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RESEARCH ARTICLE

RESERCH STUDY ON RED RAIN PHENOMENON IN KERALA STATE, INDIA

Sainudeen Pattazhy

Department of Zoology, S.N. College, Kollam- 691001, Kerala, India

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ABSTRACT

Red rain has been noticed in several parts of the world since 1818. In Kerala state, red rain occurred in different parts in 2001-2002. In 2011, the red rain occurred in isolated parts of Kerala along with which the geological phenomenon such as collapse of wells, landslides, and earthquakes were also reported. Red rain water and normal rain water were analyzed. In the red rain, a number of bio-cells and several ores including chromium (VI) were observed, in normal rain water Cr (VI) was absent and the number of bio-cells was very low. In the red rain water, bio-cells and water had shown gradual colour changes. The new findings that there is release of sub-surface gases from underground owing to geological phenomenon like earthquakes, landslides, caving in of wells, etc. Several ores (minerals) get discharged in to the atmosphere along with these gases. These ores in the red rain water gives the red colour to the water and biocells. The different colours of water corresponded to the different types of ores present in the medium. Thus a direct correlation of red rain with geological phenomenon was noted in this study.

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INTRODUCTION

Natural hazards are events that occur suddenly, causing extensive damage to life and property. Some of the common natural hazards include landslides, collapse of wells, cyclones, volcanic eruptions, earthquakes etc. Prehistoric people viewed many natural disasters with shock and as a threat to existence. Until the middle of the nineteenth century, western civilization regarded hazards as God in the strict biblical sense, as the punishment for people's sins. But later, people became aware of the calamity that occur in nature are mainly triggered by human intervention. One of the most widespread natural hazards is the unexpected and sometimes unpredictable movement of unconsolidated weathered material or weathered rock layers near the earth's surface. Landslides and avalanches, while historically not renowned for causing as large a death toll as other natural disasters such as tropical cyclones or earthquakes, have had just as dramatic an impact on property and life. Red rain was noticed in Naples, Italy (1818); Belgium (1819); England (1871); Africa (1888); Switzerland (1911); America (1955) and in Kerala, India (2001). The basic cause of red rain was unknown to the world. The present study was aimed to elucidate the real cause of red rain.

Red rain samples were collected from different parts of Kerala state during 2001- 2002 and in 2011. The water quality parameters were analysed by the methods followed by (Golterman and Clymo 1969) and (APHA 1976). The Chromium (VI) was measured by modified S- diphenyl

carbazine (DPC) Calorimetric method of Pilkington and Smith (1967).

RESULTS AND DISCUSION

In the red rain a large number of bio-cells (algae, fungi, lichens, pollen grains) and various elements like carbon (5%), silicon (11%), calcium (7%), sodium (9%), potassium (6%), phosphorus (4%), nickel (2%), chromium 111 (3.5%), chromium VI (2%), alumina (18%), carbonic acid (8%), organic matter (15%) were observed (Table 1). In the normal rain water the values of above parameters were very low. Hexavalent chromium was absent in the normal rain water. The oxidation state of chromium ranged from 2 to 6. Dominant forms are only 3+ and 6+. Trivalent chromium (Cr 111) is mostly accumulated on the topsoil. Trivalent chromium is more stable, immobile, positively charged and has less affinity for oxygen. The presence of trivalent chromium decrease with increase in the depth of soil. The hexavalent chromium (Cr VI) is mostly accumulated in deeper parts of the earth's crust. Chromium VI is a strong oxidizer, soluble and negatively charged. Again red rain water samples were analysed for hexavalent chromium by modified S- diphenyl carbazine (DPC) calorimetric method of Pilkington and Smith (1967). The presence of hexavalent chromium in red rain was again confirmed.

The new findings that biogases from under the earth's crust get released in to the atmosphere due to natural hazards like earthquakes, landslides, caving in of wells etc. which were

*Corresponding author: **Sainudeen Pattazhy**

Department of Zoology, S.N.College, Kollam- 691001, Kerala, India

widespread in Kerala in 2001- 2002. Several ores like hexavalent chromium get discharged in to the atmosphere along with these biogases. The chromium VI present in the red rain diffuses in to the biocells, which in turn gives the red colour to the water and biocells. In the red rain water samples both red cells and water had shown gradual colour changes. If the natural biocells were the cause of the red rain, the colour of the red cells and water would not have faded. The chemical colour imparted by the hexavalent chromium would be faded due to photochemical reaction. During the emission of biogases from the earth's crust, the bio-cells and other materials adhered to the plants and substratum have been released into the atmosphere. This might be the reason for high bio-cell density in the red rain water. Though these agents have been found on earth for centuries, red rain has not always occurred. The different colours of water corresponded to the different types of ores present in the medium. Thus a direct correlation of red rain with geological phenomenon was noted in this study.

Table 1 Percentage value of different parameters of red rain water Samples.

Parameters	Percentage value
Carbon	5.00%
Silicon	11.00%
Calcium	7.00%
Sodium	9.00%
Potassium	6.00%
Phosphorus	4.00%
Nickel	2.00%
Chromium 111	3.50%
Chromium VI	2.00%
Alumina	18.00%
Carbonic acid	8.00%
Organic matter	15.00%
Bio-cells	80.00%

The top soil contain trivalent Cr in the more stable form and has less affinity for oxygen. Trivalent Cr is immovable in soil and highly adsorbed over the clay particles (Arnfalk *et al.*,1996). There was decrease in the content of trivalent Cr with increase in depth of soils but there was more accumulation of hexavalent Cr at deeper parts of the earth (Noble & Hughes, 1991).

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The more clay and organic matter present in the surface soils adsorbed trivalent Cr which is positively charged but the hexavalent Cr negatively charged and also highly water soluble (Bartlett & Kimble, 1976).Thus the cause of red rain was due to the presence of hexavalent Cr ores. While trivalent Cr in trace quantity is essential to human and animal life, exposure to hexavalent Cr compounds can pose a major health risk to all forms of life. One of the way of alleviating the toxicity problems of chromium is the reduction of hexavalent Cr. However, Hexavalent Cr in nature is rapidly reduced even with the presence of trace quantity of organic matter.

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