ISSN: 0067-2904

The Effect of Cold Plasma on pH, Creatine, and the Concentration of the Most Trace Elements in Human's Nails by Using X-ray Fluorescent Method

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Received: 24/1/2021 Accepted: 10/2/2022 Published: 30/5/2022

Abstract

The aim of this study is to determine the effect of cold plasma on nails pH, creatine levels and the accumulative of some trace elements in humans nails. Creatine levels in the blood, as well as pH and trace elements, were measured before and after (1, 2) months of plasma exposure in both gender (men and women) between the ages of 22 and 25 years. Nails are exposed to cold plasma with a voltage of (175 volts) and (2 gas flow). After one month of exposure, there was no significant change in the levels of all parameters, but after 2 months, the concentration of creatine and pH had reached a near- neutral value. In both men and women, calcium concentration increased and showed a positive response to cold plasma, while the vanadium element concentration did not change over time and remained stable at (7.3×10-4). The results clearly suggest that men respond more than women. The best results were obtained after two-month period of exposure.

Keywords: Microwave plasma, XRF, Trace elements, PH, Creatine, humans nails.

تأثير البلازما الباردة على درجة الحموضة والكرياتين وتركيز معظم العناصر النزرة لأظافر الإنسان بأستعمال طريقة الاشعه السينيه الفلوريه

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الخلاصة:

الهدف من الدراسة هو استعمال طريقه الاشعه السينية الفلورية لتحديد تاثير البلازما البادرة على مستويات الحموضه والكرياتين و على تراكم بعض العناصر النزرة في الاظافر . تم قياس مستوى الكرياتين في الدم ومستوى الحموضه وتراكم العناصر النزرة قبل وبعد مرور شهرو شهرين من التعرض للبلازما الباردة لكلا الجنسين (الرجال والنساء) الذين تتراوح اعمارهم بين 22–25 سنة . تم جمع 2 مل من الدم لكل عينة في انابيب اختبار للفحوصات البايولوجيه . تم تعريض الاظافر للبلازما الباردة بفولتيه 175 فولت و 2 تدفق الغاز . اشارت النتائج ان بعد مرور شهر من التعريض لم تكن هناك اي تغير كبير في جميع القياسات , لكن بعد مرور شهرين ازداد مستوى الكرياتين وكذلك مستويات الحموضه كانت قريبه من القيمه المحايدة . ازداد تركيز عنصر الكالسيوم واظهر استجابه جيدة للبلازما الباردة في كلا الجنسين لكن تركيز عنصر الفاناديوم لم يظهر اي تغير بالتركيز في جميع الازمان وظل ثابتا" عند $7,3\times10^{-4}$. تشير النتائج بوضوح الى ان الرجال يستجيبون للبلازما اكثر من النساء ، تم الحصول على افضل النتائج بعد مرور شهرين من التعرض.

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1. Introduction

The interaction of non–thermal plasma (microwave plasma) with living tissue is widely used in medicine applications as treatment and in health care[1]. Treatment depends on building and regenerating damaged tissues, such as its ability of stopping bleeding without damaging surrounded tissue[2][3]. Human nails can be treated with microwave plasma. Its effect on human nails is studied by measuring the creatine level in blood and pH of nails . The creatine level in blood is related to nails health and it is different according to gender and weight. pH is a chemical property of a substance, and through it the nature of the substance can be identified ,whether it is acidic or basic by measuring the positive ions as (H_3O) and negative ions as (OH)[4]. The pH is a measure of the acidity or alkalinity of any substance and is measured with a scale between (0-14)[5][4]. Any substance with a pH between 0 and 6.9 is acidic, with a pH of 7 is neutral, and with a pH of between 7.1 and 14 is alkaline. Nails consist mainly of creatine as additional organs of the skin. It is produced from cells in the epidermis. The nails consist of a nail plate and a nail bed which are rich in blood vessels, that is why a doctor looks at nails during a medical examination. The PH of nails ranges between 4.5 and 5.5; this is a balanced PH that prevents the growth of fungi and bacteria.

Trace elements, such as cobalt, lead, vanadium, iron and calcium, with very small amount in the body are very important for active action and for organizing vital processes[6-9]. A deficiency in these elements leads to a dysfunctional defect in the function of cells[10]. The function of each of these trace elements depends on their composition and position in the body organs; calcium constitutes an important part of the mass of teeth and nails. Cobalt is essential because it is a vitamin supplement and essential for the metabolism of folic acid. Lead is considered a toxic substance if it is in high proportion, and due to the similarity in chemical properties between calcium and lead, lead accumulates in the bones and nails[9]. Trace elements have been measured in nails using spectroscopic analysis such as the X-ray fluorescence (XRF) method[6]. For the analysis of trace elements, the X-ray fluorescent method was used, whereby a heavy beam of charged particles irradiates samples and electrons are ejected from the inner layer of atoms [7]. The voids are filled with electron from outer layer and distinctive X-ray is emitted[8].

The aim of this study is to study the effect of cold plasma on human nails by measuring the creatine level due to its effect on nails health.

2. Materials and Method

(2ml) of blood samples were collected from men and women whose age were between (22-25 years old) before and after they were treated with plasma along (1 and 2 months). The creatine levels were estimated in blood samples using a creatine kit (Agappe Company and India origin).

Human nails were treated with cold plasma, with voltage of (175 v), before cutting nails. Plasma was applied at a distance of 3cm between the plasma source and the nails for (1min) each day for 1 and for 2 months. The nail pH was measured using the skin pH meter before and after exposure to plasma. The instrument was calibrated using pH buffers of values 3.0 and 7.0 at the beginning of each day. For every measurement, the probe was washed with distilled water and applied at right angle to the nail plate with gentle pressure for about one minute before the pH was read. The measurements were done in an air-conditioned room where the temperature ranged from 20.1 ^{0}C to 25.2 ^{0} C (mean 22.8^0 C).

After 1 month, the nails were cut, dried at (30^0 C) and grinded into powder for XRF examination. This method was used to find the amount of the accumulation of some trace elements. This step was repeated after 2 month of exposure to cold plasma.

3. Result and Discussion

The creatine levels of nails, for both men and women, were measured before exposure to cold plasma and after 1 month of exposure and after 2 months of exposure. The results of creatine analysis are shown in Tables (1and 2) and Figures (1and 2).

Table 1-The values of Creatine level for men

Sample No.	*Creatine level before exposure mg/dl*	*Creatine level after exposure(1month) mg/dl*	*Creatine level after exposure(2month) mg/dl*
1	0.95±12.3A	0.94±1.0A	0.99±1.2B
2	0.82±1.3 A	0.81±12.2A	0.89±1.5B
3	0.85±10.2A	0.86±14.1A	0.90±2.0B
4	0.99±10.2A	0.98±0.6A	1.01±1.3B
5	1.01±1.5A	1.00±0.5A	1.23±10.2B
Mean	0.924	0.923	0.98

Note: Different characters mean a significant change (P≤0.05).

Table 2-The values of Creatine level for women

Sample no.	*Creatine level before exposure mg/dl*	*Creatine level after exposure(1month) mg/dl*	*Creatine level after exposure(2month) mg/dl*
1	0.52±1.5A	0.52±10.2A	0.55±4.0B
2	0.61±1.0A	0.60±3.8A	0.65±10.1B
3	0.43±10.2A	0.44±2.1A	0.46±10.2B
4	0.44±0.2A	0.44±14.1A	0.48±0.5B
5	0.50±2.8A	0.50±4.0A	0.55±3.8B
Mean	0.5	0.5	0.53

Note: Different characters mean a significant change (P≤0.05).

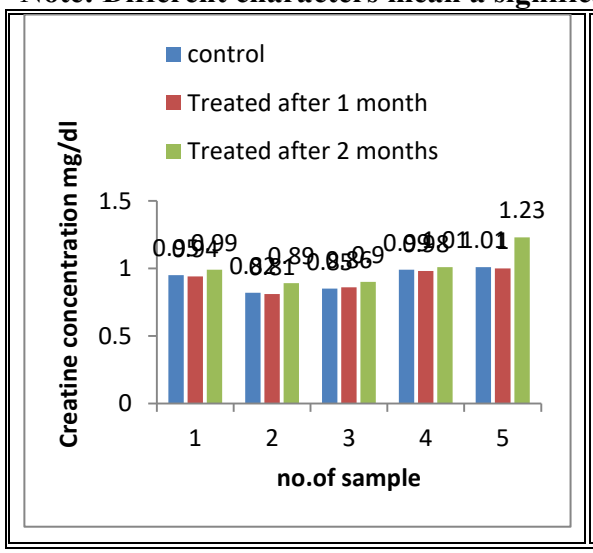


Figure 1-Levels of Creatine for men.

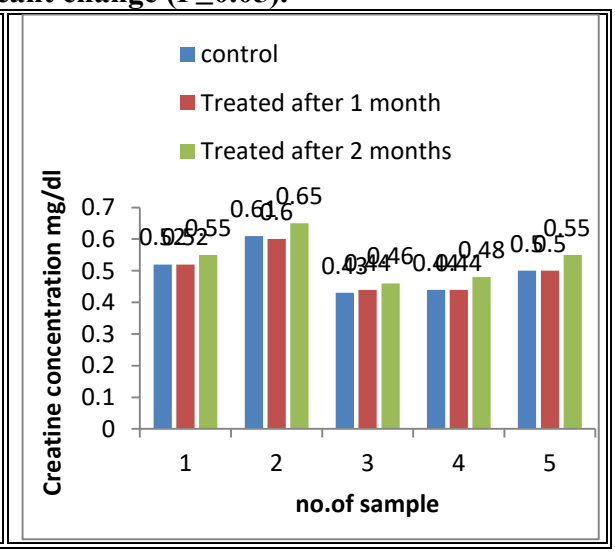


Figure 2- Levels of Creatine for women.

3.1 Result of pH

The results of pH analysis are shown in Table (3) and Figures (3 and 4).

Table 3-The values of pH level for men and women

	PH meter for men		***PH meter for women***	
Sample no.	**PH Before treatment**	**PH after treatment**	**PH Before treatment**	**PH after treatment**
1	4.2	5.6	3.2	4.5
2	5.0	5.2	4.2	5.5
3	4.1	6.5	4.0	5.5
4	5.2	6.4	3.5	4.5
5	6.0	6.3	5.0	5.3
Mean	4.9	5.9	3.9	5.1

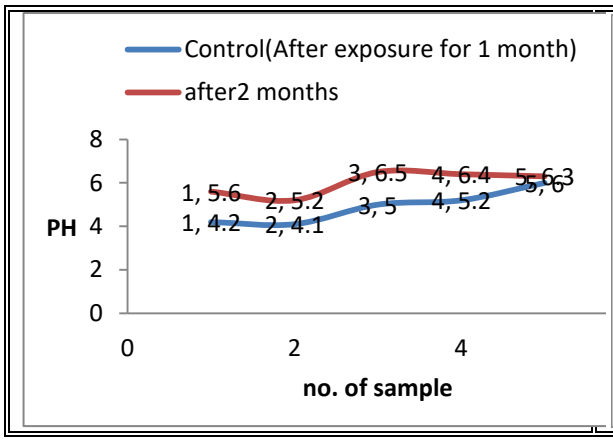


Figure 3- Levels of pH for men.

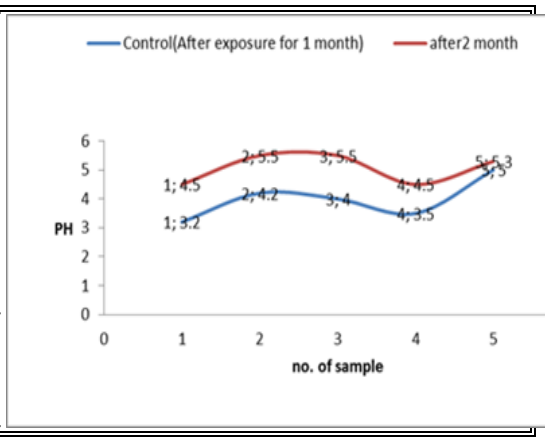


Figure 4- Levels of pH for women.

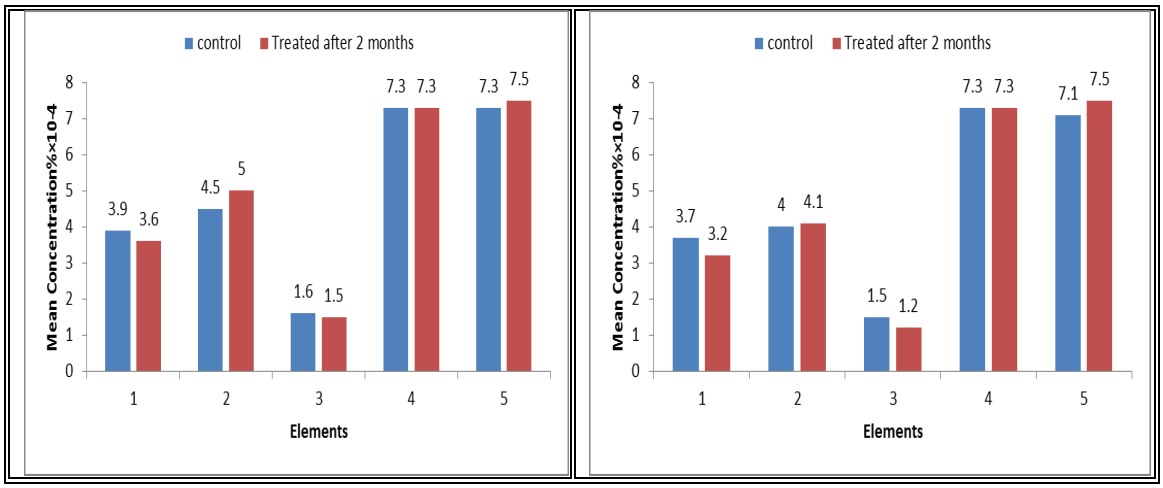
3.2 Result of X-ray fluorescent

This method was used to find the concentration of some trace elements such as iron, cobalt, lead, vanadium, and calcium. The results are shown in Table (4) and Figure (5)(a and b).

Table 4-Mean Concentration of most Trace element and Calcium for men and women

		Men	***Women***		
No. of element	**Trace element**	**Mean con. % Before treated $\times10^{-4}$**	**Mean con. % after treated (2month) $\times10^{-4}$**	**Mean con. %Before treated $\times10^{-4}$**	**Mean con. % after treated (2 month) ×10-4**
1	Cobalt	3.9±0.4A	3.6± 0.3 B	3.7±0.2A	3.2±0.4B
2	Iron	4.5±0.2 A	5±0.1A	4±0.2A	4.1±0.2A
3	Lead	1.6±0.1A	1.5±0.2A	1.5±0.5A	1.2±0.2B
4	Vanadium	7.3±0.5A	7.3±0.5A	7.3±0.4A	7.3±0.5A
5	Calcium	7.3±0.2A	7.5±0.3B	7.1±0.1A	7.5±0.3B

Note: Different characters mean a significant change (P≤0.05).



(a) **(b)**

Figure -5 Mean concentrations of elements (a) for men (b) for women.

4. DISCUSSION

The results showed that creatine levels increased after exposure to cold plasma for 2 months for both genders, men and women. There was no change in the mean concentration of creatine after 1 month, which was constant at (0.92mg/dl) and (0.5mg/dl) for men and women, respectively; that means, the microwave plasma has no effect for this period of time. The mean concentration of creatine of both men and women increased to (0.98mg/dl) and (0.53mg/dl), respectively after 2 months of exposure to cold plasma. This means that there was a good response of human nails to cold plasma. The figures and the tables showed that the amount of response in men was greater than in women due to the differences in muscles weight between them. The cold plasma stimulated the skin to produce the creatine protein which is responsible of producing layers of nails and its health. From Table 3 and Figures 3 and 4,the effect of cold plasma on nails pH can be noted. pH changed after using cold plasma for both genders at the same condition. The mean of pH of women was 3.9, hence it is acidic and it is greater than the pH of men due to using cleaning powders. But after treatment with cold plasma the acidity of nails was decreased for both genders. The mean pH changed from 3.9 to 5.1 in women and changed from 4.9 to 5.9 for men. The mean pH was nearly the neutral value. Table 4 and Figure (5, a and b) show that there is a significant change in cobalt concentration after 2 months of treatment with cold plasma for both genders, while there was no change of iron and vanadium concentrations. This means that cold plasma has no effect on iron and vanadium trace elements. As for lead concentration, there was no effect in men, but there was a significant decrease in the concentration of lead in women. There was a significant change in calcium concentration in both genders due to the effect of plasma energy on skin in stimulating vitamin D which is responsible on accumulative calcium [11][12].

5. CONCLUSION

According to the figures and tables, cold plasma had no effect on nails pH level, creatine concentration, and trace elements concentration after 1 month of exposure on all subjects. The cold plasma had a significant effect on creatine concentration, pH level and on the concentrations of the trace elements cobalt, lead and calcium after two months of exposure. While, it has no effect on the concentration of vanadium and iron trace elements for men and women. Because of the difference in physique and muscle mass between men and women, the response rate for men was higher than for women, according to the results.

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