Study of Biological growth on the Agar Surface as Fractals

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Abstract:

During the study of fractals and DLA it is observed that some natural biological pattern also follow the order and can be described in terms of Laplacian growth. There are many questions about the physical process and morphologies observed in living world. In this study we developed bacteria colony on the agar surface. Different conditions are provided to the surface. Dense colonies will appear on the agar surface. We controlled the conditions and obtained the fractal shapes. The results are compared with DLA and fractal dimensions are calculated using standard methods. It is observed that the dimensions are fractal.

Key Words: DLA., Laplacian Growth , Fractal dimensions

1.0: Introduction:

There are large number of the patterns we observe In our day today's life which are irregular but follow some symmetry. There are many biological patterns like retinal vessel , branches of trees bacteria colonies arteries of lungs etc which can be studied using the fractal their dimensions can be calculated and compared with fractal dimensions. Process behind the shape formation can be studied.

1.1:Retinal Vessels:

If human eye is observed in the background of fractals theory complicated branching is found to resembling very close to DLA [1]. A recent hypothesis suggested relationship between growth of vessels and maturation of photo-receptors, during development stage the mattering photoreceptors consume progressively more oxygen decreasing the available amount of inner retina. The migration spindle cells in the inner retina sense this diminished concentration of oxygen and release angiogenic factors[2-3]. The angiogenic factors diffuse in the plane of retina and stimulate the growth of new retinal blood vessels. Therefore diffusion plays an

essential role in the formation of vasculature in the eye but exact DLA phenomena is satisfied or not is an open question. Fractal analysis is carried out and fractal dimension is found as 1.7 which is in good agreement with the dimension of DLA.[4]

1.3:Experiment for bacteria colony

When agar surfaces are provided with the suitable conditions then it was found that bacteria colonies establish in its surface. The agar plates are kept in air for some time to acquire bacteria from the atmosphere, then dense structures are seen on its surface[8]. If you leave the food unattended, within few days various kinds of bacteria colonies are developed on its surfaces. Here one can control the accumulation. When the plates of agar are taken and the surface is inoculated at a point the plates are kept in humidifier and then incubated at 40°C within a week a DLA like structure start appearing on agar surface [9]. Fig.1 Demonstrate a bacteria colony developed on the agar surface. In figure 2 the fractal dimensions are found to be in the range of 1.63 to 1.69 and process is governed by the diffusion limited aggregation..

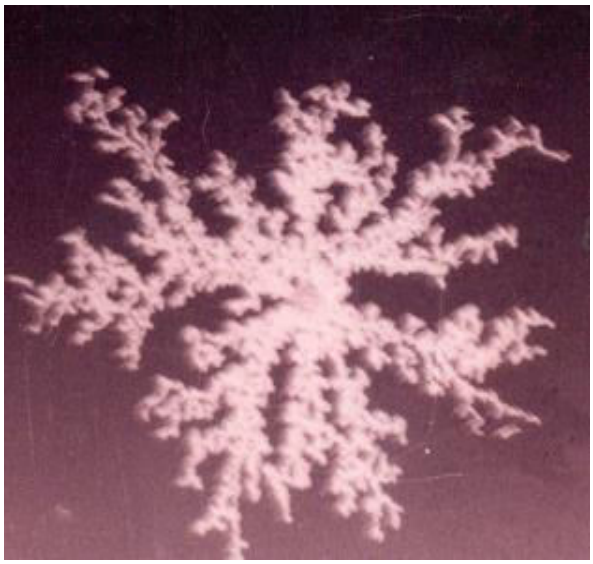

Fig: 1: Bacteria colony on the agar surface at 40^0C

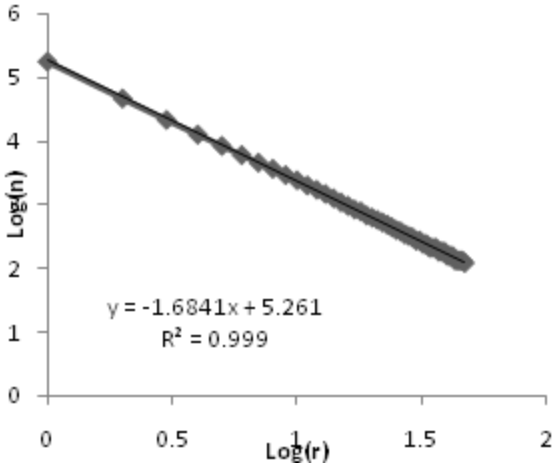

Fig2: Graph of box counting for fractal dimensions

1.4 Conclusion And Discussion:

In nature there are many mechanisms works on the principles of diffusion limited aggregation. Bacteria colony is one of the example of such deposits when simulated with DLA at laboratory condition yields the results. Some natural irregular shapes like retinal vessels

are related to DLA and their dimensions fractals. Here fractal dimensions proves to be a very useful tool in characterizing the irregular shapes.

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