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On the nature of scattering of some tea samples of Assam

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Scattered radiation at wavelength 6328Å from nine samples of blended tea solutions of different qualities have been investigated. Intensity measurements of the radiations indicate a possible correlation with the quality of the sample.

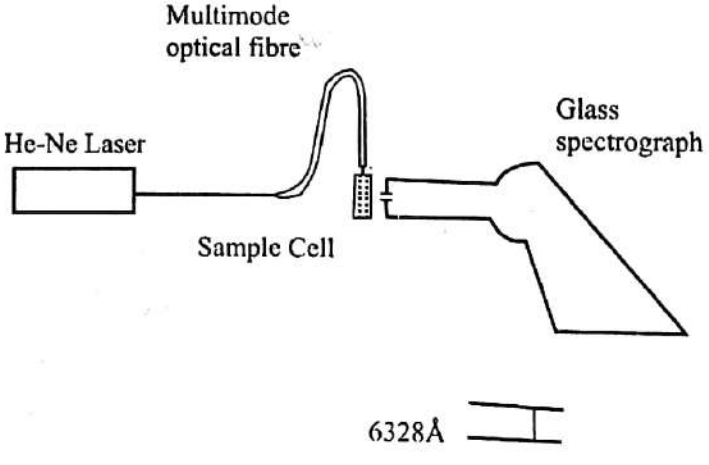
1 Introduction

The lateral scattering of a beam of light as it traverses a cloud of fine suspended matter is a common phenomenon and the first quantitative study of the laws of scattering was made by Rayleigh in 1871 and such scattering is frequently called Rayleigh scattering [1]. The mathematical investigation of the problem gave a general law for the intensity of the scattered light, applicable to any particles of index of refraction different from that of the surrounding medium, the only restriction is that linear dimension of the particles be considerably smaller than the wavelength. With a given size of the particles, long wavelength would be expected to be less effectively scattered than short ones. Compared to a gas, a liquid is very much denser medium. The positions of adjacent atoms would be correlated to some extent and the problem of calculating the scattering of light by liquids becomes more involved. Smoluchowski had used the "theory of fluctuations" to explain the optical phenomena seen near the critical points. The well-known Einstein-Smoluchowski (E-S) result for transverse scattering in liquid gives the modification of Rayleigh scattering applicable for gas molecules.

The phenomenon of scattering has used in numerous practical peoblems. In the present work we are concerned with the scattering of some tea samples of different grades selected from various tea gardens of Dibrugarh district in Assam. The primary aim is to see whether light from the tea samples in liquid phase indicates correlation with the quality of the tea. Tea is generally considered as rich sources of wide range of natural components along with natural trace elements with other minerals acquired from the soil and retain them [2].

2 Experimental

Nine tea samples of blended tea granules are carefully selected from the tea gardens of Dibrugarh district of Assam State for analysis by scattering method. We must emphasize the fact that they are of different qualities. As for example the sample designed as T1 is of high quality and it is costliest in the market. One gram of sample of each variety is dissolved in 5 c.c of hot water. The tea samples produce the usual tea colour. We have used a 5 mW He-Ne laser at 6328 Å. The radiation is allowed to be incident on the sample solution from the vertical direction.



Experimental set up to observe scattered radiation (He-Ne, 6328Å) from blended tea samples of different qualities.

The scattered light was clearly seen in the transverse direction. The cuvette containing the solution was kept in front of the silt of the spectrograph. It may be noted that optical fiber cable was used to give direction to the radiation. The scattered radiation 6328Å was photographed on usual photographic film. Fig1

(a....i) shows the scattered radiations from the tea samples under the experimental setup described above. The intensity measurements of the spectral line were carried out on a densitometer and the measurements are shown along with the spectral line in Fig1. We have used the same exposure time of two minutes for each of the samples.

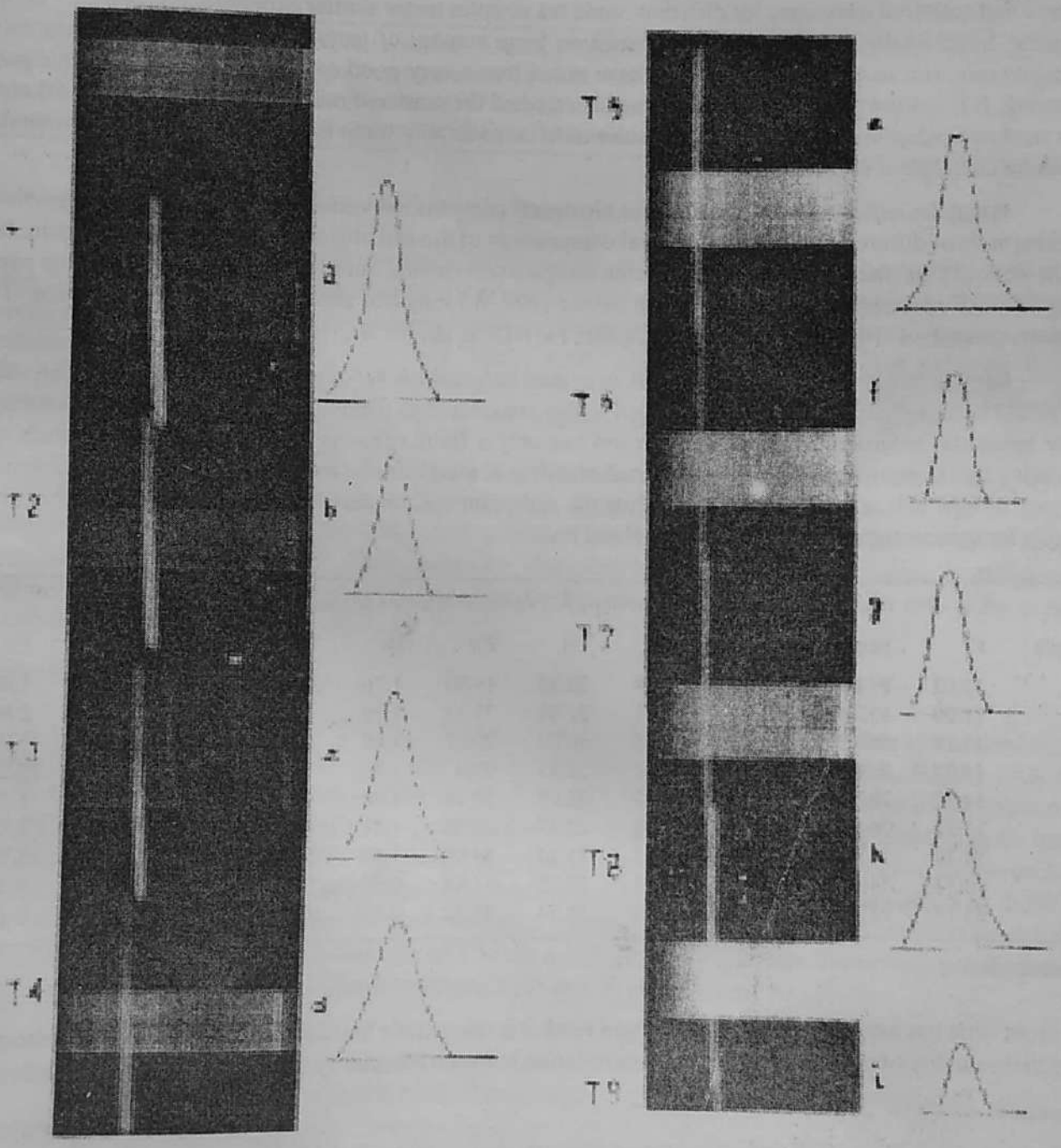


Fig 1. Scattered radiation (wavelength 6328Å) from 9 Tea Samples. The radiations were measured with the help of a densitometer and the corresponding patterns are shown.

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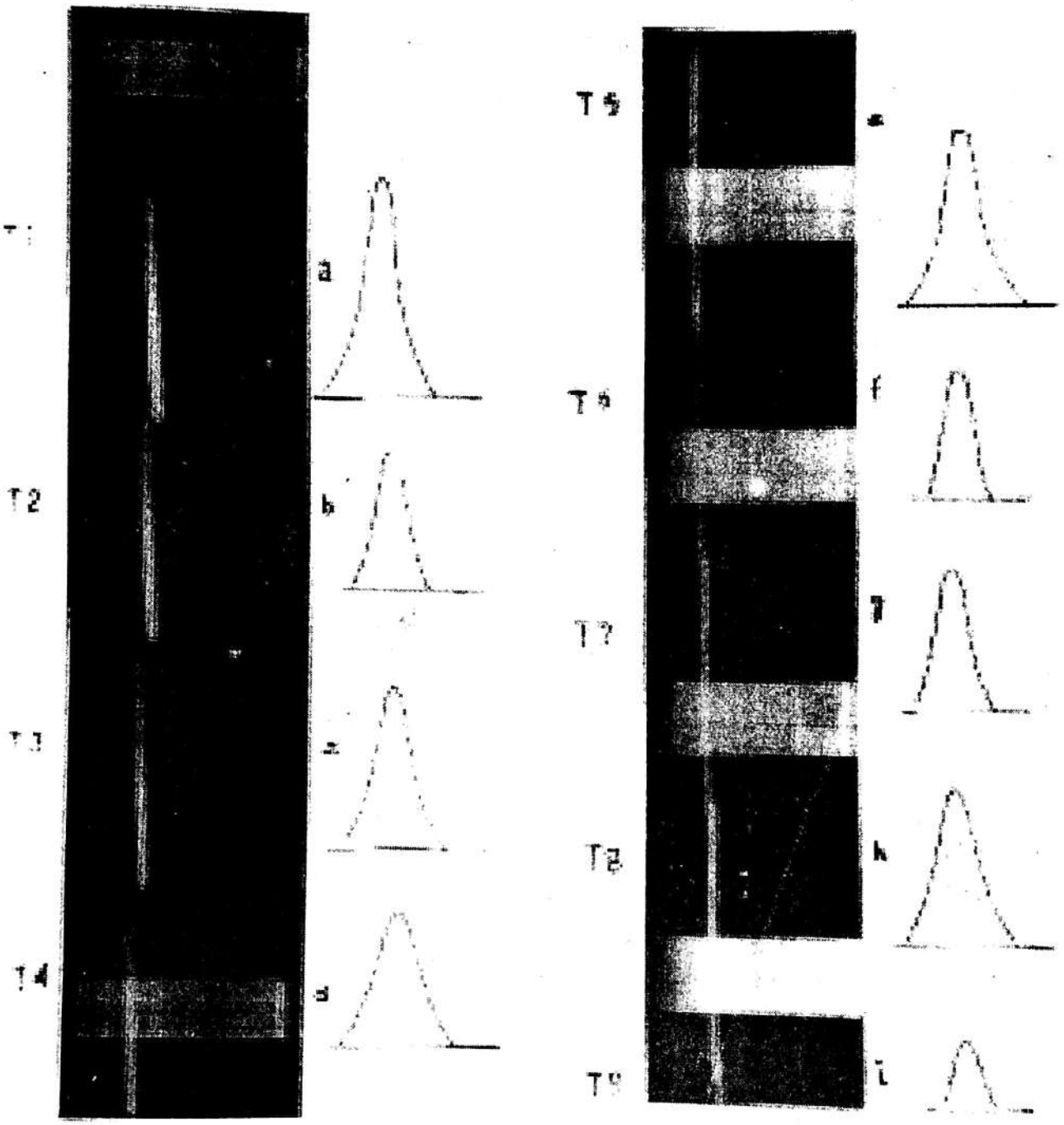

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3 Results and Discussion

As may be inferred from Fig1, there are noteworthy differences in the scattered radiation. The densitometer tracings also indicate conspicuous difference in their intensities. As for example, the scattered radiation from the sample T1 exhibits highest intensity of the scattered radiation and the scattered radiation belonging to the sample T6 indicates the lowest intensity. Due to the preliminary nature of the study it is difficult to draw quantitative conclusions correlating the quality of the tea with the scattered radiation. But we observe that scattered intensities for different liquid tea samples under similar experimental condition are not the same. Since quality of a tea sample depends on large number of factors there will be uncertainties in measurements. But in the present work we have noted that a very good quality tea samples indicate good scattering. It is worthwhile to note here that we also studied the scattered radiation of green tea leaf solution. This scattered radiation from green tea leaf solution is considerably weak as compared to that from blended tea where chlorophyll content is virtually nil.

It may be indicated here that the trace elemental composition varies in different tea plants grown in different soils of different regions as elemental composition of the soil also varies from region to region. In a recent work [3] the elemental analysis of the tea samples was carried out by one of the authors of this paper using EDXRF spectrometer involving a low power (100 W) tungsten anode X-ray tube as a source. The elements quantified in these tea samples are Cr, Mn, Fe, Ni, Cu, Br, Rb, Sr, Hg, & Pb. (Table 1)

Growth of plants is greatly dispersed, or ceased before the level of certain trace metals reach a value that would be significant for living beings. Soil is also considered as a most important sink of trace elements in the terrestrial environment. However, the soil has only a finite capacity for holding these elements and increasing this capacity may lead into increased mobility of metals in the soil – plant – living beings system and that in turn will result in biotoxicity. Thus the soil-plant system serves as an effective barrier against toxicity for some trace elements e.g. As, Be, F and Pb.

Table 1: The concentration (μg/g) of various elements in the tea samples.

Sample	Cr.	Mn	Fe	Ni	Cu	Zn	Br	Rb	Sr	Hg	Pb
T1	13.03	814.84	110.33	7.58	22.33	19.99	1.76	40.31	14.09	1.22	1.60
T2	11.09	553.48	92.14	6.41	21.89	22.32	1.16	45.77	11.29	2.28	2.66
T3	19.14	668.51	166.89	8.01	16.22	29.67	1.48	48.24	14.62	6.35	5.90
T4	14.05	764.52	352.33	6.88	22.83	98.0	3.33	38.28	13.61	42.56	28.26
T5	14.32	787.33	102.48	7.13	22.07	21.14	1.98	42.09	14.79	1.39	1.23
T6	13.27	764.62	95.72	8.02	22.37	22.75	1.81	47.06	16.98	1.70	1.09
T7	14.20	713.92	101.11	7.72	25.27	24.08	1.36	59.22	14.70	2.01	1.01
T8	10.31	740.38	132.94	7.74	27.15	74.84	0.95	55.01	16.30	1.84	1.72
T9	23.19	913.70	220.56	7.50	38.14	27.22	0.47	65.47	25.49	1.85	2.19

4 Conclusion

From what has been described in the present work it is reasonable to believe that trace elements also play a role in the quality of tea samples. There is a correlation between the quality of tea and the scattered intensity.

Reference

1 Rayleight Lord, *Scientific Paper.* (*Cambridge University Press, Cambridge*), Vol. 1 and 4, (1912).

2 Chenery E M, *Trace Elements in Tea,* 6 (1955) 174.

3 Bandhu H K, Singh B, Chand B, Garg M L, Singh Nrimal, Baruah G D, Mangal P C, *Proc Nat Sym Rad Phys,* 11 (1995) 244.

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