STUDY OF MINIMAL OPTIMAL ENVIRONMENTAL CONDITIONS FOR THE ORIGIN OF PROTOCELL-LIKE MICROSTRUCTURES IN PREBIOTIC ATMOSPHERE

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ABSTRACT

The 1:2:1:1 Jeewanu mixture shows the photochemical formation of protocell-like microstructures 'Jeewanu' (1970). The optical and electron probe microscopic observations shows that 'Jeewanu' have distinct structural organization and were able to show some properties of biological orders. The histochemical investigations show the histochemical localization of some compounds of biological interest and also show some enzyme-like activities. The 'Jewanu mixture' satisfies the optimal conditions for self-assembly and self-organization and emergence of minimal protocell-like system.

KEY WORDS : *Jeewanu, Protocell, Microstructures*

INTRODUCTION

Origin and Evolution of life is one of the most fundamental aspects of biological research. The modern scientific concept of origin of life started with 'Molecular and Chemical Evolution theory' postulated by Oparin and Haldane (1929). The modern scientific approach about origin of life is that the life originated from the lifeless matter by a slow process of Molecular Evolution. The molecules which form life were synthesized under optimal natural environmental condition. These molecules were loosely held together by the physicochemical properties of matter and some of these aggregates and develop the properties of living system.

Scientists working in the field of origin of life research are trying to understand the physicochemical conditions which might have transformed lifeless material into living systems. To theorized the 'Molecular and chemical evolution theory', and to explain the transformation of lifeless materials into living systems and origin of life in primitive reducing atmosphere, scientists synthesized various types of protocell-like models viz. Oparin, (1924) synthesised a protocell -like model "Coacervate". They have an organized and persistent organization. Fox, (1964) studied the spontaneous formation of protocell-like model Protenoid and Microspheres. These micro structures were almost uniform in size. Yangawa and Egami, (1978) produced protocell-like microstructures Mariganules under simulated primitive Earth condition. They are organized particle and have a membrane like structure but there internal structure was solubilized by the treatment of KOH solution. Szostak et. al., (2001) reported a protocell-like microstructures with boundary and template replication but no metabolic system. Zhu et.

al., (2009b) produced micro sized monodisperse vesicles. Zhu and Szostak, (2009) synthesized some protocell -like entities viz oleate vesicle, unilmellar and multilamellar fatty acid vesicle.

Bahadur et. al. (1963, 1958, 1970, and 1981) reported photochemical formation of autoreplicative, self-sustaining, protocell-like microstructures "Jeewanu" In sterilized aqueous mixture of some inorganic and organic substances using sunlight as a source of energy. The term 'Jeewanu' is a sanskrit word "Jeewa" life and a 'Nu' the smallest part of something or the indivisible. 'Jeewanu' have a distinct structural configuration. They were able to show the properties of biological order. They grow from within, multiply by budding and showing metabolic activities. They were able to show the presence of some compounds of biological interest viz. amino acids, that are present in free as well as in peptide combination (Bahadur et. al., 1963, Briggs, 1965) nucleic acid bases as purines as well as pyrimidens (Bahadur, 1970, Ranganayaki et. Al., 1972), sugars as well as ribose as well as deoxy ribose (Bahadur et. al. , 1663) and phospholipids -like materials (Singh, 1975) in them. Jeewanu mixture is able to show the presence of various enzyme-like activities viz phosphatase, ATPase, ester–ase, and nitrogenase (Bahadur and Ranganayaki, 1970, Bahadur et. al., 1963,Singh, 1973, Bahadur and Gupta, 1984).

So it was felt interesting to carry out some experiments to investigate the physicochemical conditions of Jeewanu mixture for the photochemical formation of protocell-like microstructures 'Jeewanu'.

MATERIAL AND METHOD

Method of preparation of Jeewanu (Bahadur and Ranganayaki, 1970)

The following three solutions were prepared -

4 % Ammonium molybdate (w/v)

3 % Di-ammonium hydrogen phosphate (w/v)

Mineral solution - It was prepared by dissolving following 20 mg. each of Potassium dihydrogen ortho phosphate, Sodium chloride, Magnesium sulphate, Potassium sulphate, Calcium acetate, Manganous sulphate and 50 mg. of Ferrous sulphate. The above salts were dissolved in 100 ml. of distilled water.

The solutions no. 1, 2 and 3 were taken in separate, separate conical flasks and cotton plugged; the above solutions were sterilized in an autoclave at 15 lb. pressure for 30 minutes.

After cooling, 4% ammonium molybdate solution (1 volume), 3% Di-ammonium hydrogen phosphate (2 volumes) and mineral solution (1 volume) were mixed in a sterilised conical flask. 36% Formaldehyde (1 volume) was aseptically added in the above solution.

These 1:2:1:1 mixture is known as 'Jeewanu Mixture'. These Jeewanu mixture was exposed in sunlight for photochemical formation of Protocell-like microstructure 'Jeewanu'.

EXPERIMENTALS

The routine procedure was followed for observation and microphotography. The photochemically formed 'Jeewanu' were bleached with aqueous solution of 0.25% Chromium Trioxide and then slandered protocols were follows for the histochemical localization of compounds of biological interest. Standard protocols were also followed for the study of some enzyme-like activities.

OBSERVATIONS

The optical and electron prob microscopic observations of photochemically formed 'Jeewanu' revealed that they have distinct structural organization, they are spherical in shape, blueish in colour and are capable of multiplication by budding, growth from within (Fig. 1 and 2).

The histochemical observations shows the histochemical localization of some compounds of biological interest viz Phospholipid like, basic cytoplasm-like, acidic material-like, RNA material-like (Gupta and Rai, 2013), Calcium ion-like and Thiamine pyrophosphatase-like material (Gupta and Rai. 2015).

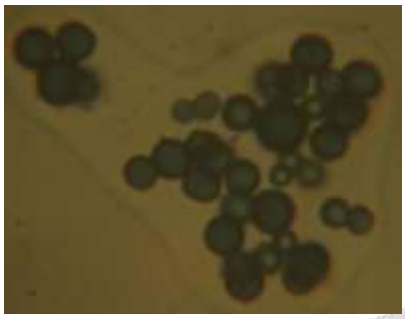
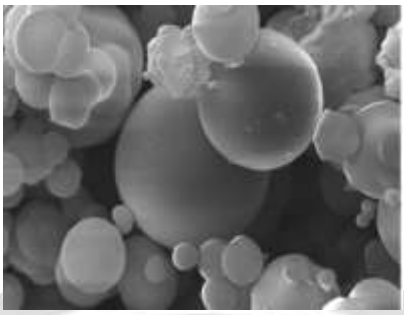


Fig. 1.



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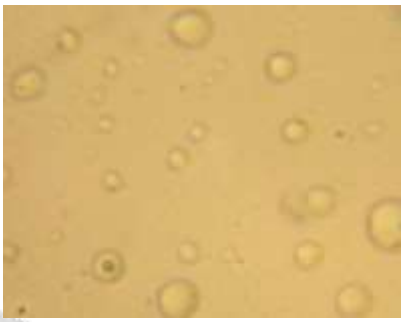

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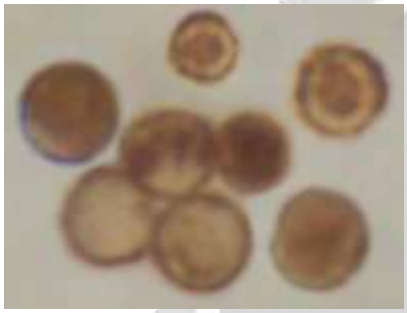

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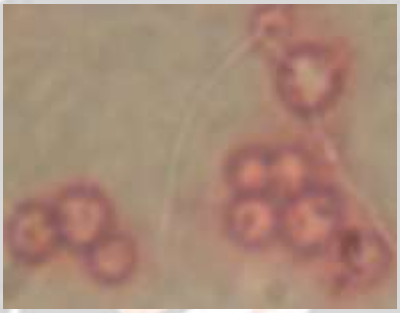
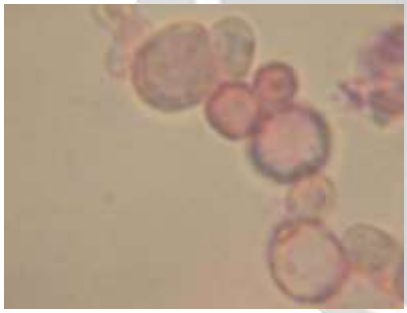


Fig. 5

Fig. 6



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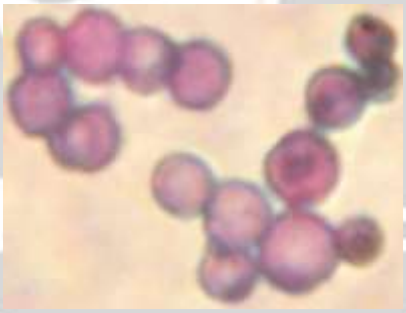

Fig. 8

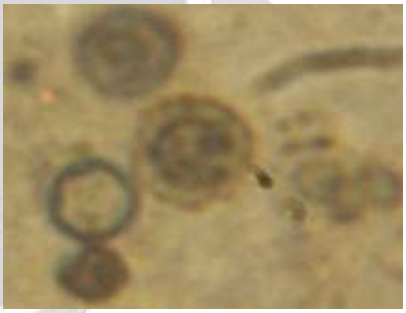

Fig. 9

Fig. 1. Showing Optical Microscopic view of 'Jeewanu.
Fig. 2. Showing Scanning Electron Microscopic view of Jeewanu.
Fig. 3. Showing Jeewanu, Bleached with 0.25% Chromium Trioxide (aqueous).
Fig. 4. Stainde with Sudan IV (5% Alcoholic) for histochemical localization of phospholipid-like substance in outer limiting boundry of 'Jeewanu'.
Fig. 5 Stained with Eoson B (1% Aqueos) for histochemical localization of basic material-like substance in 'Jeewanu'.
Fig. 6 Stained with Methyl Green for histochemical localization of acidic material-like substance in 'Jeewanu'.
Fig. 7 Stained with Pyronin Y for histochemical localization of RNA-like substance in 'Jeewanu'.
Fig. 8 Stained with Erychrome black T (0.5% aqueous) for histochemical localization of Calcium ion-like substance in 'Jeewanu'.

Fig. 9 Histochemical localization of Thiamine pyrophosphatase-like activity inside the boundry wall of Jeewanu (Eranko and Hasan Mthod).

RESULT AND DISCUSSION

The 1:2:1:1 Jeewanu mixture were able to show the photochemical formation of protocell-like microstructures 'Jeewanu'. They have distinct structural organization and were able to show the histochemical localization of some compounds of biological interest (Gupta and Rai, 2018). Jeewanu fulfill the minimal life criteria suggested by Ganti (1971) and satisfies maximum criteria suggested by Pohorille and Deamer (2002). Cairns Smith (1966) argued that the earliest energy transferring system was photoautotropic in nature and was possibly having similar to Jeewanu.

The sunlight exposed sterilised aqueous mixture of some inorganic and organic substances (Bahadur and Ranganayaki, 1970) satisfies the optimal conditions for self-assembly and self-organization and emergence of minimal protocell-like system.

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