JEE Journal of Ecological Engineering

Journal of Ecological Engineering 2022, 23(9), 231–240
https://doi.org/10.12911/22998993/151906
ISSN 2299–8993, License CC-BY 4.0

Received: 2022.06.22
Accepted: 2022.07.11
Published: 2022.08.01

Determining the Physico-Chemical and Microbiological Parameters of the Water Quality in the Batllava Lake, Kosovo

Albana Kashtanjeva[1], Idriz Vehapi[1*], Kemajl Kurteshi[1], Musaj Paçarizi[2]

[1] Department of Biology, Faculty of Mathematical and Natural Sciences, University of Prishtina, St. Mother Teresa, 10 000 Pristina, Republic of Kosovo

[2] Department of Chemistry, Faculty of Mathematical and Natural Sciences, University of Prishtina, St. Mother Teresa, 10 000 Pristina, Kosovo

* Corresponding author's email: idriz.vehapi@uni-pr.edu

ABSTRACT

The purpose of this study was to determine the quality of water in lake Batllava, through which, a part of the population of the Pristina region is supplied with drinkable water. Lake Batlava is a lake built in the 1970s. This lake is located in the village of Batlava in the municipality of Podujeva. The supply of this lake with water is made from the Brvenica river. Monitoring was finished during the period from December 2020 to May 2021. The sample were taken in three championic places: at the entrance of the lake, in the middle and in the spill, on two levels, in the surface and at depth of 30 cm. The analyzed microbiological parameters are: total coliforms, fecal coliforms, fecal streptococci and aerobic mesophilic bacteria. The physical-chemical parameters are: dissolved oxygen, saturation with O_2, water temperature, pH value, electrical conductivity, total soluble matter, total suspended matter, turbidity, chemical demand for oxygen, biochemical demand for oxygen, total organic carbon, nitrate, total solidity of calcium, magnesium, ammonia ion, chloride, sulphates, fluurite, M-alkalines, bicarbonates and heavy metals, such as: Fe, Pb, Mn, Cu, Cd. The results showed that most physical-chemical and microbiological parameters are within the limit allowed by the WHO and EPA, except in some cases where during the precipitation season there have been several overruns and for this reason, it is recommended to take monthly monitoring of the water of Lake Batllava to achieve a real assessment.

Keywords: Batlava Lake, monitoring, physic-chemical, microbiological, heavy metals.

INTRODUCTION

The increase of population numbers, increase of rapid globalisation, progressive urbanisation, industrial development and increase of intensive agriculture, have affected the surface water pollution [Ling et al. 2017]. The use of various fertilisers to increase the productivity of lands where by precipitation and later rinse arrives in waterways, rivers and lakes increase the risk of eutrophication, causing biodiversity loss. Surface waters can also be polluted by the erosion of rocks, mines, etc. [Bhateria and Jain, 2016]. About two billion people in different places of the world have not found the right way to ensure the water quality for drinking [Shamsuzzoha et al. 2018]. Therefore, water quality monitoring has become a key issue in assessing the state of lake waters in recent years to preserve and establish lake management even in the future [Seifert-Dähnn et al. 2021]. The functioning and balance of a water environment depends on its physical-chemical and microbiological quality, which changes over time due to human activities and/or climatic conditions [Gupta et al. 2017]. Monitoring and controlling nutrients and heavy metals in water resources is an important problem for both ecosystems and public health. The assessment of physical-chemical and microbiological parameters of rivers and lakes waters has been the object of the study of many foreign scientists such as [Dobrzyński et al. 2022; Sulltana et al. 2021; Siddiqua et al. 2021; Loucif et al. 2020; Haque et al. 2019; Lashari et al. 2022; Al-afify et al. 2018; Ma et al. 2021].

MATERIAL AND METHODS

Research area

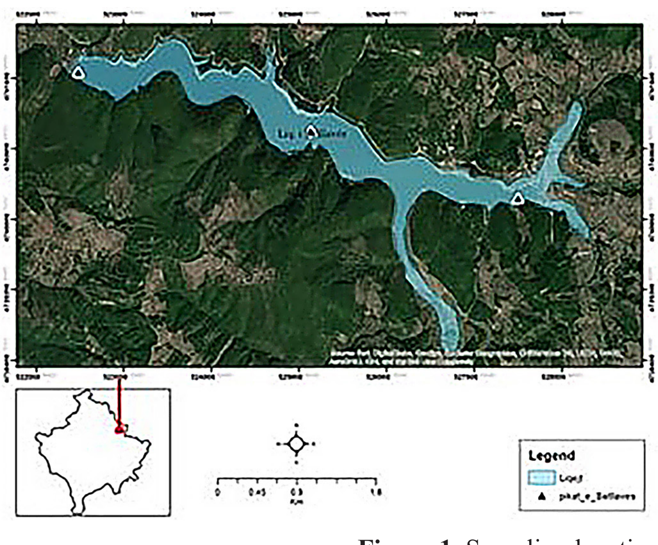
Lake Batllava is known as an artificial reservoir supplied by four subbastions, from which three small rivers flow: Turiqic, Krushevic and Ballaban [Avdullahu et al. 2012]. The lake is located in the northeastern part of Kosovo, 34.3 km^2 away from the capital Pristina, in coordinates: 42° 49′ 16” in the north and 21° 18′ 28” to the east [Sahiti et al. 2018].Batllava Lake is estimated to contain about 34.4 × 106 m^3 of water, with an annual rainfall average of about 20 × 106 m^3. This lake has a maximum length of 6 km^2, maximum width 700 m, area 3.07 km^2, average depth 48 m and surface height 640 m [Gashi et al. 2017].

Physical-chemical water analyses

Between December 2020 and May 2021, the monthly championing from lake Batllava was conducted at three stations or championing places, at two surface levels and 30 cm depth (Fig. 1) with a total of 66 samples based on the standard for lake monitoring ISO 5667-4:1987. The water samples were analyzed within 24 hours of taking the champion, while the parameters that are directly measured in the locality are: water temperature (WT), pH, dissolved oxygen (DO) and electrical conductivity (EC). The physical-chemical characteristics were taken by placing the samples in clean and high density polyethylene bottles. Before each take, the bottles have been washed 2–5 times with champion water after being washed with diluted chlorine acid. Physical-chemical parameters were analysed based on the ISO 5667-6 standard in the laboratory of the Kosovo Hydro-Meteorological Institute. Dissolved oxygen (DO) and oxygen saturation (OS) are measured with the HI 9146 device based on ISO5814:2012, water temperature (WT) is measured by the HI 98130 device based on the DIN 38404-C4 method, the potential of hydrogen ions (pH) is measured with the HI 98130 device based on the DIN 38404-C5 standard, Electrical Conductivity (EC) with the device (WTW 315i) based on the DIN EN 27888 (C8) standard method, Total Dissolved Solids (TDS) with WW 315i device based on the DIN EN 27888 (C8) (11/1993) standard methods, Total Suspension Solids (TSS) with the AADAMLAB 250 device based on the EN 872 standard method, turbidity (NTU) with AQUALITIC / PC COMPACT device based on ISO 7027; (11/1993), Biochemical Oxygen Demand (BOD) with Winkler device based on ISO 5815, Chemical Oxygen Demand (COD) with chrome device based on ISO 15705, Total Organic Carbon (TOC) with UVSECOMAM device based on the DIN EN 1484 (H3) Standard, Nitrates, Nitrites, Phosphates, Total Phosphorus as well as ammonium ions are measured with the SECOMAM device based on standard methods. In turn, heavy metals, such as Fe, Pb, Mn, Cu and Cd, were defined at the Agricultural Institute of Peja with the 4200 MP-AES device [Berg. 2015].

Microbiological analyses

Microbiological studies have been finished using the standardized procedure [APHA,



Locality:	Coordinates
L/1S L/ID	42° 48’51” N 21° 20’ 11” E 637 m
L/2S L/2D	42° 49’16” N 21° 18’ 27” E 637 m
L/3S L3/D	42° 49’38” N 21° 16’ 30” E 637 m

Figure 1. Sampling locations at Batllava Lake

2005]. The number of coliform bacteria (E.coli) is with the membrane filtration method according to ISO 9308-1: 2014 [ISO. 2014] with a volume of 100 ml water samples. Membrane filters were incubated in Medium Chromatic Coliform Agar at 36 ± 2 °C for 24 hours. After the isolation of colonies in the filter, blue colonies closed in violet that are E.coli has been counted, while suspicious colonies in red were confirmed by oxidase test [Zhang et al. 2016]. Reporting was done as CFU/100 mL. The isolation of fecal streptoheads is made using the membrane filter method in Slanetz and Bartley Agar, as CFU/100 mL. The colonies developed were then then are carried on plates of agar bile aesculin azide preheated in 44 °C for incubation of 2 hours. The parts stained in black and confirmed by the catalysis test were confirmed as fecal streptocoke [Zhang et al. 2016]. To estimate the number of mesophilic aerobic bacteria, a champion 1 ml and 0.1 ml were planted on coated plates in Agar peak extract (Plate Count Agar) that was dissolved in a 44 °C water bath, then the plates were incubated at 36 ± 2 °C for 44 hours. Reporting was done as CFU for sample 1 ml [ISO. 2014].

Statistical analysis

Principal component analyses (PCA) is one of the most used methods of data analysis with many variations that allows multidimensional data sets with quantitative variables to be analyzed [Prieto et al. 2020]. Correlations between components and initial variables are used and displayed in the form of vectors using XLSTAT statistical software. Moreover, observation gifs are presented in the PCA space. The correlation between physical-chemical and bacteriological parameters is analysed with Correlation matrix (Pearson (n).

RESULTS AND DISCUSSIONS

The results of this research show that the value of OT ranges from 8.9 mg/L to 12.1 mg/L (Table 1), while oxygen intake fluctuates from 73 mg/L to 85 mg/L. Depending on the month of sampling the change in T values was observed too, from 2.06 °C in December, January to 17.70 °C in April and May. As for the pH values, they range from 7.78 to 10.30 mg/L. The highest EC values in this research were recorded in May (308 μS/cm), while those lower (22 μS/cm) in March and April. According to Zhang et al. 2016 [Zhang et al. 2019], the increase in the EC values can occur as a result of rising saltvalues and water evaporation during high temperatures. The values of TDS and TSS in this research fluctuate from 112 mg/L to 154 mg/L for TDS and 4.8 mg/L to 50 mg/L for TSS. The increase in TDS mainly occurred in December, January and continued in February. According to Kükrer and Mutlu, 2019 this increase in TDS leads to the increase of phytoplankton in water [Kükrer and Mutlu. 2019]. The NTU values range from 1.09 to 51.7 mg/L. The values for COD and BOD were recorded in January and February but continued in March with values of 3.1 mg/L to 21 mg/L for COD and from 1.1 mg/L to 9.5 mg/L per BOD. This increase occurred in the first locality as a result of heavy rainfalls in these months and river flows. High levels of COD and BOD are linked to anthropogenic activities, such as household waste and fishing activities [Sallam et al. 2018]. The lowest value for TOC that has been recorded is 0.8 mg/L while the highest 6.0 mg/L. Pollution of water with nitrites and nitrates poses one of the most dangerous threats to public health [Sipahi et al. 2016]. As for the distribution of NO_3^- and NO_2^- during this research values 0.56 mg/L for NO_3^- and 0.10 mg/L for NO_2^- were recorded which were within border values by WHO and EPA. TH during this monitoring ranged from 5.54 mg/L to 16.8 mg/L for the month of April. For HCa the average value recorded per month is 4.80 mg/L, value that on the basis of WHO water is classified as soft.

Cadmium concentration (Cd) changed just in March with <0.002 mg/L, while other values were the same as <0.001 mg/L. Even in the evaluation of Malsiu et al. 2020 [Malsiu et al. 2020], Cd concentration was <0.001 mg/L, the values within the range set by Directive 98/83/EC and WHO standards. Iron concentration (Fe) reached the highest value in January by 0.060 mg/L, while in the study of Gashi et al.2017 [Gashi et al. 2017] the average concentration was 0.23 mg/L. Lead level increased only in March, in 3/H locality by 0.02 mg/L, the same as Gashi et al. 2017, while in other months the average concentration was <0.01 mg/L, within the border values by WHO and Directive 98/83/EC, the same as preliminary research by Malsiu et al. 2020 (Table 3). The average concentration of manganese (Mn) was 0.018 mg/L, this value

Table 1. Descriptive statistics (mean ± SD and range (min - max) of physicochemical parameters of water in Batllava Lake

Physicochemical parameters	Symbol	Locality					
		Mean ± SD [min–max]					
		Locality/1 S	Locality/ 1D	Locality 2/S	Locality2/D	Locality3/S	Locality 3/D
Dissolved Oxygen	DO	11.036±1.259	10.67±0.894	10.74±0.96	10.40±1.17	10.01±1.30	10.01±1.30
		[8.9–12.7]	[9–11.40]	[9.2–11.7]	[8.8–12]	[8–11.30]	[8–11.3]
Saturation with O_2	Sol O_2	99.294±15.187	97.13± 17.012	98.60±20.15	96.60± 20.12	89.43±11.28	89.37±17.40
		[85–126]	[80–130.00]	[73–134]	[81–136]	[77–110]	[76–124]
Water temperature	T	8.578±5.821	8.22±5.615	8.67±5.90	8.40±5.52	8.67–5.90	8.63±6.07
		[2.06–17.4]	[3.1–17.70]	[3.6–17.4]	[4.2–17.5]	[3.2–18.8]	[3.8–18.7]
Value of pH	pH	8.380±0.30	7.63±2.530	8.47±0.73	8.37±0.54	8.35±0.31	8.18±0.31
		[7.93–8.81]	[2.78–10.30]	[8.0–9.9]	[7.85–9.3]	[7.57–9.07]	[7.78–8.61]
Electric conductivity	EC	289.73± 10.514	284.16±21.531	277.98±23.37	268.22± 28.41	282.85±45.13	287.17±56.34
		[275.48–307.09]	[254.14–307.09]	[245.41– 302.81]	[233.77–303.88]	[226.01–342.16]	[224.07–378.0]
Total dissolved solids	TDS	144.55± 5.365	140.75 ±9.901	137.57±10.94	131.36±16.86	133.76±17.82	134.75±17.29
		[137.74–153.545]	[127.07–153.55]	[122.705–151.405]	[112–151.94]	[113.03–155.15]	[112.03– 154.08]
Total suspended solids	TSS	24.531±15.961	21.43± 13.682	20.95±11.30	20.44±10.73	20.64±8.94	19.74±.8.34
		[5.3–50]	[8.1–46.00]	[4.8–38.5]	[5.3–37.2]	[9.9–35.5]	[8.10–33]
Turbidity	NTU	19.00± 15.130	17.62± 16.179	17.48±16.59	17.04±18.44	13.83±12.25	13.63±13.74
		[3.29–41.4]	[3.94–45.90]	[1.19–49]	[1.09–51.7]	[1.0–34.3]	[0.61–38.90]
Chemical oxygen demand	COD	11.438±5.755	11.45 ±4.924	9.68±5.28	9.48±5.94	10.45±6.0	10.45±6.50
		[3.3–21]	[3.8–17.50]	[3.1–14.9[	[3–16.4]	[2.8–16.8]	[2.00–17.20]
Biochemical oxygen demand	BOD	5.224±2.664	5.16± 2.295	4.35±2.57	4.27±2.86	4.24±2.8	4.69±3.13
		[1.4–9.545]	[1.6–7.95]	[1.1–6.77[	[1.1–7.7]	(1.1–7.63)	[0.70–7.82]
Total organic carbon	TOC	3.345±1.674	3.34± 1.422	2.85±1.66	2.83±1.89	2.80±1.89	3.09±2.04
		[0.9–6.0]	[1.1–5.00]	[0.8–4.7]	[0.8–5.4]	[0.8–5.2]	[0.50–5.40]
Nitrate	NO_3^-	0.548±0.265	0.67± 0.369	0.56±0.19	0.60±0.31	0.65±0.24	0.79±0.33
		[0.26–0.88]	[0.398–1.15]	[0.175–0.662]	(0–0.87)	[0.19–0.82]	[0.21–1.6]
Total hardness	TH	7.749±1.675	7.48± 1.912	7.59±1.89	7.5±61.74	7.48±1.80	7.49±1.77
		[5.76–10.47]	[5.544–11.14]	[5.768–11.2]	[5.887–10.92]	[5.48–10.81]	[5.82–10.86]
Hardness of calcium	FCa	5.093±1.504	4.48± 0.942	4.46±0.85	4.40±0.80	4.52±1.07	4.80±1.39
		[3.58–7.84]	[3.30–6.16]	[3.86–6.14]	[3.64–5.94]	[3.58–6.61]	[3.70–7.28]
Calcium	Ca^{2+}	36.430±10.780	32.08± 6.760	32.24±6.95	31.45±5.76	32.34±7.71	34.31±9.96
		[25.62–56.13]	[23.62–44.11]	[27.62–46.11]	[26.026–42.55]	[25.63–47.31]	[26.42–52.05]
Magnesium	Mg^{2+}	12.258± 3.396	12.98 4.585	13.36±4.24	13.71±4.38	12.82±4.03	11.70±7.80
		[8.50–18.22]	[9.7216–21.61]	[8.02–20.66]	[9.75–21.61]	[8.26–18.23]	[0–22.83]
Amonium ion	NH_4^+	0.060± 0.031	0.05±0.023	0.03±0.03	0.05±0.02	0.05±0.02	0.05±0.02
		[0.016–0.097]	[0.023–0.097]	[0.011–0.094]	[0.016–0.079]	[0.02–0.074]	[0.02–0.07]
Phosphates	PO_4^{3-}	0.036± 0.018	0.02±0.004	0.03±0.02	0.04±0.05	0.04±0.027	0.02±0.00
		[0.025–0.07]	[0.015–0.03]	[0.025–0.072]	[0.025–0.14]	[0.025–0.09]	[0.02–0.03]
Chloride	Cl^-	6.858± 1.853	6.00± 1.271	6.86±1.07	6.31±0.81	6.55±.0.75	6.25±1.30
		[4.71–8.77]	[4.562–7.50]	[5.51–7.918]	[5.167–7.22]	[5.78–7.44]	[4.39–7.67]
Sulfate	SO_4^{2-}	20.304± 1.352	20.49± 0.917	20.43±1.65	20.39±1.47	20.52±1.67	20.46±1.49
		[18.71–22]	[19.488–22.00]	[18.8–23.5]	[18.5–23]	[18.9–27.3]	[18.5–23.1]
Nitritet	NO_2^-	0.10±0	0.10±0	0.08±0	0.08± 0	0.07±0.0	<0.007±0
		[0.1–0.1]	[0.1–0.10]	[0.08–0.08]	[0.08–0.08]	[0.07–0.07]	[<0.007–<0.007]
Fluorine	F^-	0.145±0.039	0.16±0.053	0.18±0.07	0.15±0.04	0.14±0.06	0.15±0.05
		[0.07–0.18]	[0.063–0.22]	[0.102–0.30]	[0.096–0.226]	[0.09–0.26]	[0.9–0.23]
M-Alkalinity	MA	2.750±0.783	2.51±0.576	2.51±0.56	2.48±0.55	2.39±0.54	2.47±0.55
		[2.06–4.41]	[1.92–3.34]	[2–3.34]	[1.88–3.26]	[1.84–3.4]	[1.96–3.38]
Bikarbonates	HCO_3^-	167.75±47.751	153.31 ±35.119	152.91±34.19	156.41±28.85	145.65± 33.38	150.58±33.46
		[125.7–245.3]	[117.1–203.74]	[122–203.74]	[125.7–198.86]	[112–207.4]	[119–206.18]

Table 2. The spatial-temporal extenson (average ± standard deviation) of microbiological parameters for Lake Batllava

Microbiological parameters		Locality Mean ± SD [min–max]					
		Locality/ 1S	Locality/ 1D	Locality 2/S	Locality 2/D	Locality 3/S	Locality 3/D
Total coliform	CFU/100ml	37 ± 35.716	23.00 ± 30.41	9.17 ± 19.08	5.33 ± 6.15	13.33 ± 21.93	33.5 ± 26.80
		[0–87]	[0–81]	[0–48]	[0–14]	[0–57]	[0–67]
Fecal coliform	CFU/100ml	152.33 ± 137.63	178.17 ± 174.44	143.50 ± 128.13	129.17 ± 139.90	134.33 ± 139.38	128.17 ± 156.98
		[29–378]	[21–434]	[17–304]	[5–325]	[7–315]	[7–401]
Fecal streptococci	CFU/100ml	60.67 ± 98.768	91.67 168.33	33.50 ± 56.63	23.67 ± 55.05	31.00 ± 51.08	70.50 ± 167.32
		[0–252]	[0–428]	[0–138]	[0–136]	[0–126]	[0–412]
Aerobic mesophilic	CFU/100ml	55.33 ± 27.595	59.17 ± 35.47	52.33 ± 37.96	49.83 ± 52.14	58.83 ± 45.96	66 ± 163
		[4–83]	[9–96]	[15–116]	[4–145]	[9–140]	[6.33–163]

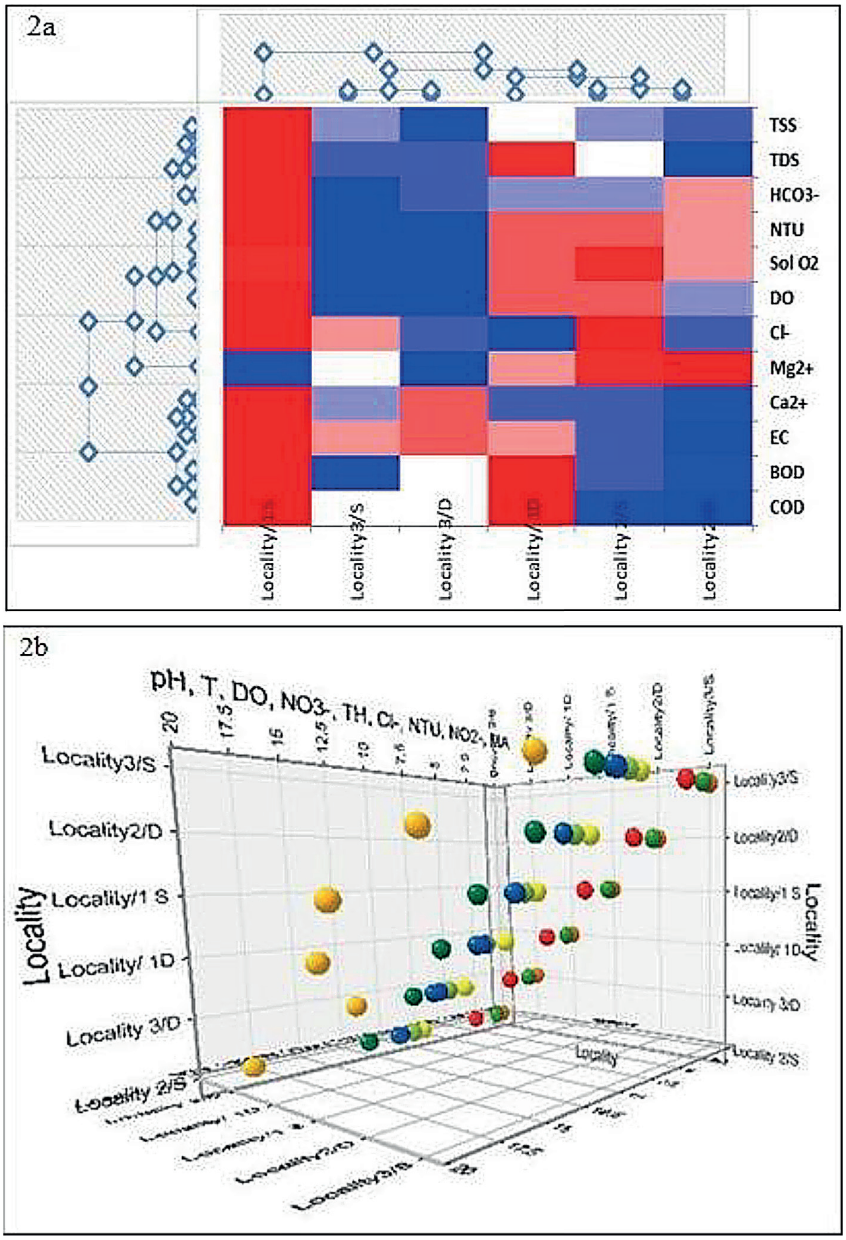


Figure 2. Heat map and distribution of physico-chemical parameters in localities; a) 12 different parameters were selected. Blue highlight corresponds to a small expression value up to red which represents the highest level of expression; b) distribution of some physico-chemical parameters (pH, T, DO, NO_3^-, TH, Cl-, NO_2 and MA) in localities

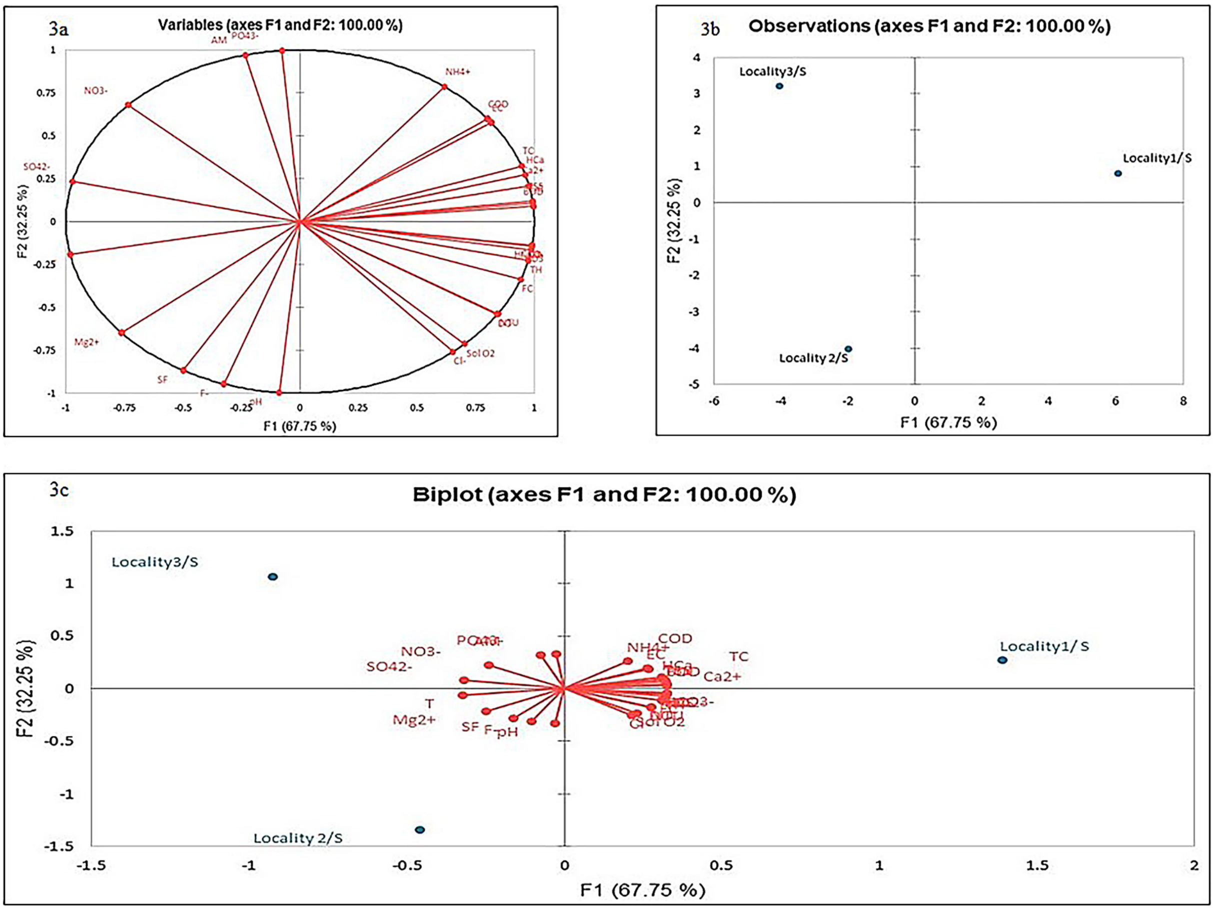


Figure 3. Principal component analyses (PCA) of the average of physical-chemical and bacteriological parameters fot the months analysed taken at three water surface championing points (L1/S- L3/S); a) The correlation between F1 and F2 variables between physical-chemical and bacteriological parameters; b) Distribution of the samples taken in three localities by the PCA; c) Biplot correlation that presents the distribution of localities in relation to the factors analysed in the F1×F2 plain

was smaller than the preliminary research by Gashi et al. 2017 [Gashi et al. 2017] and Malsiu et al. 2020 [Malsiu et al. 2020]. The average concentration of Cr during the research was <0.001, the same value as preliminary research and within the limit allowed by the WHO and Directive 98/83 EC. The spatial-temporal extenson of microbiological parameters is presented in Table 2. The maximum number of TC 0.87 CFU/100 ml is recorded in L/1S in January, followed also in L/1D with 81 CFU/100 ml. The increase of the number of E. coli bacteria shows fecal contamination and is considered to be a risk to human health [Djuikom et al. 2006]. The highest numbered FC (E.coli) are registered in May, in L1/D with 434 CFU/100 mL, followed by 357 CFU/100 mL in January, while the smallest value is registered in March L2/D with 5 CFU/100 mL. SF are very important in raw water tests as they are used as an indicator of the presence of fecal pathogens that survives longer than E. Coli, within drinking water and are more resistant to drying and chlorination [WHO, 2011]. The maximum SF number is reached the month of January and February, in L1/D with 428 CFU/100 mL. AM reached the maximum number in January, at L3/D with 163 CFU/100 mL, while the minimum in L/1S in the April with 4 CFU/100 mL.

The PCA presents a useful tool to obtain data for many variables and for focus there are only a few components (Imtara et al. 2018). The results obtained from the principal component analyses (PCA) for the 23 physical-chemical and 4 bacteriological parameters of 3 localities (surface and depth) for the months of sampling are presented in Figure 2, 3, 4, 5 and Table 4. The results obtained from the water surface analysis shows that we have a biplot correlation between variables in the F1 axis with (67.75%) and F2 (32.25%). The correlation between variables as well F1 dh F2 factors presented in Figure 3 shows a positive correlation between most variables with the F1 axis except Mg^{2+}, T, pH, NO_3, PO_4^{3-} and fecal Streptokokes. In turn, most variables present a negative correlation with the F2 axis except mesophilic aerobics, NH_4, BOD, TOC and F^-. Regarding water depth analyses for three champions as seen in Figure 4, there is a high negative correlation between most variables with the F1 and F2 axis, except T, pH. TH, Cl, HCa and PO_4^{3-}. As for the metals analyzed by the PCA (Fig. 5) indicates a biplot correlation between variables in the F1 axis with (66.29%) and F2 (21.82%), in total 88.10%.

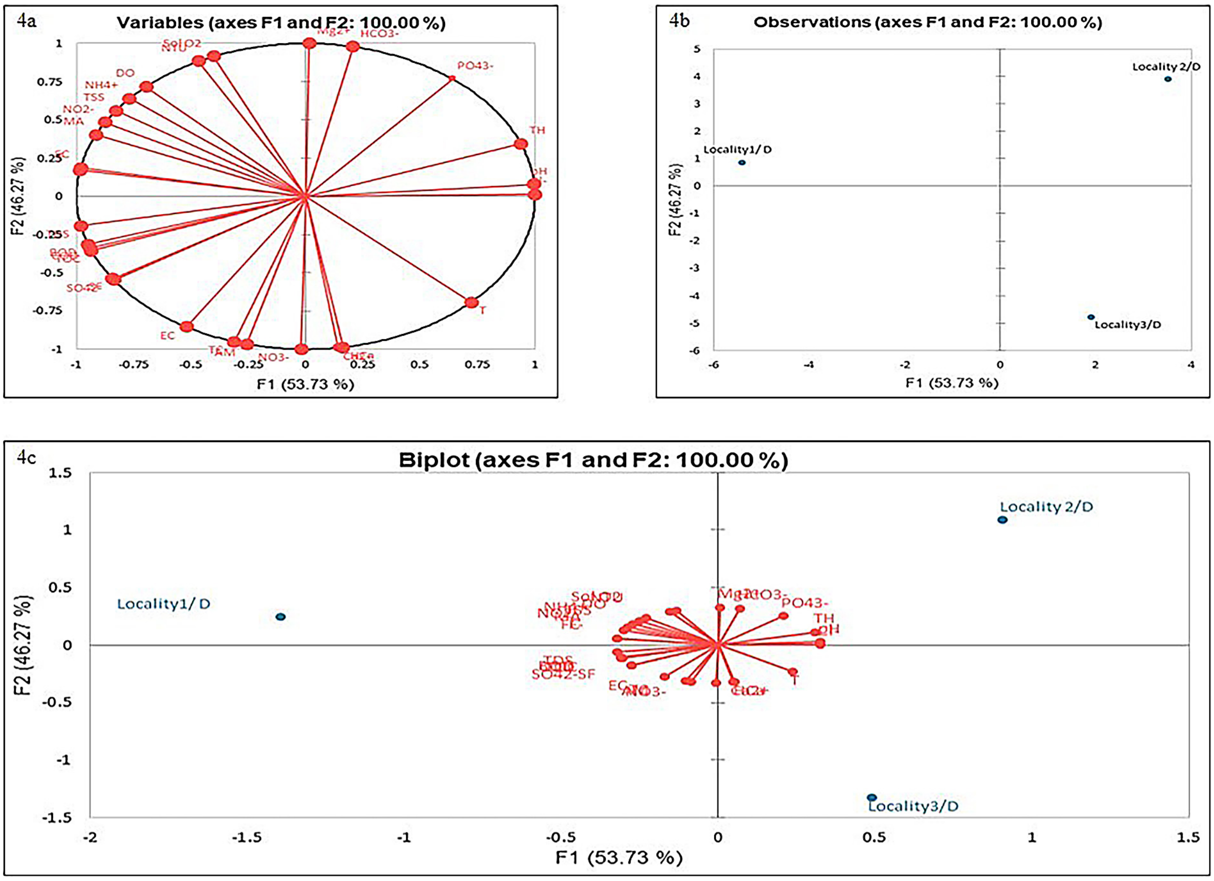


Figure 4. Principal component analyses (PCA) of the average of physical-chemical and bacteriological parameters for the months analysed, taken at three water depth championing points (L1/D- L3/D); a) The correlation between F1 and F2 variables of physical-chemical and bacteriological parameters; b) Distribution of the samples taken in three localities by the PCA; c) Biplot correlation that precedes the distribution of localities in relation to the factors analysed in the F1xF2 plain

Table 3. Distribution of heavy metals (current study) and preliminary studies

Month	Cd	Fe	Pb	Mn	Cr	Cu
December	<0.001	0.015	< 0.01	0.019	<0.001	/
January	<0.001	0.060	0.002	< 0.01	<0.001	/
February	<0.001	0.052	<0.01	0.018	<0.001	/
March	<0.002	0.010	<0.02	0.021	<0.001	/
Aprill	<0.001	0.046	<0.01	0.015	<0.001	/
May	<0.001	0.050	<0.01	<0.01	-0.001	/
Average	<0.001	0.038	<0.01	0.018	<0.001	
Gashi et al. 2017	/	0.23	0.02	0.024	0.0016	0.0077
Malsiu et al. 2020	< 0.001	0.264	< 0.01	0.036	< 0.001	0.006
EEC[a] 98/83	0.005	0.2	0.01	0.05	0.05	2

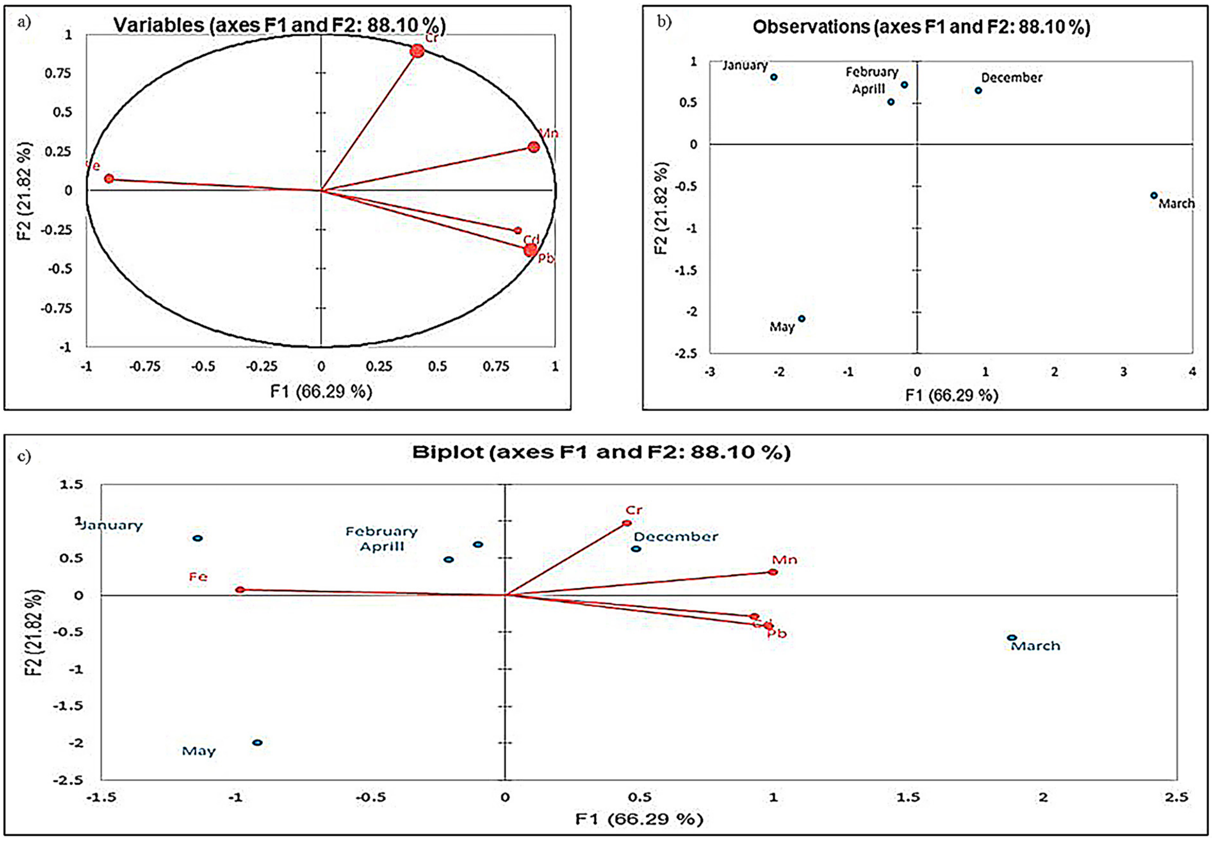


Figure 5. Principal component analyses (PCA) of the average for the months analyzed of heavy metals presented by biplot corelation through F1 and F2 variables; a) Correlation of k and F2 variables for heavy metals; b) Distribution of heavy metals taken in three localities; c) Biplot Corelation, which presents the distribution of localities in relation to the factors analysed in the F1xF2 plain

Table 4. Pierson's koreanation matrix (n) between physical-chemical and bacteriological parameters

Variables	DO	Sol O2	T	pH	EC	TDS	TSS	NTU	COD	BOD	TOC	NO3-	TH	HCa	Ca2+	Mg2+	NH4+	PO43-	Cl-	SO42-	NO2-	F-	MA	HCO3-	TC	FC	SF	AM
DO	**1**																											
Sol O2	**0.95**	**1**																										
T	-0.261	-0.368	**1**																									
pH	-0.019	0.01	0.787	**1**																								
EC	0.121	-0.187	0.223	-0.268	**1**																							
TDS	0.801	0.585	-0.15	-0.272	0.68	**1**																						
TSS	**0.813**	0.633	-0.046	0.077	0.46	**0.858**	**1**																					
NTU	**0.97**	**0.984**	-0.413	-0.048	-0.08	0.668	0.738	**1**																				
COD	0.356	0.108	-0.321	-0.598	**0.816**	0.795	0.629	0.254	**1**																			
BOD	0.586	0.391	-0.437	-0.576	0.689	**0.871**	0.682	0.509	**0.898**	**1**																		
TOC	0.537	0.347	-0.461	-0.613	0.686	**0.834**	0.631	0.465	**0.894**	**0.997**	**1**																	
NO3-	-0.746	-0.787	-0.041	-0.456	0.291	-0.35	-0.627	-0.77	0.108	0.019	0.085	**1**																
TH	0.78	0.623	0.284	0.419	0.374	0.733	**0.892**	0.673	0.324	0.47	0.415	-0.657	**1**															
HCa	0.314	0.057	0.314	0.156	0.763	0.629	0.682	0.171	0.591	0.635	0.621	0	0.731	**1**														
Ca2+	0.348	0.09	0.344	0.18	0.766	0.653	0.693	0.195	0.576	0.63	0.612	-0.033	0.761	**0.998**	**1**													
Mg2+	0.206	0.462	-0.345	0.115	**-0.86**	-0.33	-0.163	0.372	-0.55	-0.482	-0.504	-0.583	-0.2	-0.786	-0.774	**1**												
NH4+	0.017	-0.128	-0.262	-0.217	0.408	0.273	0.473	0.044	0.625	0.538	0.55	0.147	0.223	0.606	0.552	-0.46	**1**											
PO43-	0.034	0.099	0.297	0.699	-0.43	-0.26	0.238	0.114	-0.36	-0.483	-0.525	-0.635	0.263	-0.064	-0.072	0.449	0.154	**1**										
Cl-	0.425	0.333	0.726	0.805	0.116	0.298	0.507	0.303	-0.16	-0.148	-0.211	-0.688	0.761	0.374	0.421	0.017	-0.229	0.522	**1**									
SO42-	-0.695	-0.659	-0.054	-0.428	-0.02	-0.46	-0.721	-0.699	-0.08	-0.361	-0.326	0.591	**-0.85**	-0.605	-0.615	0.04	-0.325	-0.326	-0.52	**1**								
NO2-	**0.86**	0.778	-0.613	-0.46	0.273	**0.837**	0.779	**0.861**	0.681	**0.83**	0.803	-0.453	0.537	0.314	0.319	0.069	0.347	-0.158	-0.011	-0.49	**1**							
F-	0.284	0.415	-0.054	-0.065	-0.31	0.025	-0.274	0.264	-0.38	-0.168	-0.178	-0.179	-0.09	-0.497	-0.442	0.431	**-0.901**	-0.401	0.088	0.157	0.032	**1**						
MA	**0.836**	0.684	-0.048	0.103	0.421	**0.828**	**0.92**	0.765	0.519	0.724	0.686	-0.513	**0.925**	0.764	0.778	-0.26	0.415	0.051	0.459	**-0.87**	0.75	-0.149	**1**					
HCO3-	**0.815**	0.735	-0.163	0.15	0.181	0.67	**0.854**	0.81	0.363	0.616	0.583	-0.566	**0.859**	0.646	0.652	-0.09	0.447	0.179	0.381	**-0.95**	0.728	-0.183	**0.959**	**1**				
TC	0.19	-0.075	0.059	-0.266	**0.888**	0.65	0.5	0.045	0.773	0.801	0.811	0.332	0.448	**0.893**	**0.882**	**-0.9**	0.604	-0.458	-0.009	-0.31	0.366	-0.409	0.599	0.446	**1**			
FC	0.614	0.529	-0.655	-0.745	0.349	0.738	0.472	0.585	0.719	0.74	0.726	-0.186	0.159	0.024	0.033	0.073	0.103	-0.432	-0.241	0.033	**0.848**	0.234	0.366	0.269	0.256	**1**		
SF	-0.104	-0.17	-0.535	**-0.913**	0.424	0.245	-0.212	-0.139	0.531	0.547	0.593	0.669	-0.41	-0.027	-0.039	-0.38	0.075	**-0.917**	-0.739	0.465	0.26	0.179	-0.137	-0.241	0.423	0.582	**1**	
AM	-0.524	-0.709	0.131	-0.441	0.71	0.051	-0.26	-0.649	0.462	0.304	0.349	**0.875**	-0.32	0.347	0.326	**-0.84**	0.269	-0.655	-0.418	0.478	-0.25	-0.274	-0.218	-0.386	0.647	0.016	0.678	**1**

CONCLUSIONS

The results obtained from this study shows that some of the physical-chemical parameters of water quality during the season with lot of precipitation are quite high and beyond the permitted limits of the WHO and EPA. The number of bacteria showed increases in the months of precipitation as a result of the large flows from the Brvenica river that supplies water to this lake.

On the basis of these observations, it is concluded that the water of lake Batllava must be monitored every month to undertake the necessary measures in the adequatetreatment before it is used for drink. While this lake is also used for recreation activities, it is necessary to take the measures to prevent high pollution and introduce appropriate guidelines at the time of crossing the border of values allowed by the WHO and EPA.

REFERENCES

1. Al-afify D.G.A., Othman A.A., Ramadan M.F. 2018. Characterization of chemical and microbiological quality of Nile River surface water at Cairo (Egypt). Rend. Lincei. Sci. Fis. e Nat, 29 (3), 725–736.
2. APHA. 2005. Standard methods for analysis of water and wastewater. Am. Public Heal. Assoc. Inc., Washingt. D.C. 21th Ed, 2001–3710.
3. Avdullahu S., Fejza I., Tmava A. 2012. Protecting water resources from pollution in the Lake Batllava. IJNES, 6(3), 67–72.
4. Belal A.A.M., El-Sawy M.A., Dar M.A. 2016. The effectof water quality on the distribution of macrobenthic fauna inWestern Lagoon and Timsah Lake, Egypt.I. The Egyptian Journal of Aquatic Research, 42(4), 437–448.
5. Berg I. 2015. Validation of MP-AES at the Quantification of Trace Metals in Heavy Matrices with Comparison of Performance to ICP-MS, Örebro Univ. Sch. Sci. Technol.
6. Bhateria R., Jain D. 2016. Water quality assessment of lake water: a review. Sustain. Water Resour Manag, 2, 161–173.
7. Djuikom E., Njine T., Nola M., Sikati V., Jugnia L. 2006. Microbiological water quality of the Mfoundi River watershed at Yaoundé, Cameroon, as inferred from indicator bacteria of fecal contamination. Environmental Monitoring and assessment, 122(3), 171.
8. Dobrzyński J., Kulkova I., Wierzchowski P.S., Worobel B. 2022. Response of Physicochemical and Microbiological Properties to the Application of Effective Microorganisms in the Water of the Turawa Reservoir. Water, 14(1), 12.
9. Gashi F., Frančišković-Bilinski S., Bilinski H., Rexhepi A., Robaj A. 2017. Assessing the distribution of trace elements in water from Batllava Lake (Kosovo). Sustain Water Resour Manag, 7(2), 273-380.
10. Gupta A., Gupta R., Singh R.L. 2017. Microbes and Environment. In: Singh, R. (eds) Principles and Applications of Environmental Biotechnology for a Sustainable Future. Applied Environmental Science and Engineering for a Sustainable Future. Springer, Singapore.
11. Haque M.A., Jewel M.A.S., Sultana M.P. 2019. Assessment of physicochemical and bacteriological parameters in surface water of Padma River, Bangladesh. Appl Water Sci, 9, 10.
12. Imtara H., Elamine Y., Lyoussi B. 2018. Physicochemical characterization and antioxidant activity of Palestinian honey samples. Food Sci Nutr, 6(8), 2056–2065.
13. International Standardization Organization (ISO). 2014. Water Quality—Enumeration of Escherichia coli and ColiformBacteria—Part 1: Membrane Filtration Method for Waters with Low Bacterial Background Flora., Int. Organ. For Standardization Geneva, Switzerland.
14. Kükrer S., Mutlu E. 2019. Assessment of surface water quality using water quality index and multivariate statistical analyses in Saraydüzü Dam Lake, Turkey. Environ Monit Assess, 191(2), 71.
15. Lashari A.H., Ali N., Mohiuddin M., Ali J., Ullah S., Ujjan S. A. Rashid W. 2022. Estimation of Water Quality Parameters of Rawal Lake and Its Associated Tributaries. Polish Journal of Environmental Studies, 31(3), 2149-2155.
16. Ling T.Y., Soo C.L., Liew J.J., Nyanti L., Sim S.F., Grinang J. 2017. Application of multivariate statistical analysis in evaluation of surface river water quality of a tropical river. J. Chem, 5737452.
17. Loucif K., Neffar S. T., Menasria M., Maazi CH., Houhamdi M, Chenchouni H. 2020. Physico-chemical and bacteriological quality assessment of surface water at Lake Tonga in Algeria. Environ. Nanotechnology, Monit. Manag, 13(5), 100284.
18. Ma L., Zhu L., Wang J. 2021. Source Apportionment and Risk Assessment of Heavy Metals (Cd, Cu, Ni, Pb, Zn, and Mn) in Surface Sediments from the Dragon Lake, Bengbu, China. Polish Journal of Environmental Studies, 30(3), 2203-2212.
19. Malsiu A., Shehu I., Stafilov T., Faiku F. 2020. Water quality and sediment contamination assessment of the Batllava Lake in Kosovo using fractionation methods and pollution indicators. Arabian Journal of Geosciences, 13, 5.
20. Prieto N., Manful C., Pham T.H., Stewart P.C., Manful C.F. 2020. The use of XLSTAT in conducting principal component analysis (PCA) when evaluating the relationships between sensory and quality attributes in grilled foods. Methods, 7(2), 100835.
21. Ram A., Tiwari S.K., Pandey H.K. 2021. Groundwater quality assessment using water quality index (WQI) under GIS framework. Appl Water Sci, 11, 46.
22. Sahiti H., Bislimi K., Dalo E., Murati K. 2018. Effect of water quality in hematological and biochemical parameters in blood of common carp (Cyprinus carpio) in two lakes of Kosovo. NESciences, 3, 323–332.
23. Sallam G.A.H., Elsayed E.A. 2018. Estimating relations between temperature, relative humidity as independed variables and selected water quality

parameters in Lake Manzala, Egypt. Ain Shams Engineering Journal, 9(1), 1–14.

24. Seifert-Dähnn I., Furuseth I.S., Vondolia G.K., Gal G., de Eyto E., Jennings E., Pierson D. 2021. Costs and benefits of automated high-frequency environmental monitoring - The case of lake water management. J Environ Manage, 285, 112108.
25. Siddiqua A.S., Sadef Y., Ahmad SS., Farid M. 2021. Evaluation of Water Quality and Its Potential Threats Along River Chenab Using Geo Statistical Techniques.," Polish J. Environ. Stud, 30 (6), 5239–5254.
26. Sipahi H., Hamitoğlu M., Ölçek R, Atakci., Aydin A. 2016. Total Nitrite And Nitrate Levels In Public Water Supplies Of Istanbul City. Turkish Journal of Pharmaceutical Sciences, 13(8), 41-50.
27. Sulltana S., Chowdhury A., Sultana T., Alam K, Khan R.A. 2021. Physicochemical and microbiological evaluation of surface water quality of aquaculture ponds Located in Savar, Dhaka, Bangladesh. GSC Adv. Res, 9, 138–147.
28. Shamsuzzoha M., Rasheduzzaman M, Ghosh R.C. 2018. Building resilience for drinking water shortages through reverse osmosis technology in Coastal Areas of Bangladesh. Procedia Engineering, 212, 559.
29. WHO. 2011. Guidelines for drinking-water quality, fourth edition. http://www.who.int/water_sanitation_ health/publications/2011/dwq_guidelines/en/. Accessed 1 March 2018.
30. Zhang Z., Wang J.J., Ali A., DeLaune R.D. 2016. Heavy metal distribution and water quality characterization of water bodies in Louisiana's Lake Pontchartrain Basin, USA. Environmental Monitoring and Assessment, 188(11), 628.