



Investigation of Water Quality and Fish Status of Karimganj Haor Area in Kishoreganj

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Abstract

The study was conducted to investigate the physicochemical parameters and anionic constituents in water of the haor area of Karimganj during the period from October to December 2016. The water samples were collected from 3 different sampling stations as St-1 (Bailabeel), St-2 (Ummabeel) and St-3 (Alkharabeel) for analyzing the temperature, electrical conductivity (EC), total dissolved solid (TDS), pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), alkalinity, hardness, fluoride (F⁻), chloride (Cl⁻), bromide (Br⁻), nitrite (NO₂⁻), nitrate (NO₃⁻), and sulphate (SO₄²⁻) in water. The study also assessed the fish status of the Karimganjhaor area. The result of the study showed that the mean temperature (26.2 °C) of water was within the standard limit. The mean EC and TDS contents were 555 μS/cm and 526 mg/l, respectively which was satisfactory level for aquatic organisms. The mean DO (6.7 mg/l) content was favorable but BOD (2.7 mg/l) content indicated some extent of organic waste pollution. The mean pH and alkalinity were 7.30 and 338 mg/l, respectively indicated alkaline condition in haor water, and whereas hardness was 122 mg/l revealed that the water was suitable for fish production. The mean concentration of F⁻, Cl⁻, Br⁻, NO₂⁻, NO₃⁻, and SO₄²⁻ were 0.35, 130.3, 0.16, 3.38, 34.84 and 85.60 mg/l, respectively depicted that the water were poorly improvised with these anionic constituents.

Keywords: Anionic, Beel, Karimganjhaor, Kishoreganj, Physicochemical, Water quality

Introduction

An aquatic ecosystem is the way in which living organisms interact within a body where groups of interacting organism dependent on one another and their water environment for nutrients and shelter (Uddin *et al.*, 2013). Life evolved in aquatic ecosystems such as has phytoplankton, zooplankton, aquatic plants, insects, fish, birds, mammals, and others been stable and better buffered against environmental change than terrestrial ecosystems (Paterson, 2016). Aquatic biodiversity has enormous economic and aesthetic value and is largely responsible for maintaining and supporting overall environmental health. Moreover, humans have long depended on aquatic resources for food, medicines, and materials as well as for recreational and commercial purposes such as fishing and tourism (Islam *et al.*, 2014). Bangladesh possesses enormous area of aquatic ecosystems in rivers and streams, freshwater lakes and marshes, haors, baors, beels, water storage reservoirs, fish ponds, flooded cultivated fields and estuarine systems with extensive mangrove swamps (Chakraborty, 2005). Over 1.4 million identified species live on earth, and experts estimate that as many as another 10 million to 100 million unidentified species may exist (Helfrich *et al.*, 2009). Fish supplements about 60% of our daily animal protein intake. More than 17 million people

including about 1.4 million people depend on fisheries sector for their livelihoods by fishing, farming, fish handling and processing (Meghlaet *al.*, 2013).

Pollution in aquatic environment is a growing problem worldwide and currently it has reached an alarming rate (Mahfuzaet *al.*, 2012). There are about 114160 hectares of beels, 192367 hectares of haors, and about 5488 hectares of baors in Bangladesh. Haor is a mosaic of aquatic habitats including rivers, streams and irrigation canals, large area of seasonally flooded cultivated plains and combination of hundreds of inter-connect beels (Chakraborty, 2005). But there are a number of threats to haor area, some of the most common threats are: pollution (pesticides, fertilizers/nutrients, metals, oil spills, solid waste and sewage disposal); Climate change (rise of temperature, drought, floods, cyclones, storms, sea-level rise); rivers regulation and water diversion (Bhattacharjee *et al.*, 2012); irrigation infrastructure including floods control dams/dykes; overexploitation of resources (fish, turtles, tortoise, water fowls, reeds, trees, aquatic plants); conversion and drainage of wetlands for agriculture, aquaculture, and commercial development; human settlement/habitation (Islam *et al.*, 2010); deforestation or destruction of forests; extraction of minerals and peat; introduced pest plants and animals (invasive plants and animals); algal

blooms/eutrophication (Rahman *et al.*, 2012); trans-boundary water regulations and pollution; dewatering of water bodies for fishing; and siltation due to removal of vegetation (Islam *et al.*, 2014).

During the last few decades, agricultural activities have been expanded in the wetland area of Kishoreganj district very rapidly which has affected the wetland ecosystems adversely both in qualitative and quantitative aspects (Uddin *et al.*, 2013). Siltation, over-exploitation of natural resources, improper use of agrochemicals and other natural and man-made interruptions are the causes for depletion of haor area (Yasmeen *et al.*, 2012), which result scarcity of food, fuel, fodder, degradation of habitat and poverty, therefore, the risks of pollution impact are rising upwards sequentially (Mokaddes *et al.*, 2013). According to Sabbir *et al.* (2010), water quality focuses on the various aspects of the physicochemical parameters and anionic constituents of water that detect the status of pollution and suitability of a particular water body for various aquatic organisms as well as fisheries. The water quality of a water body largely depends on the interactions of various physicochemical factors (Galib *et al.*, 2013); on the other hand, nutrient properties in aquatic ecosystems are usually monitored by measuring their anionic concentrations in water (Rahman *et al.*, 2013). Thus, the investigation of physicochemical parameters and anionic concentrations in water of the Kishoreganj haor area is essential since even slight changes in their concentration above the acceptable levels can result in serious environmental and subsequent impact on fisheries management. The study was carried out with the following objectives: (i) to investigate the physicochemical water quality and major anions in water, and (ii) to assess the fish status in the Karimganj haor area of Kishoreganj district.

Materials and Methods

Study area

The study area was located in the Karimganj haor area, Kishoreganj district which was approximately latitude 24°45'83"N and longitude 90°88'33"E. The area is a massive water world around the study area and only water all around, and few islands like villages amid of the water. The Kishoreganj District with an area of 2688.59 km² is bounded by Netrokona and Mymensingh districts on the north, Narsingdi district on the southwest and Brahmanbaria district on the southeast, Sunamganj and Habiganj districts on the east, Gazipur and Mymensingh districts on the west (Banglapedia, 2016).

Samples collection

The water samples were collected from 3 sampling stations denoted as St-1 (Bailabeel), St-2 (Ummabeel) and St-3 (Alkharabeel) of the haor area during the period from October 2016 to December 2016. To analyze the water quality, 500 ml water was collected by plastic bottles with double stoppers from each sampling points. Before sampling, the bottle were cleaned and washed with detergent solution and treated with 5% nitric acid (HNO₃) over night. The bottles were finally rinsed with deionized water and dried. At each sampling station, the sampling bottles were rinsed at least three times before sampling was done. Pre-prepared sampling bottles were immersed about 10 cm below the surface water. After sampling, the bottles were screwed carefully and marked with the respective identification number. The samples were acidified with 10% nitric acid (HNO₃), were placed in an ice bath and were brought to the laboratory. The samples were filtered through 0.45 μm micro-pore membrane filter and were kept at freeze to avoid further contamination until analysis. Primary data for fish status was collected from fisherman, wholesalers and retailers in the form of interview. Secondary data were collected from journals, books and Directorate of Fisheries (DoF), Kishoreganj.

Sample analysis

The physicochemical parameters of water samples were analyzed in the laboratory of the Department of Environmental Science and Resource Management, Mawlana Bhashani Science and Technology University, Tangail. The water temperature and pH were determined by the thermometer and digital pH meter (Model: pH Scan WP 1, 2 and made in Malaysia), respectively. Digital EC and TDS meter (Model: HM digital and made in Germany) was used to determine EC and TDS, respectively. The DO was determined by digital DO meter (Model: D.46974 and made in Taiwan). The BOD was measured by two steps where initial DO₁ was measured immediately after collection and after 5 days DO₅ was measured by incubation in the dark condition at 20°C for 5 days. Alkalinity was determined by titration method with 0.1 N HCl after addition 2-3 drops of methyl-orange indicator and hardness was also determined by titration method. For analysis of anionic properties in water the prepared sample was taken in a vial and analyzed for F⁻, Cl⁻, Br⁻, NO₂⁻, NO₃⁻, and SO₄²⁻ by Ion Chromatograph (HIC-10-A, Shimadzu, Japan) in the laboratory of the Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh, Bangladesh

Statistical analysis

The collected data were compiled and tabulated in proper form and were subjected to statistical analysis. The Microsoft Office Excel software was used to present and interpret the collected data. The results of the study were presented in charts and tabular forms.

Results and Discussions

Physicochemical water quality parameters

The highest temperature of the haor was 27.6°C at St-3 in October and the lowest was 24.4°C at St-2 in November, whereas the mean temperature of the study was 26.2°C. The standard limit of water temperature is 20.0 to 30.0°C (EQS, 1997) and the study showed that all the recorded temperature was within the standard limit. In the Ashulia beel, the water temperature was found 28.7 to 31.7°C during wet season and 22.4 to 25.6°C during dry season, respectively, which was found within the standard by EQS (1997) ranged indicated that almost suitable for fishes or aquatic habitat and breeding ground as well (Islam *et al.*, 2010) and this study is almost similar to the present study.

The highest EC of the haor was found 630 $\mu\text{S}/\text{cm}$ at St-2 in December and the lowest was 484 $\mu\text{S}/\text{cm}$ at St-1 in October with the mean EC was 555 $\mu\text{S}/\text{cm}$ and the

standard limit of EC in water is 700 $\mu\text{S}/\text{cm}$ (EQS, 1997) and the study showed that all the observed EC were within the standard limit. In wet season the ranges of EC was ranged from 130 to 310 $\mu\text{S}/\text{cm}$ and in dry season the ranges of EC was 341 to 442 in the Ashulia beel, might be due to the seasonal variations (Islam *et al.*, 2010) comparatively lower than the present study. EC ranged from 645 to 688 $\mu\text{S}/\text{cm}$ during the dry season and the mean EC was 663 $\mu\text{S}/\text{cm}$ in the Mokesh beel showed that all the observed values were within the standard limit (Barmon, 2016) and all these studies are relatively similar to the present study.

The highest TDS content of the haor was recorded 568 mg/l at St-2 in December and the lowest was 468 mg/l at St-3 in October. The mean TDS content of the study was 526 mg/l and the standard limit of TDS in water is 1000 mg/l (ADB, 1994) and the study showed that all the observed TDS contents were within the standard limit. In Ashulia beel, TDS ranged from 80 to 132 mg/l in wet season and 207 to 276 mg/l in dry season (Islam *et al.*, 2010). The highest TDS content of the Mokesh beel was observed 586 mg/l in February and the lowest was 541 mg/l in March which were within the standard limit (Barmon, 2016) and these studies are found almost similar to the present study.

Table 1. Physicochemical water quality parameters of the haor area.

Parameters	Sampling stations	Months			Mean	Standard
		October	November	December		
Temp. (°C)	St-1	27.5	26.8	24.5	26.2	20.0-30.0 (EQS, 1997)
	St-2	27.3	26.7	24.4	26.1	
	St-3	27.6	26.9	24.6	26.4	
EC (S/cm)	St-1	484	553	625	554	700 (EQS, 1997)
	St-2	487	557	630	558	
	St-3	488	556	615	553	
TDS (mg/l)	St-1	476	540	560	525	1000 (ADB, 1994)
	St-2	470	545	568	527	
	St-3	468	542	566	255	
DO (mg/l)	St-1	6.8	6.7	6.8	6.8	5.0 (EQS, 1997)
	St-2	6.7	6.4	6.5	6.5	
	St-3	6.8	6.6	6.7	6.7	
BOD (mg/l)	St-1	2.8	2.7	2.8	2.8	>2.0 (EQS, 1997)
	St-2	2.5	2.4	2.5	2.5	
	St-3	2.7	2.6	2.7	2.7	
pH	St-1	7.15	7.23	4.45	7.28	6.50-8.50 (ECR, 1997)
	St-2	7.23	7.34	7.40	7.32	
	St-3	7.18	7.35	7.42	7.32	
Alkalinity (mg/l)	St-1	315	335	366	338	>100 (Rahman, 1992)
	St-2	325	338	356	340	
	St-3	322	342	348	337	
Hardness (mg/l)	St-1	112	125	127	121	123 (Huq and Alam, 2005)
	St-2	115	128	126	123	
	St-3	122	124	125	122	

The highest DO content of the haor was found 6.8 mg/l at St-1 in October and December; and the lowest was 6.4 mg/l at St-2 in November, along with the mean DO content 6.7 mg/l. The standard limit of DO is 5.0 mg/l (EQS, 1997) and the study showed that most of the recorded DO contents were higher than the standard value depicted that the beel water quality was satisfactory level and it was suitable for fisheries and aquatic organisms. The DO contents of Chatla beel was ranged from 6.6 to 7.0 mg/l (Chowdhury *et al.*, 2010), while the highest DO content of the Mokesh beel was observed 5.5 mg/l and the lowest was 4.1 mg/l (Barmon, 2016) showed the satisfactory level of DO contents, which were almost similar to the present study. The range of investigated DO was 1.1 to 2.1 mg/l during the wet and 0.5 to 2.0 mg/l during the dry season in the Ashulia beel (Islam *et al.*, 2010) revealed that the DO content was much lower than the desired limit of 5.0 (EQS, 1997), reported that the beel water

quality was degraded and it was not suitable for fisheries and aquatic organisms, which was opposite to the present study, might be due to the presence of higher level of organic waste pollutant.

The highest BOD content of the haor was found 2.8 mg/l at St-1 in October and December; and the lowest was 2.4 mg/l at St-2 in November, along with the mean BOD content of the study was 2.7 mg/l. The standard limit of BOD is below 2.0 mg/l (EQS, 1997) and the study showed that most of the recorded BOD contents were slightly higher than the standard depicted that the beel water quality was not satisfactory level and it was not suitable for fisheries and aquatic organisms. The BOD contents were found to ranges from -4.42 to 1.6 mg/l in wet and 1.0 to 3.0 mg/l in dry season in the Ashulia beel revealed that the BOD concentrations within the desirable limit for fisheries activities (Islam *et al.*, 2010). The BOD contents of Chatla beel was ranged from 3.6 to 7.2 mg/l (Chowdhury *et al.*, 2010)

revealed that negative condition of the water body. Due to dumping of various waste into the water, the Pungli river water exceeded the standard limit of BOD content during post-monsoon season (Suravi *et al.*, 2013), which is almost similar to the present study.

The highest pH of the haor was recorded 7.45 at St-3 in December and the lowest was 7.15 at St-1 in February, with the mean pH level of the study area was 7.30. The standard limit of pH is 6.5 to 8.5 (Das, 1997) and the study showed that almost all of the recorded values were within the standard limit. The ranges of pH were investigated 7.1 to 7.8 during wet and 7.1 to 8.4 during dry season that confirmed the slightly alkaline nature of water of the beel (Islam *et al.*, 2010), while the pH of Chatla beel water was ranged from 6.5 to 6.9 (Chowdhury *et al.*, 2010). The pH both in wet and dry season of Ashulia beel was suitable for fisheries where Chatla beel water was slightly acidic. The highest pH of the Mokesh beel was 7.55 and the lowest was 7.25 revealed that water tends to be alkaline, this may be due to the alkali contain waste and effluent into the water and heavy rainfall (Barmon, 2016) and these studies are almost similar to the present study.

The highest alkalinity of the haor was recorded 366 mg/l at St-3 in December and the lowest was 315 at St-1 in February, with the mean alkalinity level of the study was 338 mg/l. The standard limit of alkalinity is >100 mg/l (Rahman, 1992) and the study showed that almost all of the recorded values were better for aquatic organisms. The ranges of alkalinity were 30 to 63 mg/l during wet and 90 to 115 mg/l during dry

season that confirmed the acidic nature of water of the beel (Islam *et al.*, 2010), while the alkalinity of Chatla beel water was ranged from 25 to 35 mg/l (Chowdhury *et al.*, 2010). The alkalinity both in wet and dry season of Ashulia beel and Chatla beel water was slightly acidic.

The highest hardness of the haor was recorded 128 mg/l at St-2 in November and the lowest was 112 at St-1 in October, with the mean hardness level of the study was 122 mg/l. The standard limit of hardness is 123 mg/l (Huq and Alam, 2005) and the study showed that almost all of the recorded values were better for aquatic organisms. The ranges of hardness were investigated 30 to 91 mg/l during wet and 115 to 127 mg/l during dry season (Islam *et al.*, 2010), while the hardness of Chatla beel water was 60 to 180 mg/l (Chowdhury *et al.*, 2010). The hardness both in wet and dry season of Ashulia beel and Chatla beel water was good for aquatic environment.

Anionic properties in water

The study showed that the highest concentration of fluoride of the haor was 0.47 mg/l at sampling St-2 in December and the lowest was 0.21 mg/l at St-1 in October. The standard of fluoride is 1.70 mg/l (EU, 1989) and all the recorded values were lower than the standard levels. The result revealed that the water of the haor was not impoverished with F containing substances. Quraishi *et al.* (2010) studied that, the concentration of F⁻ ranged from 0.20 to 0.30 mg/l in Gulshan lake, Bangladesh, which is almost similar to the present study.

Table 2. Anionic water properties (mg/l) of the haor area.

Anions	Sampling stations	Months			Mean	Standard
		October	November	December		
Fluoride (F ⁻)	St-1	0.21	0.35	0.43	0.33	1.70 (EU, 1989)
	St-2	0.24	0.39	0.47	0.37	
	St-3	0.28	0.34	0.46	0.36	
Chloride (Cl ₂)	St-1	110.2	125.6	145.7	124.5	250.0 (EU, 1989)
	St-2	120.5	128.8	154.6	134.5	
	St-3	114.5	130.4	148.2	132.0	
Bromide (Br ₂)	St-1	0.12	0.17	0.14	0.14	10.00 (EU, 1989)
	St-2	0.15	0.14	0.17	0.15	
	St-3	0.18	0.19	0.16	0.18	
Nitrite (NO ₂)	St-1	1.42	3.11	4.32	2.95	0.50 (EU, 1989)
	St-2	3.72	3.67	4.87	4.08	
	St-3	1.88	2.65	4.85	3.12	
Nitrate (NO ₃)	St-1	24.21	34.98	39.64	32.94	50.00 (EU, 1989)
	St-2	32.45	38.97	42.84	38.09	
	St-3	27.45	32.76	40.65	33.62	
Sulphate (SO ₄ ²⁻)	St-1	90.38	93.22	99.64	94.41	200.00 (EU, 1989)
	St-2	65.80	71.42	82.52	73.25	
	St-3	88.32	88.52	90.65	89.16	

The highest chloride concentration of the haor was 154.6 mg/l at station St-2 in December and the lowest was 110.2 mg/l at St-1 in October. The standard of chloride is 250.0 mg/l (EU, 1989) and all the recorded values were lower than the standard levels. The result revealed that the water of the haor was not impoverished with Cl⁻ containing substances. Ahmed *et al.* (2011) found that, Cl⁻ content in Buriganga river water during rainy, dry and summer seasons were 60.74, 69.18 and 59.4 mg/l, respectively and in Karnatoli river water Cl⁻ content was 17.18, 33.53 and 22.3 mg/l during rainy, dry and summer season, respectively. This result differs from the present study due to seasonal variation and excessive amount of rainfall.

The study found that the highest concentration of bromide of the haor was 0.19 mg/l at St-3 in November and the lowest was 0.12 mg/l at St-1 in October. The standard of bromide is 10.00 mg/l (EU, 1989) and all the recorded values were much lower than the standard levels. The result revealed that the water of the haor was not impoverished with Br⁻ containing substances as well as not satisfactory level for fish production. The highest concentration (0.25 mg/l) of bromide was observed in dry season as months of February and

March (Afrin *et al.*, 2015), which is relatively similar to the present study.

The highest nitrite concentration of the haor was 4.87 mg/l at St-3 in December and the lowest was 1.42 mg/l at St-1 in October. The standard of nitrite is 0.50 mg/l (EU, 1989) and all the recorded nitrite concentrations were much higher than the standard levels. The result revealed that the water of the haor was highly impoverished with NO₂⁻ containing substances. It might be due to the direct discharge of NO₂⁻ containing substances into the haor water. Nitrites are the intermediate products which occur in water distribution systems and natural waters. Alam *et al.* (2004) found that the concentration of nitrite at Demra in Shitalakhya river was 0.2 mg/l in rainy season and 0.3 mg/l in dry season, which was almost opposite to the present study.

The study recorded that the highest concentration of nitrate of the haor was 42.84 mg/l at St-2 in December and the lowest was 24.21 mg/l at St-1 in October. The standard of nitrate is 50.00 mg/l (EU, 1989) and all the recorded values were lower than the standard levels. The result revealed that the water of the haor was not impoverished with NO₃⁻ containing substances as well as not satisfactory level for fish production. The

concentration of NO₃⁻ was ranged from 1.2 to 3.2 mg/l in rainy season and from 11 to 13.5 mg/l in dry season at Demra in Shitalakhya river (Alam *et al.*, 2004).

The highest sulphate concentration of the haor was 99.64 mg/l at St-3 in December and the lowest was 71.42 mg/l at St-2 in November. The standard of sulphate is 200.00 mg/l (EU, 1989) and all the recorded nitrite concentrations were much lower than the standard levels. The result revealed that the water of the haor was not impoverished with sulphate containing substances. Alam *et al.* (2004) recorded that the SO₄²⁻ concentration was ranged from 130 to

151 mg/l in rainy season and from 13.5 to 15.3 mg/l in dry season at Demra in Shitalakhya river.

Status of fishes in the haor

A total of 30 fish species belonging to 15 families were recorded in the study area (Table 3). Among the families Cyprinidae was the largest family having 9 species followed by Schilbeidae and Bagridae were same 3 species, Clupeidae and Cobitidae were same 2 species and rest of the families was only one species. Among the families, contribution of Cyprinidae was 30%, followed by Schilbeidae and Bagridae 10%, Clupeidae and Cobitidae 6.67%, and rest of the each family was 3.33%.

Table 3. List of fishes recorded in haor area of Karimganj in Kishoreganj district.

Local name	Scientific name	Family
Batasi	<i>Pseudeutropiusatherinoides</i>	Schilbeidae
Bele	<i>Glossogobiusgiuris</i>	Gobitidae
Bujuritengra	<i>Mystustengara</i>	Bagridae
Chanda	<i>Chandanama</i>	Ambassidae
Chapchela	<i>Chela cachius</i>	Cyprinidae
Chapila	<i>Gudusiachapra</i>	Clupeidae
Cheng	<i>Channaorientalis</i>	Channidae
Cholapunti	<i>Puntiuschola</i>	Cyprinidae
Darkina	<i>Esomusdanricus</i>	Cyprinidae
Dhela	<i>Osteobramacotio</i>	Cyprinidae
Garuabacha	<i>Clupisomagarua</i>	Schilbeidae
Gulshatengra	<i>Mystuscavasius</i>	Bagridae
Gutum	<i>Lepidocephalusguntea</i>	Cobitidae
Jatpunti	<i>Puntiussofphore</i>	Cyprinidae
Kachki	<i>Coricasoborna</i>	Clupeidae
Kajoli	<i>Ailiacoila</i>	Schilbeidae
Kakila	<i>Xenentodoncancila</i>	Belonidae
Kanpona	<i>Aplocheiluspanchax</i>	Aplocheilidae
Kholisha	<i>Colisafsaciata</i>	Osphronemidae
Koi	<i>Anabas testudineus</i>	Anabantidae
Leuzzadarkina	<i>Rasborarasbora</i>	Cyprinidae
Madhupabda	<i>Ompokpabda</i>	Siluridae
Magur	<i>Clariusbatrachus</i>	Claridae
Mola	<i>Amblypharyngodonmola</i>	Cyprinidae
Rani	<i>Botiadarario</i>	Cobitidae
Sarpunti	<i>Puntiusarana</i>	Cyprinidae
Shing	<i>Heteropneustesfossilis</i>	Heteropneustidae
Taki	<i>Channapunctatus</i>	Channidae
Tengra	<i>Mystusvittatus</i>	Bagridae
Titpunti	<i>Puntiusticto</i>	Cyprinidae

Conclusion

From the overall discussions, it can be concluded that the physicochemical parameters and anionic properties of haor water mostly within the standard level that was suitable for aquatic environment as well as for fish production. A total of 30 fish species belonging to 15

families were recorded in the study area. But there were several human made problem exist that may affect the water quality in future. For these reasons the study recommended to conserve the quality of the haor water and its environment by regular monitoring of haor water quality with the standards of DoE, keep

records about fish species and their status, illegal dredging must be stopped, building awareness among the local people to conserve the haor with local participation.

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