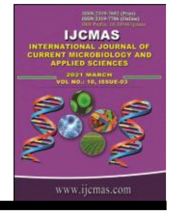
Int.J.Curr.Microbiol.App.Sci (2021) *10*(03): 1789-1793

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 10 Number 03 (2021)**
Journal homepage: http://www.ijcmas.com



Original Research Article https://doi.org/10.20546/ijcmas.2021.1003.223

Geographic and Seasonal Effects on Acidity of Water Collected from the Different Sources in Kerala

Sunitha Thomas[1], A. Prasad[1*], Vrindha Menon[2], V. L. Gleeja[3] and M. Saravanan[1]

[1]Department of Livestock Production Management, [2]Department of Veterinary Public Health, [3]Department of Statistics, College of Veterinary and Animal Sciences, Kerala Veterinary and Animal Sciences University, Mannuthy, Kerala, India

**Corresponding author*

Keywords

Kerala, Carbon cycle, pH of water

Article Info

Accepted:
15 February 2021
Available Online:
10 March 2021

A B S T R A C T

In 2018 and 2019, Kerala experienced several episodes of unprecedented floods and landslides. Every information pertaining to the carbon cycle is gaining relevance in the pursuit of adaptation strategies. Hence the present analysis was undertaken to assess the change in pH of water which has indirect effect on carbon cycle and rainfall pattern. The study analysed 1371 samples of water from three geographically distinct zones of Kerala, over a period of six years (2014 to 2019).The pH of water samples taken from different sources like open well, bore well, pond and tap water were analysed at the NABL accredited laboratory of Department of Veterinary Public Health, College of Veterinary And Animal Sciences, Mannuthy. The average pH of water was found to be 6.27 ± 0.02. The annual average pH showed an interestingly progressive trend which needs further analysis. The pH of open well (6.05 ± 0.02) was significantly ($P<0.05$) lower than the other three sources. Bore well (6.86±0.03) recorded the highest pH followed by pond water (6.67 ± 0.11) and tap water 6.76 ± 0.13), though insignificant. The water samples collected from the hilly regions recorded a neutral pH of 6.9 ± 0.13 in comparison with low lying areas (6.33 ± 0.05) and the midlands (6.31 ± 0.03). The lowest pH was recorded during monsoon (6.26 ± 0.03) and highest during pre-monsoon (6.46 ± 0.04). The rainfall recorded was lowest in 2016 and thereafter showed an increasing trend till date.

Introduction

The Kerala state is situated in the western coast of India and occupies 1.18 per cent of the country. Geographically, Kerala is distinguished as three different regions; 1) Eastern highland region 2) Central midland region and 3) Western lowland region. As we know pH of water is nothing but a measure of the acid–base equilibrium and is regulated by the CO_2–HCO_3^-– CO_3^{2-} ion equilibrium. This carbon dioxide system is important for all life forms including plants and animals used for food production.

Higher CO_2 concentration lowers the pH and lower concentration increases it. pH of any water body is determined by many factors; one of which is the chemical composition of rocks and soil through which the water percolates. Certain rocks such as limestone neutralize the acidity whereas some other rocks like granite have no effect on water pH (Watten *et al*., 2004) while others, such as granite, have virtually no effect on pH. The pH is also influenced by the amount of organic material within the water body, the decomposition of which releases carbon dioxide and forms carbonic acid upon reaction with water which could again lower the pH. Further, we have assumed that, as carbon dioxide concentration in the atmosphere has increased considerably it might reduce the pH of rain water as it falls down leading to acid rain. The amount of precipitation also plays a significant role in maintaining the pH of water.

In this climate change scenario, the floods, draught, ocean acidification and rising sea, the pressure on water bodies is expected to rise in the future. Recently, Kerala also experienced several episodes of flood and landslides. In this context, this analysis was undertaken to elucidate the change in pH of water in relation to the increasing carbon dioxide concentration and the annual rainfall of Kerala. As these changes have a direct impact on agriculture and animal production, the study has relevance in the climate change adaptation interventions.

Materials and Methods

Study area

Kerala, situated in the South-Western coast of India, is bounded by the Arabian Sea on the west and the Western Ghats in the east. It occupies 8º.17´30” N and 12º.47´40” N northern latitude and 77º.37´12” E and 74º.27´47” E eastern longitude. The climate of the state is basically tropical wet and humid but occasionally dry especially in the eastern region. This area is comprised of huge mountains and valleys and is situated immediately to the west of the rain shadow region of Western Ghats. This area is also the origin of most of the rivers of Kerala. Western Kerala comprises of coastal belts interlinked by lagoons, backwaters, coconut palm groves etc. The average daily temperature ranges from 20º C in the cooler months to 27-32º C with a maximum of 36ºCin summer. The average temperature is high in eastern highland region and lowest in the coastal areas. Kerala receives most of the rainfall during South-West monsoon which prevails from June to September. In October-November it is exposed to North-East Monsoon too. Though the average precipitation of the state is around 3107 mm (115”), it shows regional variations. The drier lowland areas receive the lowest rainfall 1250 mm (49”) and the hill slopes receives the maximum; 5000mm (200”). In summer, Kerala is prone to draught, storms and occasional rains.

Data collection and analysis

A total of 1371 water samples from areas scattered over almost all the 14 districts of Kerala were analysed at the NABL accredited laboratory of Department of Veterinary Public Health, College of Veterinary And Animal Sciences, and Mannuthy. The pH of each sample was analysed using multi-parameter water analyser. The period of study was six years, viz. 2014 to 2019.Based on season, every year was further divided as winter (Jan-Feb), Pre-Monsoon (Mar-May), Southwest (S-W) Monsoon (Jun-Sep) and Post-Monsoon (Oct-Dec) (Rainfall report-2018, Indian meteorological department) to study the effect of season and amount of rainfall on pH of water. The data was classified based on the source as open well, bore well, pond and tap water. Based on the terrain of the area of collection, it was grouped as low land region (7.5 m above MSL), midland region (7.5 to 75 m above MSL) and hilly areas (above 75 m).The annual rainfall data of this state (for six years from 2014 to 2019) was collected from the Ministry of Earth and Science (MoES), and the Indian Meteorological Department (IMD) to compare the effect of rain fall on pH of water.

Results and Discussion

The results of the present analysis revealed that the average pH of water was relatively acidic (6.27±0.02) in Kerala. The pH values obtained during the period from 2014 to 2019 were5.65±0.17, 6.13±0.20, 6.24±0.06, 6.36±0.06, 6.34±0.03, 6.49±0.05, respectively. Maximum pH was recorded in the year 2019 and the lowest in 2014.Recent studies of (Boominathan *et al.,* 2012) on the spatial assessment of groundwater quality in Kerala, had also reported that almost all the groundwater samples collected randomly from different regions of Kerala were acidic in nature and the pH ranged from 4.32-6.46, which is less than the desirable limit (6.5–8.5). Sulphide oxidation could be one among the several factors that lowered the pH of water (Weiner, 2000). The acid level of soil or the aquifer through which the ground water percolates could also make it acidic (Harikumar and Kokkal, 2009) (Fig. 1 and Table 1).

As per the Rainfall report-2016 of Indian meteorological department, the average annual rainfall of the state was lowest in the year 2016 and increased thereafter. The average pH of water was found to increase progressively from 2014 to 2019 regardless of the rainfall variations. But Anthony *et al*. (2008) observed that the oceans served as CO_2 sinks by taking up more than 30 per cent of the CO_2 released to the atmosphere by natural/ anthropogenic activities (Caldeira and Wickett, 2003), If this trend continue, the pH of surface water might lower to that extend which will potentially compromise or decrease calcium carbonate accumulation by organisms like coralreefs (Hoegh-Guldberg *et al*., 2007), calcifying algae (Kuffner *et al.*,2008) and a wide variety of other organisms (Raven *et al.,* 2008). Hence, the increasing nature of ground water pH of Kerala obtained in the present study could arouse scientific curiosity in this climate change scenario.

The variations in pH according to the different seasons were also taken into consideration. The lowest pH was observed during monsoon and highest during the pre-monsoon period. No significant difference (P> 0.05) was observed in pH between monsoon, post-monsoon and winter seasons. Earlier studies revealed that pH of water could also change according to its source. The pH of water collected from open wells (6.06 ± 0.02) was significantly (P<0.05) lower than that obtained from the other three sources. The pH of water from the bore wells recorded the highest value (6.87 ± 0.03) followed by tap water (6.74 ± 0.13) and pond water (6.68 ± 0.11) though in significant. Karthick *et al*., 2010) in his evaluation of the drinking water quality of Kerala had reported that, in about 68 per cent of tap water samples analysed, the pH remained neutral and ranged from 5.93 to 9.05 with an average of 7.17 ± 0.78, which was higher than the present result.

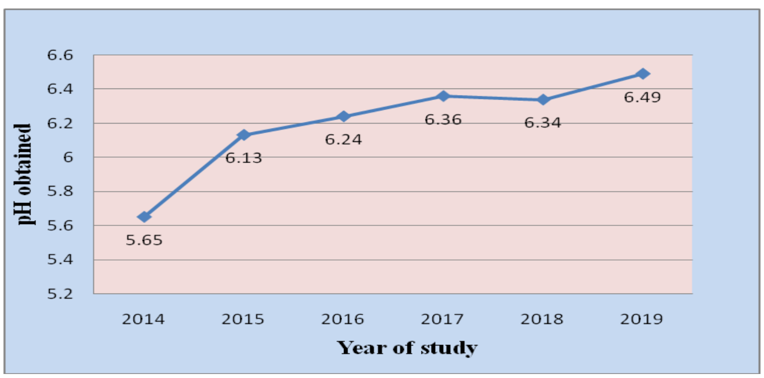
When the pH of water was analysed according to the topography of the collection site, hilly regions recorded a significantly (P< 0.05) higher pH (relatively neutral) than the other two terrains. The relatively neutral pH obtained might be the influence of the chemical composition of bedrocks and soil through which the water flows. In contrary, lower pH was reported in the hilly areas of Kerala, viz. Idukki district, (Rejith*et al*., 2009), Kottayam district (Vijith and Satheeshm, 2007), Muvattupuzhaof Ernakulam district (Gopinath and Seralathan, 2006; Laluraj and Gopinath 2006) and in the river basins of Kabbini, Periyar and Neyyar (Harikumar and Kokkal, 2009).

In conclusion the present study, the average water pH in Kerala was found to be relatively acidic (6.27 ± 0.02).The average pH of water increased progressively during the period of study; from 2014 to 2019.The reason of which has to be elucidated by sound scientific works. Kerala experienced severe episodes of flood and landslides in the last two consecutive years and could utilize such data, upon which, sustainable adaptation and mitigation strategies could be developed.

Table.1 Mean ± SE for the effect of the different variables on pH of water

Effect					
Season	**Pre-monsoon**[a]	**Monsoon**[b]	**Post-monsoon**[b]	**Winter**[b]	**P value**
	6.46 ± 0.04	6.26 ± 0.03	6.29 ± 0.06	6.32 ± 0.02	<0.05
Source	**Bore well**	**Open well**	**Pond water**	**Tap water**	
	6.87 ± 0.03[a]	6.06 ± 0.02[b]	6.68 ± 0.11[a]	6.74 ± 0.13[a]	<0.05
Terrain	**Hilly regions**	**Mid land**	**Low land**		
	6.9 ± 0.13[a]	6.31 ± 0.03[b]	6.33 ± 0.05[b]		<0.05

Fig.1 Annual average pH of ground water from 2014 to 2019 showing a progressive increase



References

Boominathan, M., Karthick, B., Sameer, A., Ramachandra, T.V. (2012). Spatial Assessment of Groundwater Quality in Kerala, India. *The IUP J. of Soil and Water Sci*. 5: 1.

Caldeira, K, Wickett, M.E. (2003) Anthropogenic carbon and ocean pH. *Nature*, 425: 365.

Gopinath, G., Seralathan, P. (2006) Chemistry of groundwater in the laterite formations of the Muvattupuzha river basin, Kerala. *J of the Geological Society of India*. 68: 705-714.

Harikumar, P.S., Kokkal, K.(2009) Environmental monitoring program on water quality. Kerala State Council for Science, Technology and Environment, Govt. of Kerala.pp-174.

Hoegh-Guldberg, O., Mumby, P.J., Hooten, A.J., Steneck, R.S., Greenfield, P., Gomez, E., Hatziolos, M.E. (2007) Coral reefs under rapid climate change and ocean acidification. *Sci*. 80: 1737–1742.

Kuffner, I.B., Andersson, A.J., Jokiel, P.L., Rodgers, K.S., Mackenzie, F.T. (2008)

Decreased abundance of crustose coralline algae due to ocean acidification. *Nat. Geosci*. 1: 114-117.

Laluraj, C.M., Gopinath, G., Kumar, P.K.D., Seralathan, P. (2006) Seasonal variations in groundwater chemistry of a phreatic coastal and crystalline terrain of central Kerala, India. *Environ. Forensics*. **7**: 335–344.

Raven, J.A. (2005). Ocean acidification due to increasing atmospheric carbon dioxide, Report to The Royal Society.

Rejith, P.G., Jeeva, S.P., Vijith, H., Sowmya, M., Hatha, A.A. (2009) Determination of groundwater quality index of a highland village of Kerala (India) using geographical information system. *J. of Environ.Health*.71:51–58.

Vijith. H., Satheesh, R. (2007) Geographical Information System based assessment of spatio-temporal characteristics of groundwater quality of upland sub-watersheds of Meenachil River, parts of Western Ghats, Kottayam District, Kerala, India. *Environ.Geology*.53:1–9.

Watten, B.J., Sibrell, P.L., Schwartz, M.F. (2004) Effect of acidity and elevated PCO_2 on acid neutralization within pulsed limestone bed reactors receiving coal mine drainage. *Environ. Eng. Sci*. 21: 786–802.

Weiner, E.R. (2000). *Applications of Environmental Chemistry: A Practical guide for Environmental Professionals*. Lewis Publishers: Florida.

How to cite this article:

Sunitha Thomas, A. Prasad, Vrindha Menon, V. L. Gleeja and Saravanan, M. 2021. Geographic and Seasonal Effects on Acidity of Water Collected from the Different Sources in Kerala *Int.J.Curr.Microbiol.App.Sci.* 10(03): 1789-1793.
doi: https://doi.org/10.20546/ijcmas.2021.1003.223