment in which they live. Successful fish health management begins with prevention of fish disease rather than treatments. Prevention of disease is accomplished through good water quality management, nutrition and sanitation.

Disease is one of the most important problems of fish production both in culture system and wild condition of Bangladesh (Rahman and Chowdhury, 1996). By the increasing intensification of fish production and lack of health management measures have lead to many disease problems of bacterial, viral, fungal and parasitic origin. Fishes have been suffering from many diseases such as Epizootic Ulcerative Syndrome (EUS), tail and fin rot, fungal, parasitic and bacterial infections (Chowdhury *et al.* 1999). In most cases hemorrhages, septicemia, lesions, gill damage are the common symptoms of the diseased fish (Chowdhury 1993, 1998). High stocking density of fish fry and fingerlings during nursery operation accelerate bio-ecological stress (Passino 1984) and fish become more susceptible to the infectious diseases (Sneiszko 1974). Some diseases have caused serious damage, not only the livelihood of fish farmers, but also to the future development of the industry. Therefore, the present study was undertaken with a view to knowing the seasonal occurrences of fish diseases along with physicochemical parameters in the three selected zones of Bangladesh.

MATERIALS AND METHODS

Study areas and data collection

The present study was carried out in three selected districts of Bangladesh *viz.*, Mymensingh, Rajshahi and Sylhet due to abundance of fish resources. A combination of participatory, qualitative and quantitative methods was used for data collection. Data about pond management practices, water quality parameters and disease fish were collected once in a month from March 2010 to December 2013. A traditional survey method of direct interview from the selected fish farmers was followed, using pre-tested questionnaire. After completing primary data collection procedure, focus group discussion with farmers and cross-check interviews with key informants

were carried out to justify of previously collected data. A total 300 farmers having different farm size were interviewed and samples were collected.

Physicochemical condition of ponds

The Physicochemical parameters (water temperature, dissolved oxygen, pH, alkalinity, total ammonia and total hardness) were measured once in a monthly throughout the year from the commercial cultured ponds by using a portable HACH kit (Model FF-2) at the time of during sampling.

Sampling techniques of disease fish

Diseased fishes were collected from the sampled water bodies and different diseases were identified according to the clinical symptoms, then by magnifying glass or under microscopic observation as well as laboratory investigation (Kabata 1985; Amlacher 1997). Incidence (%) of fish diseases was calculated from the number of diseased fishes out of the total number of fish collected during the study period.

Data analysis

The data from the questionnaire were grouped and categorized according to the different fish farmers. The whole data were entered into the MS Excel program and in the tabular from in the computer. Mainly the tabular method was used for analyzing the data.

RESULTS AND DISCUSSION

Physicochemical parameters

Seasonal variations of physicochemical parameters in Mymensingh, Rajshahi and Sylhet zone are presented in Tables 1, 2 and 3, respectively. The results are narrated in the following:

Water temperature (°C)

Water temperature in different fish cultured ponds in the three selected zones showed variations in different months of the year. In case of Mymensingh, the highest water temperature of cultured ponds was 30.7°C in the month of August 2010 and the lowest was 18.4°C in the month of January 2011. The average water temperature of Mymensingh was 26.36°C (Table 1). The lowest water temperature recorded in Rajshahi which was 16.2°C in January 2012, whereas, the highest was 33°C in July 2011 and the average was 26.45°C (Table 2). The temperature in Sylhet area was ranged from 18 to 30.8°C during July 2011 to June 2012 and having an average of 24.72°C (Table 3). Hossain *et al.* (2011) mentioned that in case of low aquatic environmental temperature, fish reduces metabolic activities, which in turn makes the fish more susceptible during the winter period towards parasitic infection. Temperature influences the regulation of virulence factors in bacterial pathogens (Finlay and Falkow, 1997). Study by Pulkkinen *et al.* (2010) on *Flavobacterium columnare* also showed that high temperature favors the development of more virulent strains in fish farms.

pH (Hydrogen ion concentration)

The highest pH in Mymensingh was 8.3 in July 2010 and the lowest was recorded as 6.5 in January 2011. The average pH of ponds water was 7.30 in the Mymensingh area. pH of Rajshahi area was 6.4 (October 2011) to 8.8 (September 2011), where the average was 7.58. The lowest and highest pH of Sylhet was 6.7 in May 2013 and 8.8 in February 2013, respectively having an average of 7.63. Fish can become in stress in water with a pH ranging from 4.0 to 6.5 and 9.0 to 11.0. Mishra *et al.* (2008) reported that the highest pH was recorded in January and in winter months. Arya *et al*. (2011) also observed low levels of pH in June and high levels in January.

Dissolved oxygen, DO (ppm)

The average DO of ponds water in Mymensingh was 4.14 ppm. The lowest and highest concentrations **of** DO in Mymensingh were recorded 3.0 in December 2010 and 4.7 in April 2011, respectively. The DO of Rajshahi area was ranged from 3.6 (December 2011) to 6.8 (July 2010) ppm, where an average was 4.47 ppm. In case of Sylhet, the highest and lowest concentrations of DO were recorded 6.6 in August 2012 and 3.7 ppm in January 2013, respectively and the average DO was 4.73 ppm. Same results were also observed by Salam *et al*. (2000) and Hossain *et al.* (2007).

Total alkalinity (ppm)

The maximum and minimum total alkalinity of Mymensingh area was 170 in January and 75 ppm in April 2011 and the average was 118.50 ppm. In Rajshahi, the minimum total alkalinity was recorded as 60 (September 2011) and maximum was 150 ppm (January 2012) with an average of 107.50 ppm. The total alkalinity in Sylhet varied from 65 (December 2012) to 120 ppm (October 2012) and the average was 93.75 ppm. Mishra *et al.* (2008) reported that the highest total alkalinity was recorded in January and lowest in October in fish ponds. Hossain *et al*. (2011) revealed that low alkalinity reduces the buffer capacity of water and badly affects the pond ecosystem, which in turn cause stress to the fish and become more susceptible to diseases.

Total hardness (ppm)

The average total hardness of ponds water in Mymensingh was 88.17 ppm. The minimum and maximum total hardness in Mymensingh were recorded 75 (January 2010) and 120 ppm (January 2011), respectively. The total hardness of Rajshahi area was ranged from 55 (September 2011) to 110 ppm (November 2011), where an average was 82.10 ppm. In case of Sylhet, the maximum and minimum total hardness were recorded 100 in August 2012 and 60 ppm in June 2013, respectively and the average total hardness was 79.20 ppm. These observations support the findings of Mishra *et al.* (2008). Khan *et al.* (1986) showed that the hardness in fish ponds varied from season to season due to their geological setting.

Ammonia (ppm)

The ammonia of Mymensingh area was varied from 0.002 (August and December 2010) to 0.060 ppm (March 2011) with an average of 0.018 ppm. In Rajshahi, the minimum amounts of ammonia was recorded as 0.002 (December 2011) and maximum was 0.065 ppm (February 2012) having an average of 0.011 ppm. In Sylhet area amounts of ammonia was ranged from 0.001 (April 2013) to 0.04 ppm (July 2012), while the average was recorded as 0.011 ppm. Islam *et al*. (2013) also observed that the highest concentration of ammonia was in February of the cultured fish ponds.

Table 1. Monthly variations of physicochemical parameters in different cultured ponds in Mymensingh during July 2010 to June 2011

Years	Months	Water temp. (°C)	pH	DO ppm	Alkalinity (ppm)	Total hardness (ppm)	Ammonia (ppm)
2010	July	30.4	8.3	4.5	120	100	0.015
	August	30.7	7.2	3.5	80	78	0.002
	September	29.3	7.3	3.5	140	90	0.004
	October	28.6	6.9	3.5	110	85	0.004
	November	26.4	6.6	4.5	150	80	0.003
	December	22.5	6.9	3.0	120	75	0.002
2011	January	18.4	6.5	3.2	170	120	0.003
	February	18.7	7.2	4.4	140	90	0.004
	March	25.4	7.3	3.8	85	80	0.060
	April	27.8	7.6	4.7	75	85	0.040
	May	29.3	7.6	5.0	110	100	0.050
	June	28.8	8.2	6.0	122	75	0.023
Mean±SD		26.36±4.30	7.30±0.56	4.14±0.8	118.50±28.96	88.17±13.15	0.018±0.02

Table 2. Monthly variations of physicochemical parameters in different cultured ponds in Rajshahi during July 2011 to June 2012

Years	Months	Water temp.(°C)	pH	DO (ppm)	Alkalinity (ppm)	Total hardness (ppm)	Ammonia (ppm)
2011	July	33	7.2	6.8	120	95	0.023
	August	32.8	7.8	4.8	100	80	0.030
	September	31.7	8.8	5.5	60	55	0.055
	October	29.5	6.4	4.2	90	60	0.020
	November	21.8	8.2	4.5	120	110	0.010
	December	19	7.4	3.6	95	85	0.002
2012	January	17	7.9	3.8	150	110	0.021
	February	16.2	8.5	3.6	110	90	0.065
	March	23.5	7.9	4.3	95	40	0.010
	April	28.9	6.8	5	100	75	0.020
	May	33	6.8	6.3	140	100	0.030
	June	31	7.2	6	110	85	0.011
Mean±SD		26.45±6.56	7.58±0.73	4.87±1.10	107.50±23.69	82.10±21.68	0.025±0.02

Table 3. Monthly variations of physicochemical parameters in different cultured ponds in Sylhet during July 2012 to June 2013

Years	Months	Water temp.(°C)	pH	DO (ppm)	Alkalinity (ppm)	Total hardness (ppm)	Ammonia (ppm)
2012	July	30.0	8.0	5.8	90	95	0.040
	August	30.8	8.4	6.6	105	100	0.020
	September	28.7	7.4	4.3	100	50	0.010
	October	24.4	6.9	4.5	120	80	0.020
	November	19.5	7.4	3.9	85	85	0.004
	December	18.0	7.9	3.2	65	75	0.013
2013	January	19.0	7.4	3.7	100	90	0.003
	February	21.5	8.5	4.5	95	80	0.008
	March	23.0	7.2	4.6	100	60	0.003
	April	25.0	7.9	4.2	75	85	0.001
	May	27.0	6.7	4.9	85	90	0.004
	June	29.7	7.7	6.4	105	60	0.003
Mean±SD		24.72±4.65	7.63±0.55	4.73±1.10	93.75±14.79	79.20±15.34	0.011±0.01

Incidence of fish diseases (%): The monthly incidence of fish diseases of Mymensingh zone have been shown in Table 4. Twelve types of different fish diseases were found in the various types of cultured ponds under the study area. It was observed that Trichodiniasis was most prevalent disease throughout the year in Mymensingh and the highest incidence (79%) was recorded in May 2010. The highest Red spot disease (67%) and Gill/fin rot (63%) were observed in April 2010 and March 2011, respectively. Dropsy and Whirling diseases were least dominant. The lowest and highest percentages of disease respectively were 7.10 in July 2010 and 41.00 in February 2011 in Mymensingh zone.

The monthly incidence of fish diseases of Rajshahi zone have been shown in Table 5. Two diseases namely, Trichodiniasis and Dactylogyrosis were found throughout the year in the study area. The lowest incidence (5%) was of Rot (fin/gill rot) disease in October 2011 and the highest (70%) was of EUS in February 2012. Whereas, Mouth fungus and Dropsy diseases were found only during December 2011 to May 2012. It was observed that the lowest and highest percentages of disease were 5.55 in July 2011 and 44.36 in January 2012, respectively in Rajshahi zone.

The monthly incidence of fish diseases of Sylhet zone have been shown in Table 6. It was found that two namely diseases, Trichodiniasis and Dactylogyrosis were found throughout the year in the Sylhet zone. The lowest incidence (5%) was of Whirling disease in July 2012 and the highest (64) was of EUS in January 2013. Mouth fungus disease was least dominant and found only during December 2012 to May 2013. The lowest and highest percentages of disease were 4.64% in June 2012 and 41.82 in December 2013, respectively in Sylhet zone. It was revealed from the study that Trichodiniasis and Dactylogyrosis were the most prevalent diseases throughout the year following Dropsy, Whirling and Mouth fungus were found as least dominant diseases. The result is in agreement with the findings of Patra and Azadi (1987) and Hossain *et al.* (2007) who reported that the prevalence of EUS was high during the winter and Trichodiniasis and Dactylogyrosis were the most prevalent diseases throughout the year. The EUS appears to be seasonal and may be associated with environmental factors especially low temperature (Macintosh and Phillips, 1986).

It was found that the average prevalence of diseases among three selected zones was different from each zone to each other. It was also observed that there was monthly variation in the rate of diseases in fish. This might be due to stocking density, environmental pollutants, concurrent health problems, weather changes, moderate water temperatures (22°C-28°C) and pond management practices (Crumlish *et al.* 2002). Within the three studied zone, Rajshahi was found as highest incidences of fish diseases and Mymensingh was least comparison to others zones. These differences in the rates and seasonal dynamics of diseases among the different localities may be attributed to the differences in environmental conditions, fish species, and the differences in the degree of water pollution as well as number of examined samples.

Table 4. Monthly incidence of diseases in fish (%) in different cultured ponds in Mymensingh district during July 2010 to June 2011

Diseases	2010						2011					
	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.
Red spot disease	0	0	0	0	43	46	53	43	64	67	0	0
Grayish white spot	32	35	54	60	20	0	0	0	0	0	0	43
Rot (fin/gill rot)	0	0	0	0	0	0	43	47	63	32	21	0
EUS	0	0	0	0	45	50	48	47	21			
Mouth fungus	0	0	0	0	0	32	45	54	57	60	0	0
Dropsy	0	0	0	0	0	0	23	28	45	32	13	0
Whirling	0	0	0	8	15	32	24	34	45	34	0	0
Ichthyophthiriasis	21	21	27	34	42	45	54	51	33	48	0	0
Trichodiniasis	32	54	43	56	57	50	45	52	50	65	79	71
Gyrodactylosis	0	0	0	23	23	45	53	52	12	4	0	0
Dactylogyrosis	0	0	0	32	43	63	62	52	12	10	8	0
Argulosis	0	0	0	0	0	0	0	32	60	42	34	0
Mean±SD	7.10 ±13.10	9.12 ±18.02	10.33 ±19.56	17.75 ±22.82	24.00 ±21.27	30.25 ±23.74	37.50 ±20.91	41.00 ±15.63	38.50 ±22.35	35.81 ±23.64	14.10 ±24.26	10.36 ±23.89

Table 5. Monthly incidence of diseases in fish (%) in different cultured ponds in Rajshahi district during July 2011 to June 2012

Diseases	2011						2012					
	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.
Red spot disease	0	13	10	7	35	54	60	63	54	56	23	4
Rot (fin/gill rot)	0	0	0	5	0	32	54	56	56	45	32	0
EUS	0	0	0	12	47	41	70	68	60	12	8	0
Mouth fungus	0	0	0	0	0	34	38	34	19	38	14	0
Dropsy	0	0	0	0	0	32	16	12	27	43	27	0
Whirling	8	0	0	0	21	30	19	23	43	34	0	0
Ichthyophthiriasis	0	7	32	23	38	54	43	51	39	31	16	12
Trichodiniasis	43	56	59	50	54	45	51	54	54	65	63	34
Gyrodactylosis	0	8	16	26	29	51	47	48	32	17	8	17
Dactylogyrosis	10	13	10	38	46	54	50	47	38	54	43	9
Argulosis	0	0	0	7	21	43	40	15	42	65	45	10
Mean±SD	5.55 ±12.94	8.82 ±16.52	11.55 ±18.69	15.27 ±16.88	26.45 ±19.83	42.73 ±9.62	44.36 ±16.08	42.82 ±19.10	42.18 ±13.00	41.82 ±17.70	25.36 ±19.04	7.82 ±10.55

Table 6. Monthly incidence of diseases in fish (%) in different cultured ponds in Sylhet district during July 2012 to June 2013

Diseases	2012						2013					
	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.
Red spot disease	8	0	0	7	43	57	55	44	43	45	18	0
Rot (fin/gill rot)	8	8	0	0	14	54	54	32	36	32	28	0
EUS	0	0	12	18	43	60	64	53	62	23	0	0
Mouth fungus	0	0	0	0	0	35	38	32	27	27	32	0
Dropsy	0	0	8	0	18	34	21	23	26	34	32	0
Whirling	5	0	0	7	43	43	35	24	48	58	12	0
Ichthyophthiriasis	12	8	17	21	36	38	43	48	45	27	38	0
Trichodiniasis	13	32	41	52	56	41	52	58	49	57	59	21
Gyrodactylosis	16	13	26	45	34	13	23	32	23	54	15	10
Dactylogyrosis	8	17	8	8	32	53	27	44	43	42	53	12
Argulosis	0	0	0	8	24	32	43	28	40	57	62	8
Mean±SD	6.36 ±5.83	7.10 ±10.28	10.18 ±13.33	15.10 ±17.93	31.18 ±15.99	41.82 ±17.93	41.36 ±14.09	38.00 ±11.94	40.18 ±11.58	41.45 ±13.53	31.73 ±20.07	4.64 ±7.16

CONCLUSION

In the present study, the variation of physicochemical parameters has more or less significant combined effect on the deterioration of water quality as well as outbreak of fish diseases. Among the diseases, Trichodiniasis and Dactylogyrosis were the most prevalent diseases recorded throughout the year following Dropsy, Whirling and Mouth fungus were found as least dominant diseases in the study areas. Within the three studied zone, Rajshahi was found as highest incidences of fish diseases and Mymensingh was least comparison to others zones. The success of fish culture depends on its proper management, which is related with understanding the biology of fish and the aquatic environment in which they live. Some diseases have caused serious damage, not only the livelihood of fish farmers, but also to the future development of the industry. Continuous monitoring of these physicochemical parameters will give farmers first and information on strategies to employ in preventing and reducing fish diseases.

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