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RESEARCH ARTICLE

# Creation of Bacteria in Tongue Diagnosis Based on Fractal Methods

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## ABSTRACT

Bacteria play a vital role in helping with digestion and protecting against harmful infections. However, the Gram-negative bacteria in Tongue will have some disadvantages in the human body. These can be diagnosed by employing the fractal concept. Bacteria's irregular shape and Complex nature can be quantified using fractal dimensions that exhibit self-similarity at different scales. The fractal measurement procedure deliberates the dissimilarity and surface complexity of the tongue-inclusive spot on the tongue. An image of the tongue is analyzed by the HarFa Fractal Method. The Sobel improved Box counting Method is employed to enumerate the outgrowth of Bacteria in Tongue. Lacunarity is to examine the interlude present in the tongue. The escalating lacunarity value implies an extreme degree of heterogeneity. It undergoes a professional design of proportions that contain opinions about a dimension of how an entity tops up capacity. Additionally, an elevated crash on the skin deepens, the growth of spots that enfold the tongue via numerous configurations, hence modifying the common tongue to a malformation. To scrutinize the affected area in the tongue and estimate its measurement, employ the arithmetical process of rescue measures along with increasing the nature of the diagnosis.

**Keywords:** Bacteria, Fractals, HarFa analysis, Lacunarity, Tongue diagnosis

## Introduction

Keji Liang, Xiaodan Huang, Hua Chen, LilingQiu, YanshanZhuang, ChuanZou, YunpengBai, and Yisheng Huang made a case report on Tongue diagnosis and treatment in traditional Chinese medicine for severe Covid-19.The relation between Chinese medicine and western medicine in Tongue diagnosis. Mainly examined Tongue Color, and fur thickness related to the intensity of Covid-19 by analyzing the various Tongue images. These characteristics of the tongue help the patients limit the risk of Covid-19. [1] Pierre G. Vico, Didier Dequanter, Nicolas de Saint AubinSomerhausen, Guy Andry and Louis H. Cartilier analyzed the deep margin of Tongue carcinoma using the Fractal dimension as a prognostic tool. A modified Box-counting method is enumerated to assess the complexity of $T_1$-$T_2$ Tongue carcinoma. Examined with different groups of patients, the Kaplan-Meier log-rank test provided statistical analysis. Further, the outcome implies Fractal analysis provides Structural measurement and relevancy should be assessed. [2] In this paper, bacteria present in Tongue are examined by Fractal methods like HarFa Fractal Analysis for image analysis and the Sobel Improved Box Counting Method for analyzing the outgrowth of bacteria. Normal as well as infected tongues are examined to determine the size of the Bacteria.

### *Fractals*

Fractal calculation enlarged in the previous 20 years, and among the majority shining along with applicable technical locating of the centuplicate, delinquent it's ascribed by Benoit B. Mandelbrot. Fractals occur with an understanding of parabolic

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geometry. Some are asymmetrical. Fractals have a few likenesses. Almost all fractals exist identically, i.e., the amplification of some proportion is similar to the initial entity in a particular technique. Fractals exist throughout, as in the term of Michael F. Barnsely. Fractals possess numerous requests in the area of cytology.[3,4] Implementation of fractals exists galore in the area of activity in healing art. Tongue diagnosis is a fascinating subject worth reading. Diagnosis and treatment of diseases through direct human observation in various forms, such as pulse diagnosis, tongue diagnosis, is efficient and cost-effective.[5]

### *Tongue diagnosis*

The tongue is a soft, sturdy organ on the floor of the mouth. It is composed of skeletal muscle fibers. The skeletal muscles can easily be controlled, which gives the tongue its mobility. It's one of the maximum important peripheral organs. The tongue is basically "U"-shaped Fig. 1 and is slightly pinkish. Ridges and colored spots are seen migrating over the surface of the tongue, a harmless condition generally referred to as geographic tongue. The interesting fact about the tongue is that it's the pleasant indicator of diverse illnesses in the body. That exists on account of the incidence of tongue prognosis in most styles of living world protection. In Chinese medicine, the tongue plays a vital role in identifying the disease.[6] From Figs. 1 to 3 Tongue features aren't the same for all. Feature-operating external tongues are bound to indicate the radical source. In this paper, to enhance the results, detected the edges of the tongue and patches using Sobel Edge Detection and then applied the Box Counting Method.[7] By identifying the infected area in tongue interior body parts, infection can be easily examined. Both the normal and infected tongues are examined by the HarFa Fractal Analysis[8] method to determine the dimension. From the dimension value, the outgrowth of bacteria can be identified. Analysis of tongue diseases using dimension proves to be an efficient tool when compared to the existing methods.

## Methods

Physical features vary from individual to individual. In this line, the features of the tongue are also not the same. It has complex characteristics, exhibiting irregularities depending on a person's health. These irregularities guide us to employ fractal theory in tongue diagnosis. Detect the edges using the Sobel Edge Detector in HarFA, and then apply Box Counting Method.[8]

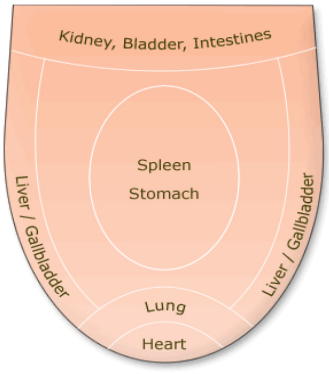



**Fig. 1.** Zone therapy of tongue.




**Fig. 2.** (a), (b) normal tongue.

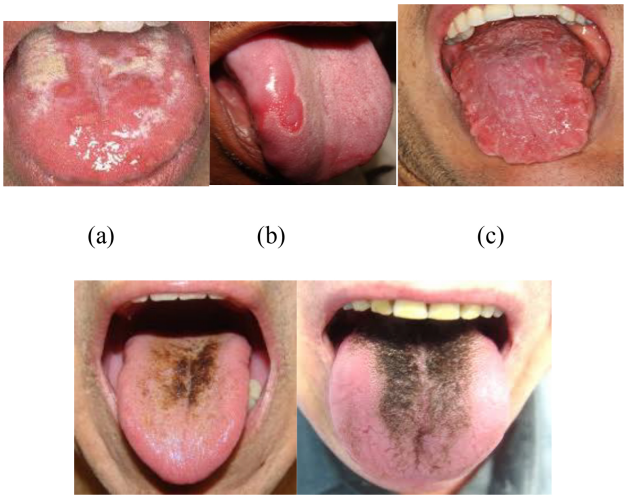



**Fig. 3.** (a), (b), (c), (d), (e) infected tongue.

### *HarFA – Fractal image analysis*

ZmeskalO et al.[9] possess accomplished Box inspecting grand design inside the scheme signed out

**Table 1.** Data examining tongue depiction applying SIBCM.

| | Scaling | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Image | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | DB |
| (a) | 1655 | 1038 | 724 | 538 | 399 | 323 | 252 | 205 | 175 | 1.1 |
| (b) | 1813.5 | 1197 | 902.5 | 717.6 | 591.5 | 502.7142 | 436 | 358 | 330 | 1.2 |
| (c) | 676 | 447 | 331 | 256 | 215 | 176 | 158 | 145 | 124 | 2.5 |
| (d) | 999 | 677 | 493 | 388 | 324 | 261 | 238 | 199 | 177 | 2 |
| (e) | 969 | 636.6665 | 450 | 362.9998 | 295.6666 | 254 | 213.75 | 191.5556 | 175.1999 | 2.15 |

**Table 2.** HarFA stochasticinspection of tongue-SIBCM.

| | Distinct | | | Continual | | |
|---|---|---|---|---|---|---|
| Figure | BW | BW + B | BW + W | BW | BW + B | BW + W |
| (a) | 1.0369 | 1.0399 | 1.9990 | 1.1302 | 1.1080 | 1.9810 |
| (b) | 0.990 | 1.1045 | 1.0984 | 1.0548 | 1.0186 | 1.980 |
| (f) | 1.4901 | 1.2718 | 1.8844 | 1.3765 | 1.414 | 1.9987 |
| (g) | 1.061 | 1.0315 | 1.8829 | 1.0390 | 1.0013 | 1.887 |
| (h) | 1.1007 | 1.0098 | 1.9836 | 0.9309 | 0.877 | 1.9760 |

**Table 3.** HarFA stochasticinspection of tongue (CBCM).

| | Distinct | | | Continual | | |
|---|---|---|---|---|---|---|
| Figure | BW | B + BW | W + BW | BW | B + BW | W + BW |
| (a) | 1.126 | 1.943 | 1.701 | 1.9320 | 0.0678 | 0.983 |
| (b) | 1.543 | 1.070 | 1.822 | 0.0038 | 0.5360 | 0.9374 |
| (c) | 1.868 | 1.643 | 1.904 | 1.9901 | 1.6102 | 0.8590 |
| (d) | 1.565 | 1.678 | 1.962 | 0.2071 | 0.5778 | 1.9068 |
| (e) | 1.9460 | 1.6070 | 0.9446 | 1.9216 | 0.6831 | 1.0589 |

as HarFA, that existgenerate by the developedsomatic and joinedalchemy, practical college of Bino inside the Czech self-government. The computation noticeable by this grand design is signed out as Box inspecting computation ($D_{BBW}$). The regulation acts like: closelattice of dissimilar dimension $1/\epsilon$ is delayed in the depiction. The survey of effort pack $N_{BBW}$ ($\epsilon$), which holds some part of the stochastic, is enumerated. A box inspecting the grand design was used for evaluating the stochastic resources of a cervical malignant tumor. The grand design is often used to determine the stochastic Box quantization of a computerized portrait of stochastic construction. HarFAexamineinky and colorless vision. Box inspecting grand design used the wrapping of stochastic design escorted by picture element of package (squares) along with estimating according to what innumerable packs $N_{BW}$, $N_{BBW} = N_B + N_{BW}$ *or* $N_{WBW} = N_W + N_{BW}$ of the picture element are essential to enfold the stochastic complete site. $N_B$-no of darkquadrangle,

- $N_W$-number of white squares,
- $N_{BW}$-number of black and white squares,
- $N_{BBW}$-number of black and white and black squares,
- $N_{WBW}$-number of black and white and white squares.

Performing again a certain computation accompanied by the dissimilar dimension of boxes $r = 1/\epsilon$ tend to out-turn in the algebraic grid dimension $r$ and the integer of package $N(r)$ required to enfold the stochastic entirely. The slant of continuous functions

- $\ln N_{BW}(r) = \ln (K_{BW}) + D_{BW} \ln(r)$,
- $\ln N_{BBW}(r) = \ln (K_{BBW}) + D_{BBW} \ln(r)$,
- $\ln N_{WBW}(r) = \ln (K_{WBW}) + D_{WBW} \ln(r)$,

provide $D_{BW}$, $D_{BBW}$, $D_{WBW}$, the stochastic capacity. $D_{BW}$ identifies the valuables of the boundary of stochastic design. $D_{BBW}$ distinguishes stochastic design in the use of a black backdrop, and, $D_{WBW}$ distinguishes stochastic design on a white backdrop. Starting with the overhead declare plan of action, establish the stochastic design of the tongue in disjoint and constant procedures Tables 2 and 3. Certain furnished with the ferocity of the disorder on the tongue andtend to be eager to help in the discovery of the required high-flown body part. [8]

## *Sobel improved box counting method*

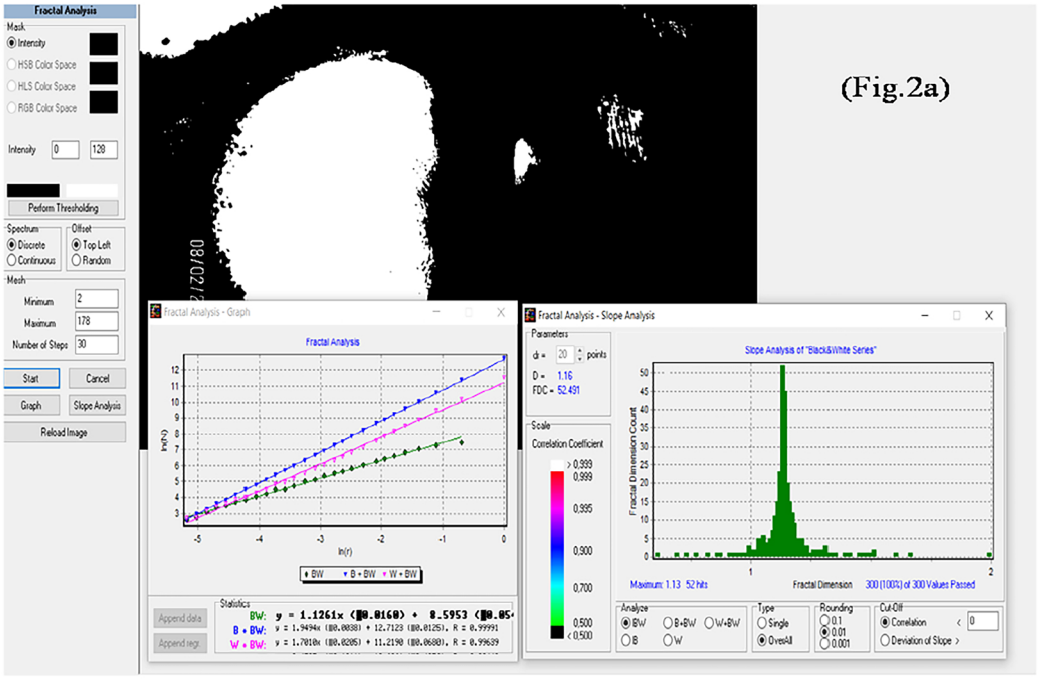
Sobel mechanics is a disjoint delimitation mechanic that enumerates an estimation of the slope of the resemblance ferocity function. Individually, in the

resemblance, the outcome of the Sobel mechanic is whichever the correlated slope direction or norm of this direction is specified by

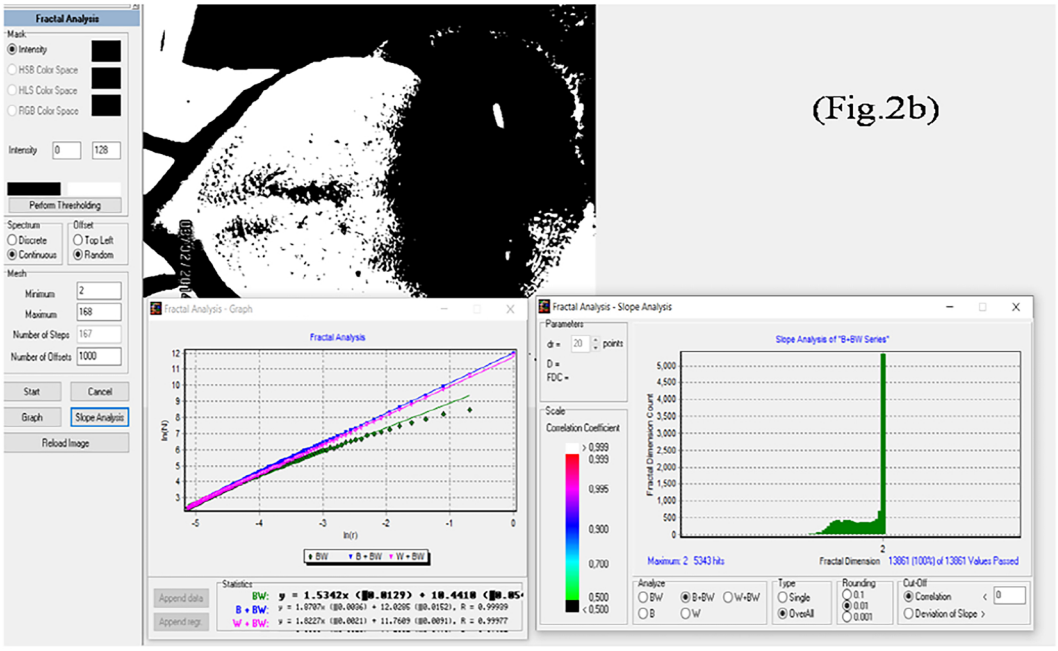
$$S_x = \frac{1}{8}\begin{bmatrix} 1 & 0 & -1 \\ 2 & 0 & -2 \\ 1 & 0 & 1 \end{bmatrix} = \frac{1}{8}\begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix} * \begin{bmatrix} 1 & 0 & -1 \end{bmatrix}$$

$$S_y = \frac{1}{8}\begin{bmatrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & 2 & -1 \end{bmatrix} = \frac{1}{8}\begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix} * \begin{bmatrix} 1 & 2 & 1 \end{bmatrix}$$

$$S_{xy} = \sqrt{{S_x}^2 + {S_y}^2}$$

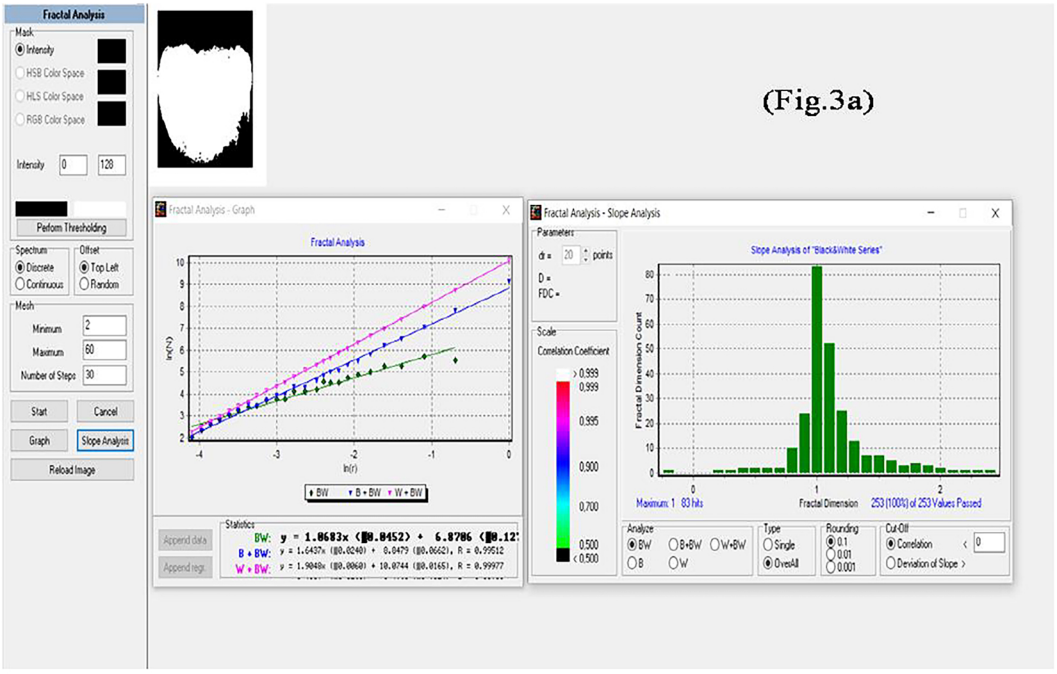



(i)

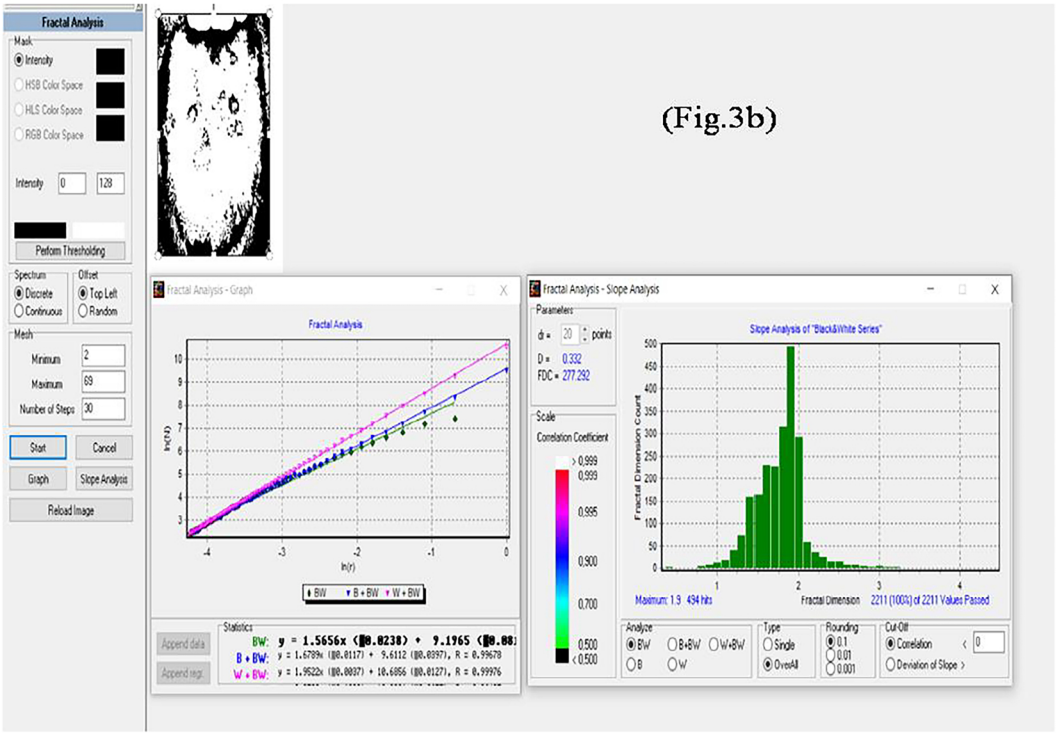



(ii)

**Fig. 4.** Graphical representation of normal tongue images-SIBCM.




(iii)




(iv)

**Fig. 4.** Continued.

Those essences are convoluted, accompanied by an unedited resemblance to enumerate an estimation of the outgrowth. $S_x$ Calculates the parallel swapping and $S_y$ the upright swapping. Lacunarity analysis has been performed after obtaining the images filtered through the Sobel Edge Detection method.

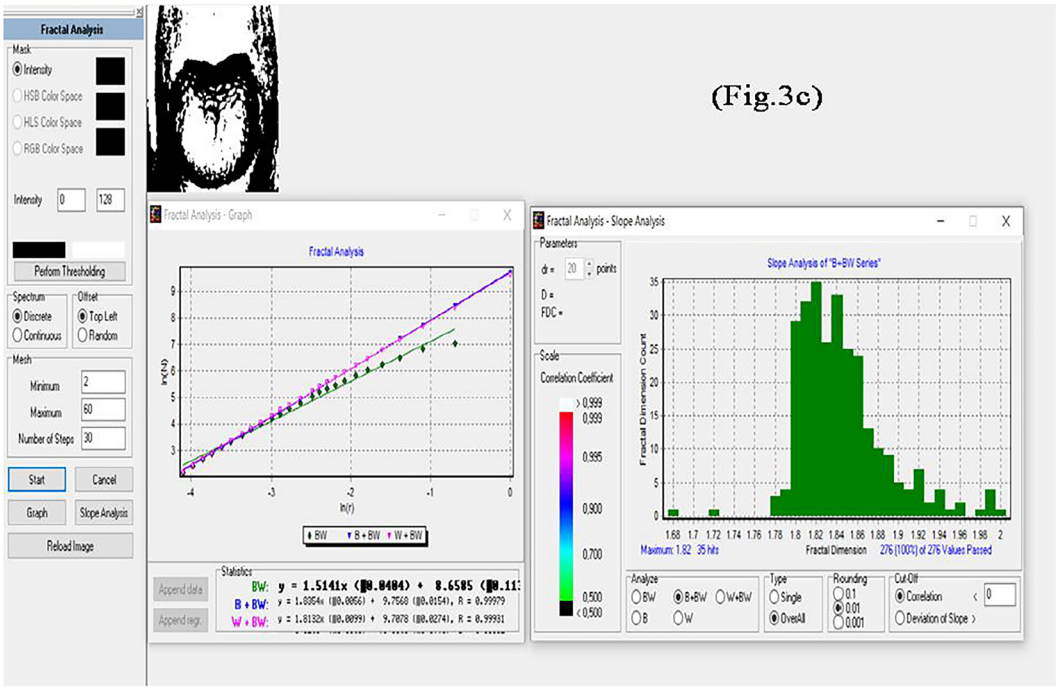



**Fig. 5.** Graphical representation of infected tongue by CBCM using HarFA.

## *Lacunarity*

Mandelbrot coined the word "Lacunarity", meaning aperture. The aforementioned is a strange stuffabout-stochastics. Aperture regulates the appearance of the entity. Appearance, in a single sensation, perchance contemplates the texture of an entity. Assuming that the least integer of aperture in an entity comesinto view as glossy (similar). Continuously alternative, an enormous integer of aperture provides the entity of

irregular texture (different). Dissimilarityis endlessly planes on the tongue so specify all the existence of apertures. Lacunaritypossesses supplications in medical science, visualization, earth science, ecosystems, as well as further. Lacunarity associated with dealing out the aperture dimension is to rate the shortage of whirling along with transformation unchanging or regularity in the resemblance the aforementioned beside lamina conditional on.

$$\Rightarrow L(r) = 1 + \left[\text{var}(r)/\text{mean}^2(r)\right]$$

Here mean (r) and var (r) are the mean and variance respectively.[10]

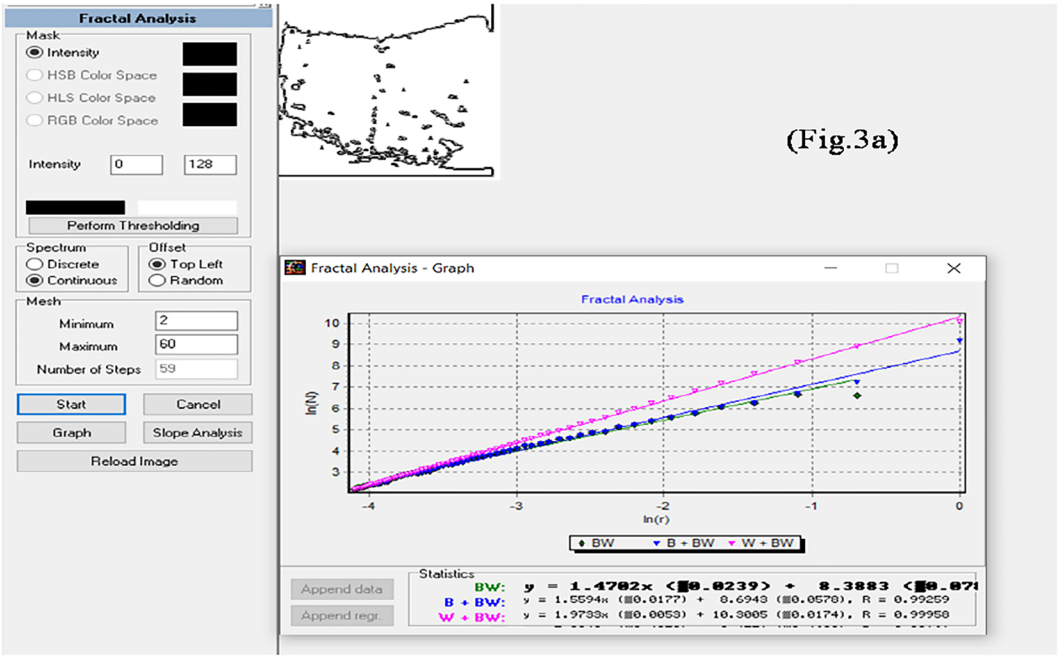
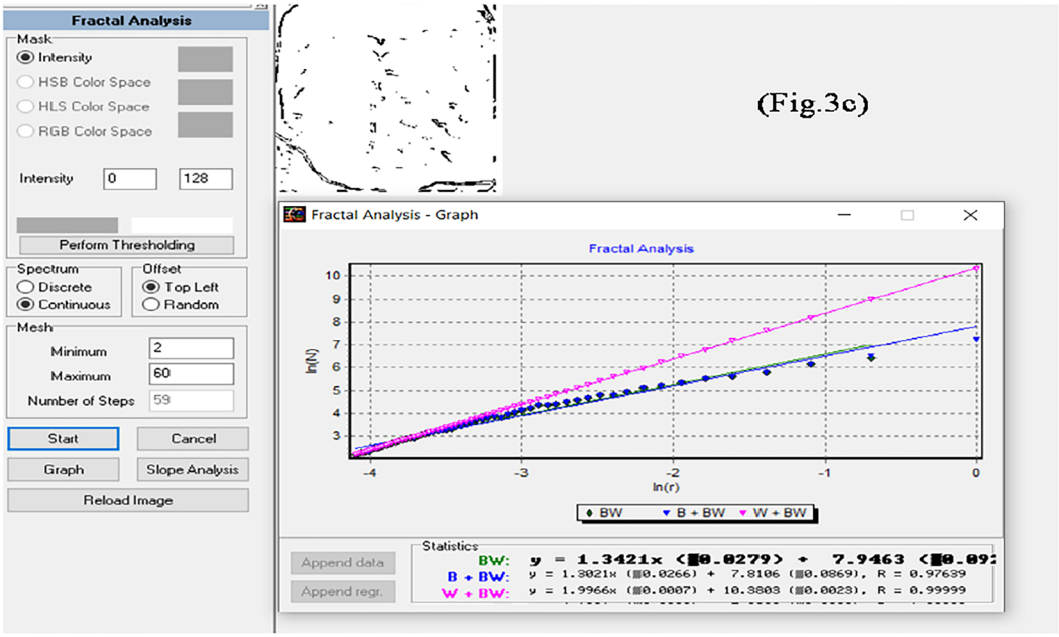



**Fig. 6.** Fractal analysis of infected tongue SIBCM using HarFA.




(iii)

**Fig. 6.** Continued.

## Results and discussion

Random dimension investigations exist and are utilized to describe transmission infection to the tongue beginning atusualinadditionfierceness. Notablyhigh–riseconstructiveintricacyexistfame for usual along with transmit infection to tongue. The size enlarges accompanied by the inclusion of spot functioning the language. The usual tongue manifests a diminish size of 1.1, while the contaminated tongues manifest an excessive dimension.[11] In Table 1, the Figs. 1 to 3 are analyzed at different scales to examine outgrowth of bacteria in Tongue by using Sobel improved Box counting method. First and second images of Fig. 4 represent the Slope analysis of normal Tongue image where the dimension value is lowest. Third and Fourth imagesrepresent the Slope analysis of Infected Tongue where the dimension value is escalating.

From Fig. 4(i) and (ii) Normal tongue image Fig. 2(a) and (b) is analysed using Sobel Improved Box Counting Method. The slope analysis will show the depth of bacteria present in tongue.

From Fig. 4(iii) and (iv) Infected tongue image Fig. 3(a) and (b) is analysed using Sobel Improved Box Counting Method. The slope analysis will show the depth of bacteria present in tongue. The depth of the sickness has been located by HarFA. Assessing whereby $N_{BW}$, $N_{BBW}$ along $N_{WBW}$ exist a hoody stochastic completely. Certain unfashionable finishes owing to the diverse picture. Look at that for SIBCM Fig. 4, Table 2, the ordinary tongue indicates a lesser size, at the same time as the inflamed ones show a higher measurement.[12,13] Normal Tongue does not contain any patches or spots on the Tongue, while the Infected Tongue is in reverse case. Slope analysis represents the depth of the infected region. Both discrete and continuous values are measured for different figures. The complex nature of Bacteria is analyzed by this unique value.

From Fig. 5(i) and (ii) Infected tongue image Fig. 3(c) and (d) is analysed using Continuous Box Counting Method. The slope analysis will show the depth of bacteria present in tongue. Once more, as in the previous case, observe that in HarFA Fig. 5(i), (ii), Fig. 6(i), (ii), (iii), and Table 3 too, CBCM shows better fractal measurement for the normal tongue than the inflamed ones. For that reason, a clean cut difference is received for inflamed along with non-fatal tongues. The Sobel side perception technique enables the recognition of the borderline concerning the tongue, which became useful within the analysis of boundary descriptors.[14]

In Fig. 6(i), (ii), (iii) Fractal analysis for the Infected Tongue Fig. 3(a), (b), (c). The remaining images can be analysed in the same way. The perimeter of the tongue varies from individual to character, for this reason indicating an infectious tongue. Knocks appearing on the floor of the tongue provide dissimilarity with the outer edge. Lacunarity evaluation Tables 4 and 5 executed, reveals that the

**Table 4.** Data inspection of tongue figures employing lacunarity.

| Figure | | Factor | Mean | SD | Variance | Lacunarity = 1 + (Var/Mean^2) |
|---|---|---|---|---|---|---|
| (a) | Original | 1 | 121.3 | 43.7 | 1909.69 | 1.129790011 |
| | | 0 | 246.6 | 35.6 | 1330.53 | 1.024132014 |
| | Histo | 1 | 129.1 | 54.3 | 2948.49 | 1.176907878 |
| | | 0 | 117.9 | 35.5 | 1260.25 | 1.090662793 |
| (h) | Original | 1 | 154.7 | 63.6 | 4044.96 | 1.169018251 |
| | | 0 | 168.7 | 49.2 | 2420.64 | 1.085055037 |
| | Histo | 1 | 149.0 | 69.2 | 4788.64 | 1.215694788 |
| | | 0 | 58.5 | 47.9 | 2294.41 | 1.670439039 |

**Table 5.** Data inspection for few tongue figures employing lacunarity.

| Figures | (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
|---|---|---|---|---|---|---|---|---|---|---|
| Primary | 1.00 | 1.00 | 1.07 | 1.08 | 1.09 | 1.08 | 1.03 | 1.05 | 1.09 | 1.07 |
| Histoexpanded | 1.01 | 1.02 | 1.4 | 1.3 | 1.6 | 1.5 | 1.35 | 1.25 | 1.32 | 1.31 |

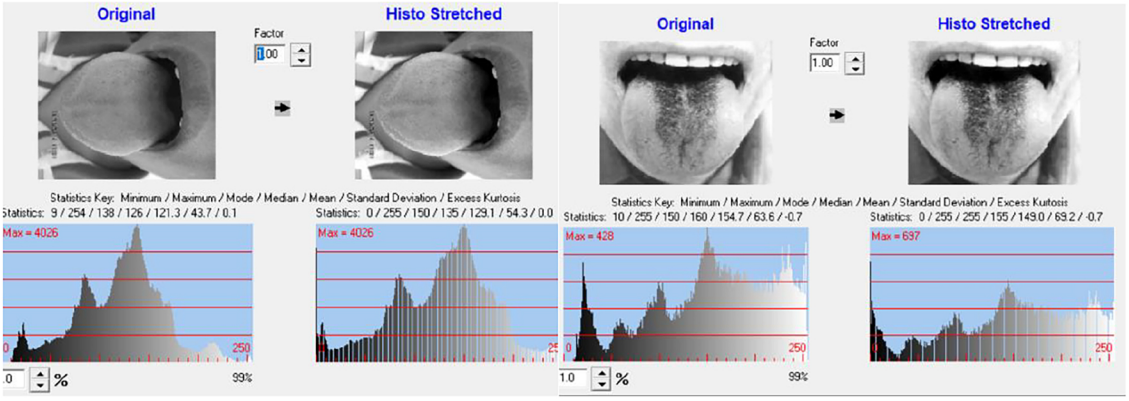



**Fig. 7.** Graphical representation of histo stretched (Lacunarity) for normal and infected tongue.

histo stretched picture of I has the least price, while II has the best price. [15,16] Excessive gap cost specifies the excessive diploma about array, that's the instance escorted by II. The infected tongue contains more gaps than the normal tongue. By using the Histo Stretched Software Lacunarity values are calculated. From Fig. 7 the lacunarity value of a normal tongue is nearly zero, whereas for an infected tongue, approximately 1 in the presence of Bacteria can be analyzed.

## Conclusion

More samples were analyzed, and only a few of the samples are discussed here. The spot on the tongue may be dissimilar on account of systematic along with unusual language that is examined by HarFA, a random assessment ofan application. This patch suggests the presence of bacteria on the tongue. The size manifests the depth of the disorder. Gapse evaluates the appearance of the tongue, i.e., the lamina, along with the diffusion of the unoccupied region. Out of the particular process, the depth of disorder that might exist is noticed. The excessive size implies the superiority of the potency of the infection. Tongue escorted by further inky spots exhibits superior dimension. The stochastic computation of dimension will no doubt that take placein almost all hoping appliances on the account of successive therapy choices by the numerous therapeutic circumstances. This will be extremely favorable on the account of testification by determining the illness together with the satisfactory treatment.

## Authors' declaration

- Conflicts of Interest: None.
- We hereby confirm that all the Figures and Tables in the manuscript are ours. Furthermore, any Figures and images, that are not ours, have been included with the necessary permission for republication, which is attached to the manuscript.
- Authors sign on ethical consideration's approval.
- No animal studies are present in the manuscript.
- Ethical Clearance: The project was approved by the local ethical committee at Vels University.

## Authors' contribution statement

G.J contributed to developing the research idea, collecting samples and analyzing result. S.P wrote the paper, conducting test, analyzing the results and send it to the journal for publishing.

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# إنشاء البكتيريا في اللسان التشخيصي باستخدام الطرق الكسورية

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جامعة فيلس، تشيناي، الهند.*(VISTAS)* قسم الرياضيات، معهد فيلس للعلوم والتكنولوجيا والدراسات المتقدمة

## الخلاصة

تلعب البكتيريا دورًا حيويًا في المساعدة على الهضم والحماية من العدوى الضارة. ومع ذلك، فإن البكتيريا سالبة الجرام الموجودة في اللسان لها بعض العيوب في جسم الإنسان. ويمكن تشخيص هذه العيوب باستخدام مفهوم الكسور.يمكن قياس الشكل غير المنتظم للبكتيريا وطبيعتها المعقدة باستخدام أبعاد كسورية تظهر تشابهًا ذاتيًا بمقاييس مختلفة. تتعمد عملية القياس الكسورية عدم التشابه وتعقيد السطح للبقعة التي تشمل اللسان على اللسان. يتم تحليل صورة اللسان باستخدام طريقة HarFa الكسورية. يتم استخدام طريقة العد المربعة المحسنة من Sobel لحصر نمو البكتيريا في اللسان.إن الخلل هو فحص الفواصل الموجودة في اللسان. وتشير قيمة الخلل المتزايدة إلى درجة شديدة من التباين. ويخضع لتصميم احترافي للنسب التي تحتوي على آراء حول بُعد كيفية تعبئة الكيان للقدرة. بالإضافة إلى ذلك، يؤدي الاصطدام المرتفع على الجلد إلى تعميق نمو البقع التي تغلف اللسان من خلال تكوينات عديدة، وبالتالي تعديل اللسان الشائع إلى تشوه. لفحص المنطقة المصابة في اللسان وتقدير حجمها، استخدم العملية الحسابية لإجراءات الإنقاذ جنبًا إلى جنب مع زيادة طبيعة التشخيص

**الكلمات المفتاحية:**البكتيريا، الكسيريات، تحليل HarFa، الفجوة، تشخيص اللسان.