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Short Communication

Seasonal changes in carbohydrate content of three Kashmir lakes

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Abstract

Of the three lakes studied for seasonal variation of carbohydrate content, Trigam and Khanpur lakes presented no significant seasonal variations in both 'hydrolysable' and 'non-hydrolysable' sugars while a definite seasonal pattern was discernible within the Tilwan lake. On an average, the carbohydrate content was higher in Trigam ($\bar{x}$ = 24.2 mg l^{-1}) and Tilwan (39.0 mg l^{-1}) as compared to Khanpur lake ($\bar{x}$ = 11.0 mg l^{-1}), which fits in well with their higher trophy in relation to water chemistry and biological communities.

Key words: Carbohydrates, Kashmir lakes, eutrophication.

1. Introduction

The biological activities occurring within the lakes result in the production of a number of organic substances. Out of these, carbohydrates are a class of compounds which have great significance in providing information on the rate of photosynthesis and carbon accumulation within the system. Estimation of carbohydrates in the lake waters, therefore, provides an important information on the extent of lake productivity and the rate of enrichment. Although a considerable amount of data is available on the water chemistry of Kashmir lakes[1], hardly any information is available on the carbohydrate content of lake waters. The present paper provides data on 'hydrolysable' and 'non-hydrolysable' sugars of some Kashmir lakes.

2. Description of lakes

Three lakes *viz*. Khanpur, Trigam and Tilwan situated towards north-west of Srinagar were studied. These lakes are small in area with a maximum depth of 4.5 m (Table I). The lake catchment area comprises elevated "Karewa plateau" parts of which are under orchard and agricultural crops, and the lakes are surrounded by human settlements.

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Table I
Morphometry and the physical features of the three lakes

Parameter	Lake		
	Khanpur	Trigam	Tilwan
Area (ha)	13.5	14.0	43.5
Maximum length (m)	450	700	1450
Maximum breadth (m)	300	200	300
Maximum depth (m)	4.5	2.3	2.2
Mean depth (m)	1.95	1.45	0.70
Length of shoreline (km)	1.70	2.25	3.50
Maximum temperature (°C)	33	32	32
Minimum temperature (°C)	6.5	4.0	5.0
Extinction coefficient (K)	1.31	6.26	8.66

Trigam and Tilwan lakes have closed basins and Khanpur has an outlet which drains into River Jhelum. The lakes do not develop summer stratification and almost throughout the water column is well mixed.

3. Materials and methods

Water samples were collected on seasonal basis during 1983–84 and one set of samples were studied in different seasons. Two sites, one in the centre of the lake and the other towards the lake shore, were used for Khanpur lake (fig. 1) and both surface as well as bottom water samples were analysed. For surface samples, 1 litre polythene bottles were used and samples from deeper parts for Ruttner plexiglass samplers were used. In the case of Trigam and Tilwan lakes, only surface samples have been collected from two sites in each case, one site towards the centre and the other close to human settlement. Unfiltered water samples were used for the analysis. While non-hydrolysable sugars were estimated with the method of Golterman *et al*[2], hydrolysis was carried out with the help of 1 N H_2SO_4 in a boiling water bath[3].

4. Results and discussion

Table II gives the data on seasonal variation in carbohydrate content of lake waters. In the case of Khanpur lake average maximum hydrolysable sugar content of 12 mg l^{-1} was recorded during winter-spring seasons and minimum concentration of 6 mg l^{-1} was recorded during summer. For non-hydrolysable sugars the upper mean value (16.5 mg l^{-1}) was observed in autumn and the minimum ($\bar{x}$ = 4.75 mg l^{-1}) in summer. In Trigam lake the values recorded indicated appreciable increase in the carbohydrate content with hydrolysable sugars being maximum ($\bar{x}$ = 39 mg l^{-1}) in summer and maximum non-hydrolysable sugars in spring ($\bar{x}$ = 31.33 mg l^{-1}). The extent of variation in these

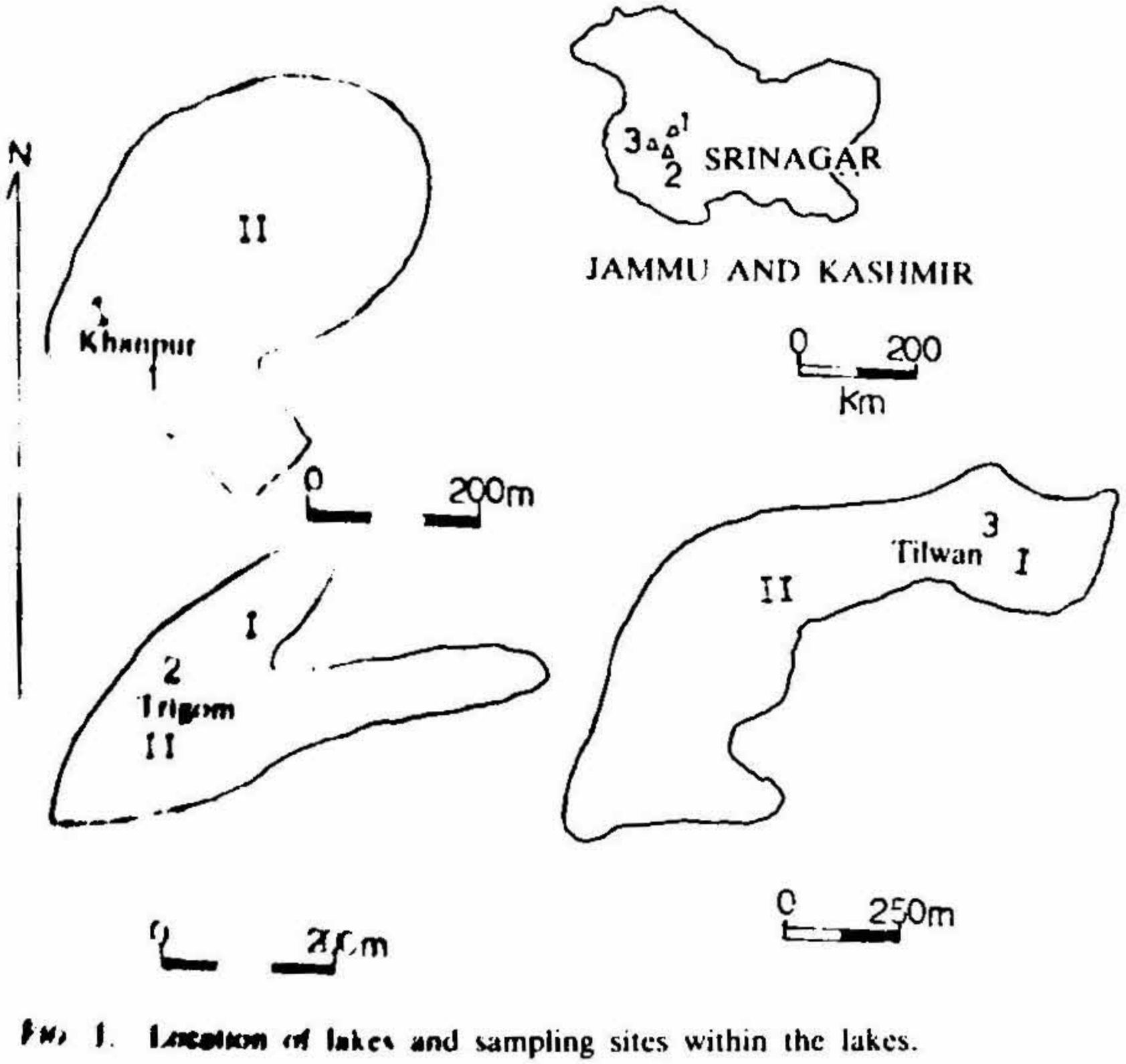

Fig. 1. Location of lakes and sampling sites within the lakes.

cases was not very significant. The minimum concentration for non-hydrolysable carbohydrates obtained in summer was appreciably low ($\bar{x}$ = 9.33 mg l^{-1}).

In Tilwan lake, carbohydrate content increased throughout the study period with mean hydrolysable and non-hydrolysable content being 60 and 87.33 mg l^{-1} recorded during the same season *i.e.* winter. High concentration of carbohydrates during late autumn and winter has been attributed to the meteorologic input to the lakes and also due to decomposition of animal and plant material[4]. In the present study low carbohydrate values observed during spring in Tilwan lake could be related to increased water dilution due to frequent rain followed by increased catchment run-off and subsequent increase in lake volume. The low summer carbohydrate values observed for Trigam and Khanpur lakes may be attributed to their utilization by luxuriant growth of macrophyte vegetation in summer. The relationship of carbohydrate content among the three lakes was made using 'F' values (Table III). This gives an idea of the extent of variation and their significance.

From Table III it can be seen that in the case of Tilwan lake, the 'F' value is greater than the table value and, therefore, the variance between the sites and within different seasons is significant at 5% level for both hydrolysable and non-hydrolysable sugars. In the case of other two lakes the values are less than the table values and as such the variations are not significant.

Table II

Seasonal variation in the carbohydrate content (mg l $^{-1}$) of the lakes

Site		*Winter*		*Spring*		*Summer*		*Autumn*	
		HY	NHY	HY	NHY	HY	NHY	HY	NHY
(*i*) *Khanpur lake*									
I	S	16	4	10	10	4	2	14	8
	B	12	4	14	10	14	10	10	8
II	S	12	20	14	23	2	2	12	22
	B	8	24	10	5	4	5	10	28
$\bar{x}$		12	13	12	12	6	4.75	11.5	16.5
S.D. ±		2.8	9.11	2	6.67	4.69	3.27	1.66	8.76
(*ii*) *Trigam lake*									
I		35	12	23	33	10	8	32	10
II	S	20	43	52	23	12	10	18	36
	B	43	8	42	38	14	10	40	10
$\bar{x}$		32.67	21	39	31.33	12	9.33	30	18.67
S.D. ±		9.53	1.56	12.03	6.24	1.63	0.94	9.09	12.26
(*iii*) *Tilwan lake*									
I		86	114	5	10	5	10	80	100
II	S	59	70	5	10	7	12	50	60
	B	35	78	10	10	10	12	32	66
$\bar{x}$		60	87.33	6.67	10	7.33	11.33	54	75.33
S.D. ±		20.83	19.14	2.36	0	2.05	0.94	19.8	17.61

HY = Hydrolysable sugars; NHY = Non-hydrolysable sugars; S = Surface; B = Bottom.

Table III

Calculated 'F' values for the three lakes

	Lakes		
	Khanpur	Trigam	Tilwan
Hydrolysable sugars	2.79	3.34	8.03
Non-hydrolysable sugars	1.36	1.50	19.56
Degree of freedom	3.12	3.8	3.8
Table value at 5% level of significance	3.49	4.07	4.07

The high carbohydrate content observed in Trigam and Tilwan lake waters may probably be due to the fact that these lakes support higher phytoplankton density as reported by Wani.[5] According to Handa[6] the dissolved carbohydrates in the ocean are derived mainly from phytoplankton living in the surface layers and mostly occurring as free saccharides. Fleischer[7] reported significant correlation between sugar content and

productivity in a number of lakes which differed in trophic levels. In the present study also, Trigam and Tilwan lakes, which are at a higher level of eutrophication indicated higher carbohydrate content thus supporting the inferences drawn from the studies on water quality by Koul[8]. It may be concluded that the derivation of trophic status of a water body on the basis of carbohydrate content could perhaps be a much easier approach than using conventional methods.

References

1. Zutshi, D. P., Subla, B. A., Khan, M. A. and Wanganeo, A. — Comparative limnology of nine lakes of J&K Himalayas, *Hydrobiologia*, 1980, 72, 101–12
2. Golterman., H. L., Clymo, R. S and Ohnstad, N. A. M. — *Methods for physical and chemical analysis of freshwaters*. IBP Handbook No. 8 Blackwell Scientific Publishers, 1978.
3. Colowick, S. P. and Nathan, O. K. — *Meth. Enzymology*, 1957, 3, 34–35.
4. Likens, G. E. — Nutrients and eutrophication, Symposium, American Society for Limnology and Oceanography. In *Environmental chemistry* (ed. G. Englinton). The Chemical Society, London, 1972, 22–26.
5. Wani, I. A. — *Plankton dynamics of two lakes of Kashmir* – M.Phil. dissertation, University of Kashmir, Srinagar, 1983.
6. Handa, N. — In *Symposium on organic matter in natural waters* (ed. D. W. Hood), University of Alaska, 1970, 129–152.
7. Fleischer, S. — Environmental organic chemistry of rivers and lakes. *Arch. Hydrobiol.*, 1972, **70**, 392.
8. Koul, V. K. — *Water chemistry and pollution status of some Kashmir lakes*. Ph.D. thesis, University of Kashmir, Srinagar, 1985.