IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Study of Bacteria colony on agar surface as Fractal

S.Q. Chishty[1] Mohd Khizar[2]

1: Dept. of Physics Dr. Rafiq Zakaria college for women Aurangabad. M.S. India

2: Dept. of Physics, Kohinoor college of arts Science and commerce Khultabad M.S. India

Abstract:

In the present study fractals are grown using the bacteria colony. For this purpose cell is designed and the growth processes are studied using this cell. Different colonies are studied at different temperatures. There are large number of parameters which control the growth process. In the on going process images are photographed with the help of video camera. Fractal dimensions of these shapes are calculated using computerized box counting method. The results obtained are compared and discussed. It was seen that the growth satisfy the Laplace equation.

Key words: Bacteria colony, fractals, fractal dimensions

Introduction :

The study of Fractal growth is one of the physical phenomena observed in many growth experiment. For example dielectric breakdown, bacteria colonies, aggregation models etc. All these process are governed by diffusion limited aggregation (DLA) [1,2] , the structures so developed are branched and self similar dendrites are with increasing and multiple branches. These shapes are interested to study due to their particular nature. Dimensions of these shapes are fractured and known as fractal dimensions

There exists a great variety of possible patterns which can be classified based upon their growth mechanism and geometrical properties [3]. The patterns which generally appear are divided into two groups depending on the stability . It intended to demonstrate that a tip can be either unstable (a) and go through repeated splitting shown in figure 1 and lead to dendritic growth. Unstable tips results in disordered structures with no apparent symmetry. If tips are stable in the sense that small perturbations around their stationary shape decay relatively quickly, the obtained pattern have a symmetry of varying degree[4] Figure 1show most commonly occurring possibilities. In some cases the interface bounds a region which is homogeneous on a length scale comparable to the size of the object[5-6] While under different conditions the

growing pattern has an open branching structure corresponding to fractal dimension. All combinations of the above two sets occur in nature[7].

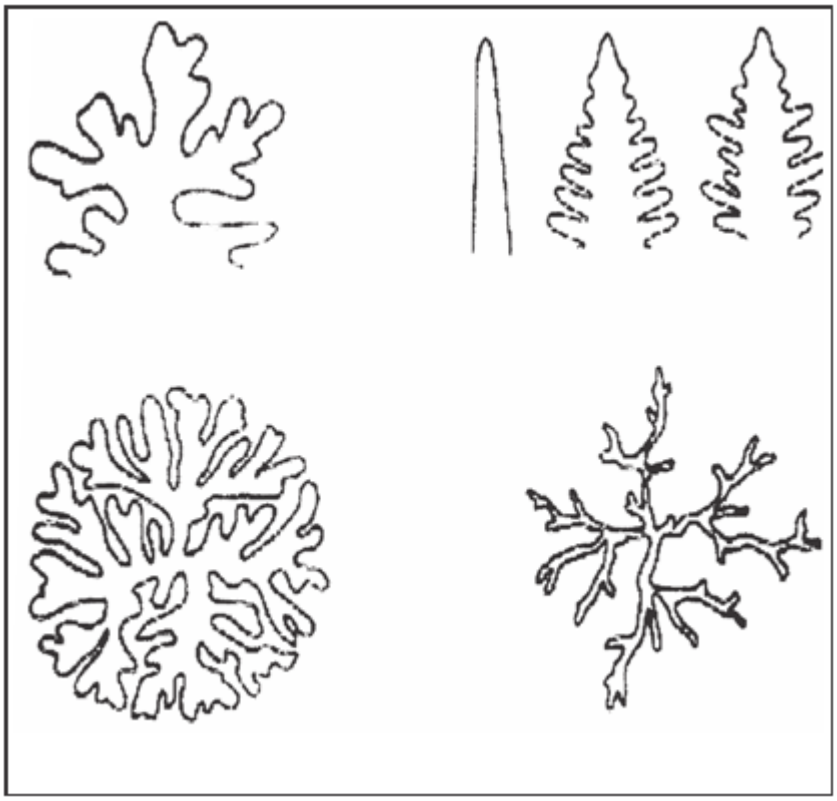


Figure 1: different Possible fingering pattern

Experimental setup :

When agar surfaces are provided with the suitable conditions then it was found that bacteria colonies establish in its surface[8]. The agar plates are kept in air for some time to acquire bacteria from the atmosphere, then dense structures are seen on its surface[9-10]. 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 [11]. Fig.2 Demonstrate a bacteria colony developed on the agar surface. and process is governed by the diffusion limited aggregation. Further analysis of the process is under progress.

The cell consist of one glass plates of circular shape , the thickness of plates are 1 mm . a thin layer of agar is placed over it [12-13]. Thickness of this layer is in micrometers, when subjected to environment bacterial cells develop over the surface of agar by consuming nutrients Different temperatures are maintained in in incubator which is suitable for growth. There are large number of points seen on the surface. Then after certain duration of time size of the colonies increases. The agar surface is protected to avoid other superimposing bacteria colonies. As the diameter of colonies are in mm and difficult to analyze we used

magnifier system. The fractal dimensions are calculated using box counting method with the help of computer programming .the dimensions of the shapes are found to be in the range of 1.3 to 1.6

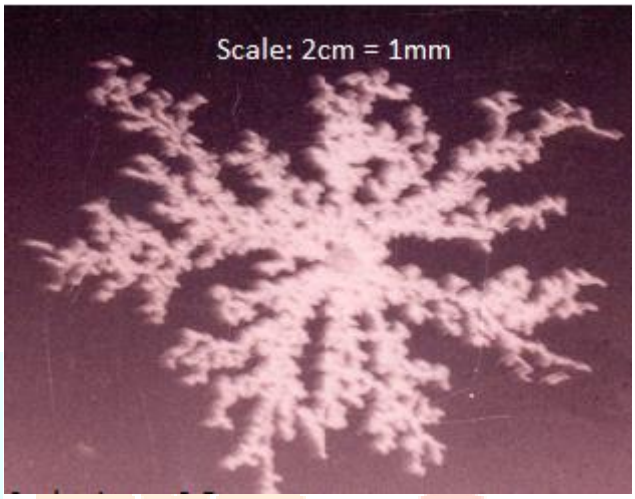
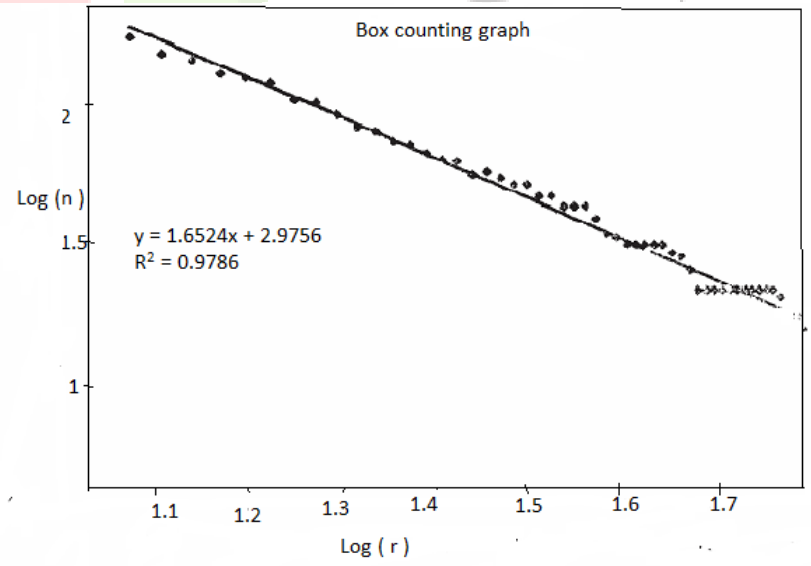


Figure: 1 : Image of bacteria colony deposited on Agar surface at 40 ^{0}C

To obtain the images of generated shapes in cell video camera is used. Efforts are taken to focus the camera properly. Zoom lenses are used for this purpose. Elaborate arrangements are made to keep video camera perpendicular to the cell. The complete arrangements is kept at room temperature in the laboratory 21 inch colour monitor is used to observe the branching pattern[14-15].

The images so obtained are digitized using proper software and fractal dimensions are calculated for each image. It is found that the fractal dimensions[16-17] are in the range from 1.3 to 1.65



Conclusion and Discussion:

The above results can be interpreted on the basis of specific internal structure. If the cell is not prepared to provide an ordering of molecules on a length scale comparable to 'w' the direct or randomly changes within sample. As a result of the orientational disorder the screening effects become dominant the mechanism for the reference of fluctuations is provided .The medium is strongly orientation dependent. Thus local ordering of molecules indicates early or hard local.. With the different parts of the sample in this case behavior is expected to be analogues to that observed for isotropic medium. Compact the structure more is the fractal dimensions leads towards the dimensions of plane. Open the structre fractal dimensions are easily predictable,

References:

[1] Witten T.A., and Sander L.M; phys. Rev. B27 , 5686 (1983).

[2] Vicsek Tama's ; 'Fractal Growth Phenomena' world scientific Singapore (1992).

[3] Stephen Buczkowski phy. A. 252 23-24 (1998).

[4] Vicsek T; phy. Rev. lett. 53, 2281 (1984).

[5] Vicsek, T; and Kertesz, J; Euro phys. News 19, 24 (1988).

[6] Vicsek T; 'Fractal Growth Phenomena' world scientific Singapore (1992).

[7] Patil A.G' Ph.D Thesis 'Studies in Fractal growth phenomena' Dr. B.A.M. University, Aurangabad (2001).

[8] Erin S at el Bacterial Stigmergy An organizing principleof molecular collective behavior of bacteria (2015)

[9] Kandi,V, J at el journal of Medical microbiology and Diagnosis , vol 5 bacterial colony characterstics June (2015)

[10] Patil A.G : Ph.D Thesis 'Studies in Fractal growth phenomena' Dr. B.A.M. University, Aurangabad (2001).

[11] Rakotaomalalla; Salin D; and Watzky P; J.phys. II France, 7, 967-972 (1997).

[12] Markus Alber and Joachim Peinke phy. rev. E. 57, 5 (1998).

[13] Hele Shaw J.S; Nature 58,34 (1998).

[14] Paterson, L; J. Fluid mechanics 113, 513 (1981).

[15] Gregeria. A.J; and Schwartz L.M, J. fluid mech. 164 - 383 (1986).

[16] Tarafdar, S; and Roy.S; 'Fractals' 3,1,99 - 103 (1995).

[17] chishty at el fractal aggregation of copper paryicles, oriental journal of chemistry 29 (03) 1183-1186 sep 2016

[18] Chishty ,Farooqui S. Abid fractal viscous fingering in thick oil Asian journal of chem. May 2014