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The Effect of Cold Plasma on Skin Using Texture Analysis

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Abstract: *this research presented a new technique of using the effect of microwave plasma on the a skin,four groups of mice are used in this search with different time of exposure the time of exposureare" (20,50,90)" a control group is also used to compare the result. The microwave plasma which is used in this search has a voltage of about "175v and gas flow on 2 with room temperature", the textural features and the statistical features are obtained from the second order co-occurrence matrix, in which the textural images which has been obtained shows that the plasma effected the skin when it exposure for different time.*

Keywords: *microwave plasma, textural analysis, skin care, second order features.*

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I. Introduction

Plasma is commonly an ionized gas. It is combine of charge particles (electron, ion and molecules). The term ionized return to the existence of one or more free electron. Which are not required to an atom or molecules. The new technology in the field of physical plasma is the microwave plasma which defined as electromagnetic waves with wavelength ranging from (1mm) to (1m) and with frequency ranging from (300 GHz) to (300 MHz) [1,2].(shad thesis) Texture is an important feature for the analysis of many types of images[3,4]. Texture analysis is one of the most important techniques used for the analysis and classification of image regions where repetition of image pixels occurs [5]. An important approach to area description is to quantify its texture content. There is no formal definition of texture exists however, this descriptor provides intuitively many measures of properties such as smoothness, coarseness, and regularity.Statistical approaches yield characterizations of textures asgrainy, smooth, coarse, and so on. Structural techniques focus on the arrangement of image primitives, such as a description of texture based on regularly spaced parallel lines [6]. In statistical texture analysis, texture features are calculated from the statistical distribution of combined intensities at specified positions relative to each other in the image. Statistics is classified as first-order, second-order and higher-order statistics, according to the number of the intensity points (pixels) in each combination [7,8].

II. Medical plasma

The earlier report from medical plasma focusing on the usage of argon plasma for chronic wound treatment in the skin surgery. Argon plasma also can be used in medical practice as a source of gaseous nitric oxide. The result of using argon plasma on animals showing that there is no side effect on the tissue and there is no respiratory problem and not finding any acute or chronic inflammatory[9].

Skin care : the bacteria or fungal side effect are causing many dermatological problems. There are thousand skin disease of acneiform eruption, dermatitis, melanocytic (cancerous), pruritic to vascular related affliction, the plasma can help by reduce the complication of bacteria and fungi in future the designer of plasma can be treatment some disease themselves may become possible[8].

Textural analysis

In statistical texture analysis, texture features are calculated from the statistical distribution of combined intensities at specified positions relative to each other in the image. Statistics is classified as first-order, second-order and higher-order statistics, according to the number of the intensity points (pixels) in each combination [7].

second order statistics: The category of second order statistics include gray level co-occurrence matrix. Haralicket. al suggested that there is 14 feature can be obtained from GLCM which contain information about image textural characteristics[8].

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GLCM have information about the position of pixel having similar gray level values. It is two dimensional array $P(i,j)$, both row and column represent the set of possible image value.
$P_d(i,j) = n_{ij}$ wheren_{ij} represent the number of co-occurrence of the pixel value (i,j) lying at distance d in the image.
The co-occurrence matrix P_d has dimension $n \times n$, which n is the number of gray level value in the image. The texture feature that derived from co-occurrence matrix are [10]:
The most important features which are used in this search are:

1- Contrast : it determines the intensity difference between a pixel and its neighborhood, it can be represented by the following equation: [11].

$$contrast = \sum_{i\,j=1}^{n} P_d\,(i,j)^2 \text{.....(1)}$$

2- Correlation : it measuring the pixel correlation and how it correlated with its neighborhood pixels its value lies between (-1 and +1), when the value is (-1) its negatively correlate and when its (+1) its positive correlate, it define as [11,12]:

$$correlation = \sum_{i=0}^{G-1} \sum_{j=0}^{G-1} \frac{P(i,j)(i-\mu_x)(j-\mu_y)}{\sigma_x \sigma_y} \text{.....(2)}$$

μ_x, μ_y : mean value in the x and y direction.
σ_x , σ_y : standard devation in both direction (x,y).

3- Homogeneity: measuring the purity of the image texture, it can be represented by the following equation[13]:

$$Homogeneity = \sum_{i,j}^{G-1} \frac{P_d}{1+(i-j)^2} \text{.....(3)}$$

4- entropy :it is the sum. Of squared elements. Its range from (0 to 1) its inversely proportional to the entropy it can be represented by the following equation [14]:

$$entropy = \sum_{i,j=0}^{G-1} (P_d\,(i,j))^2 \text{.....(4)}$$

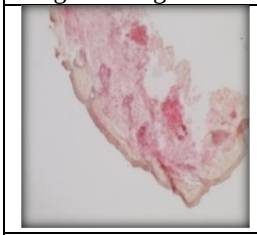
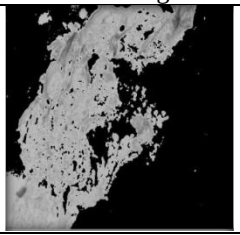
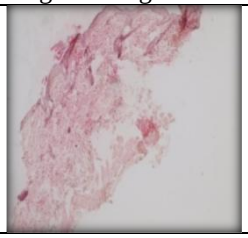
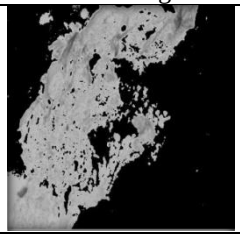
III. Methodology

four groups of mice are exposure to plasma by removing the hair of the mice , the time of exposure is 20,50,90 and the control case. The tissue samples are processed and then sections are placed onto glass slides to organize them at many magnification levels to view the change in the tissue after delivering dose of plasma. The biologist examine these glasses by imaging it under microscope to analyze these image by digital image processing technique. Therefore histology provides a scientific foundation for clinical research, education, and practice[15]. The threshold is used to remove the glass of the slid which appear as white region and may affect the textural analysis result. the threshold is obtained by the following equation , in which the value of T is chosen from the histogram.

A pixel becomes{ white if its grey level is > T
black if its grey level is≤ T. (5)

IV. Discussion

1. Control group:the group include 4 mice used as control without any exposure, Figure (1) shows the control group for the texture image and the threshold image, a threshold techniqueis used to get the skin texture from the back ground of the imagessixteen mice are taken for search, each group are taken four mice.The texture images are taken with magnification of 10X from the microscope.table (1) shows the texture features for the co-occurrence matrix for the control group.

Original image Mice.1	Threshold image	Original image Mice.2	Threshold image
			
Original image Mice.3	Threshold image	Original image Mice.4	Threshold image

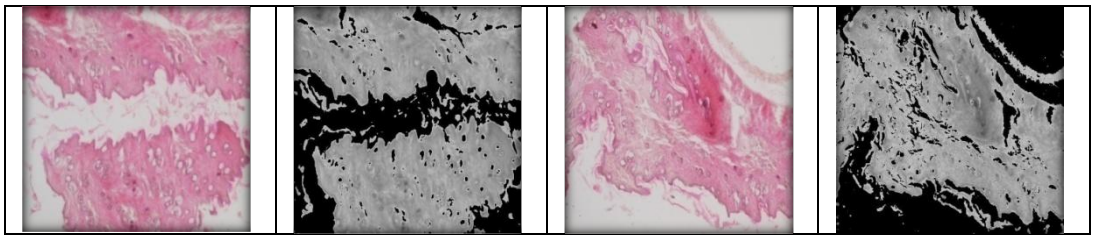


Figure (1) shows the texture image and threshold image for control group (skin case).

Table (1) the texture feature of co-occurrence matrix for control group (skin case).

No. of Mice	Contrast	Correlation	Energy	Homogeneity
1	0.5153	0.95365	0.4038	0.95355
2	1.08795	0.90155	0.35575	0.9044
3	1.16445	0.85065	0.2307	0.87755
4	1.64665	0.82425	0.1824	0.8391
Average	1.103588	0.882525	0.293163	0.89365

2. **Second group (skin case)** : the mice exposuring to microwave plasma for 20 second, figure (2) represented the second group which is the skin case exposure to 20 second. table (2) presented the second order statistical features.

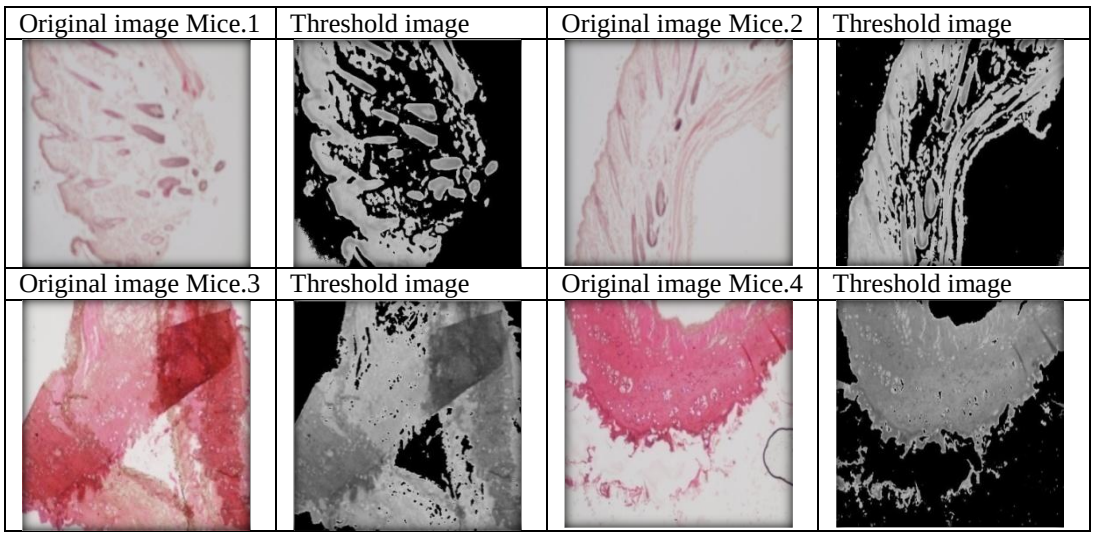


Figure (2) shows the texture image and threshold for (20 second exposure) skin case**.**

Table (2) the texture feature of co-occurrence matrix for Second group with 20 second exposuring to microwave plasma (skin case).

No. of mice	Contrast	Correlation	Energy	Homogeneity
1	1.59215	0.85505	0.3519	0.8949
2	1.60075	0.86225	0.3407	0.8918
3	0.8072	0.86145	0.14595	0.8975
4	0.80145	0.89445	0.2857	0.90885
Average	1.200388	0.8683	0.281063	0.898263

3. **Third group (skin case)** : the mice exsposure for 50 second to microwave plasma. Figure (3) represented the third group which is the skin case exposure to 50 second. the features are mean, entropy, mean square and energy. Table (3) listed the texture feature extracted from the second order co-occurrence matrix for the third group which exposure to 50 second of microwave plasma.

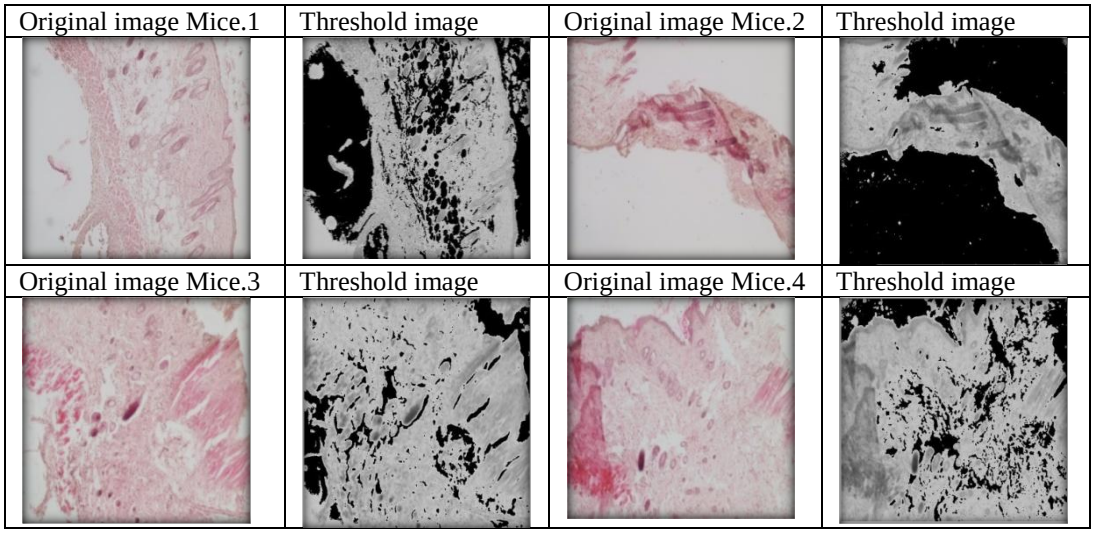


Figure (3) shows the texture image and threshold for (50 second exposure) skin case.

Table (3) the texture features of co-occurrence matrix for Third group with50 second exposuring to microwave plasma

No. of Mice	Contrast	Correlation	Energy	Homogeneity
1	2.2708	0.79345	0.22955	0.9428
2	0.52235	0.94935	0.38865	0.82435
3	1.4721	0.76055	0.35945	0.85015
4	2.14745	0.70765	0.24185	0.8348
Average	1.603175	0.80275	0.304875	0.863025

4. **Fourth group (Skin case)**: the mice exsposure to90 secondof microwave plasma. figure (4) represented the fourth group which is the skin case exposure to 90 second. table (4) listed the texture feature extracted from the second order co-occurrence matrix for the third group. Table (4) shows the average value for the statistical features for laws mask and co-occurrence matrix.

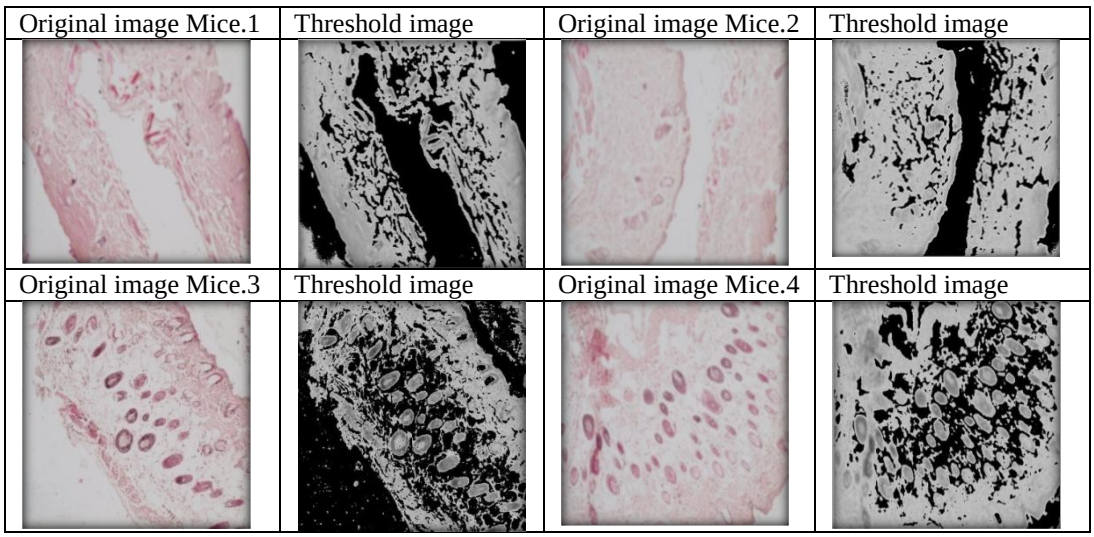


Figure (4) shows the texture image and threshold for (90 second exposure) skin

Table (4) The texture feature of co-occurrence matrix for Third group with 90 second exposuring to microwave plasma

No. of Mice	Contrast	Correlation	Energy	Homogeneity
1	1.953	0.82235	0.256	0.8612
2	1.5089	0.83145	0.8606	0.89645
3	3.13265	0.7032	0.2018	0.7724
4	2.38735	0.75995	0.24345	0.8369
Average	2.245475	0.7792375	0.3904625	0.8417375

Figure (5) and table(5) represented the co-occurrence feature for the skin, the contrast increase with increasing the exposure time (i-e) the difference in the intensity between the adjacent pixel increase and the texture become more regular with the plasma exposure. The correlation curve show decreasing with exposure to plasma (i-e) neighborhood pixel become less correlated with each other and the homogeneity curve shows increasing at 20 second and the curve decrease with time of exposure, the homogeneity measure how much the neighboring pixel are homogenous with each other.

Table (5).Co-occurrence matrix in (control, 20 second, 50 second, 90 second) exposure to plasma.

Statistical features	control group	20 second	50 second	90 second
Contrast	1.1035875	1.2003875	1.603175	2.245475
Correlation	0.882525	0.8683	0.80275	0.7792375
Energy	0.2931625	0.2810625	0.304875	0.3904625
Homogeneity	0.89365	0.8982625	0.863025	0.8417375

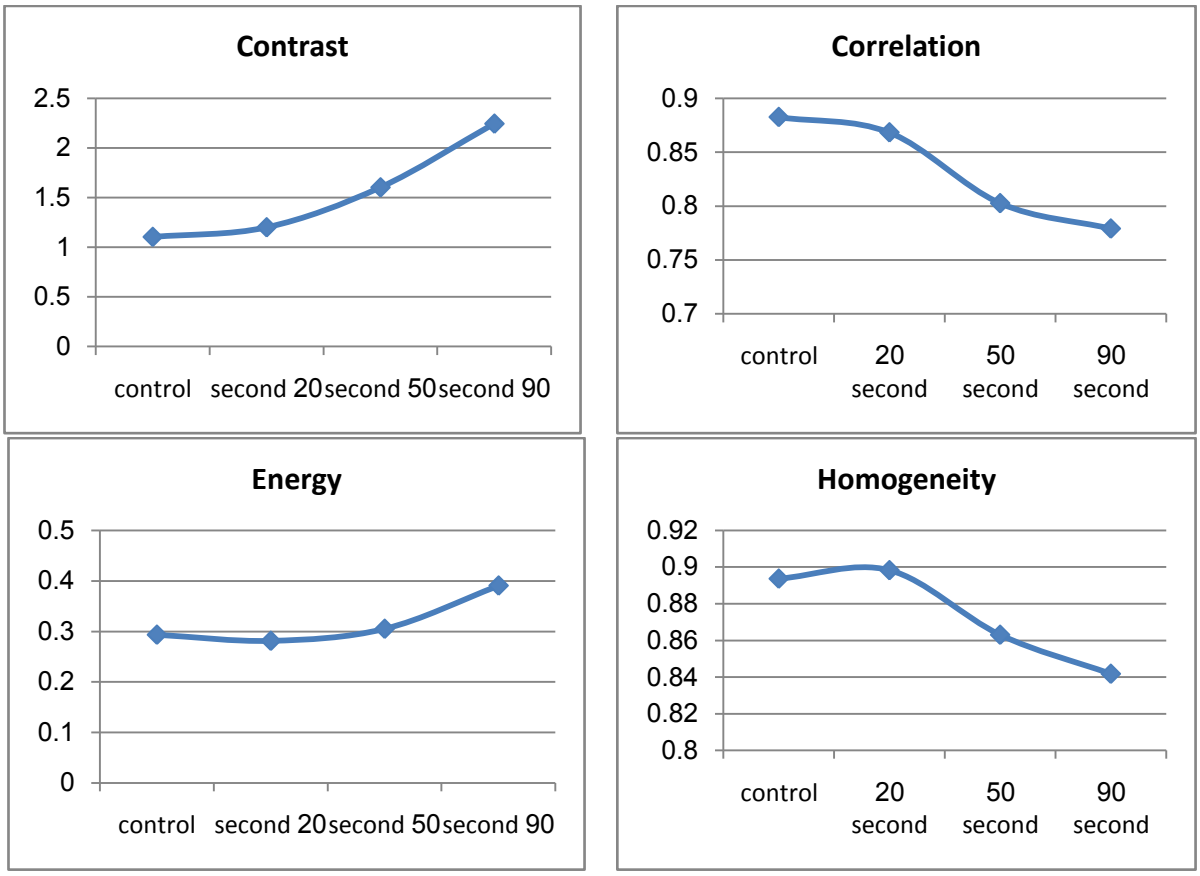


Figure (5) shows the curve for the statistical featuresof the co-occurrence matrix .

V. Conclusion

1. The microwave plasma effected on the skin.
2. The value of Homogeneity reach it maximum in 20 second in which the tissue shows it response.
3. The energy reach it maximum value in 90 second this means that the skin tissue become more pure and clean, since the energy proves the number of gray level in the image and when the energy is high the number of gray level decrease.
4. the value of the contrast increased withtime exposure. and the correlation value decreased with time increasing the plasma
5. the skin become more regular and clean by using the plasma effect

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