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"Copper" coins as an anti-inflammatory agent

Yuri Pivovarenko*
Research and Training Center 'Physical and Chemical Materials Science' Under Kyiv Taras Shevchenko University and NAS of Ukraine, Kiev, Ukraine
Corresponding Author: Yuri Pivovarenko. Research and Training Center 'Physical and Chemical Materials Science' Under Kyiv Taras Shevchenko University and NAS of Ukraine, Kiev, Ukraine
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Abstract

Since the sensitivity of pathogenic bacteria to antibiotics creates intractable problems, doctors are forced to look for other anti-inflammatory means. Considering this, the anti-inflammatory properties of copper metal and its alloys deserve attention. At the same time, the lack of acceptable ideas about the nature of the phenomena that determine the anti-inflammatory properties of metallic copper and its alloys complicates their medical use. Given this state of affairs, it is proposed here to link the anti-inflammatory effect of metallic copper and its alloys with their ability to negatively electrify both human tissue and the bacteria and viruses present in them. This article presents the facts and ideas on which this proposal is based.

Keywords: metal therapy; copper; inflammation; cancer; thrombosis

Introduction

It was previously established that a number of microorganisms pathogenic to humans quickly die upon contact with the surfaces of metallic copper and copper alloys at room temperature. In particular, it has been shown that contact with such surfaces is fatal both for pathogenic bacteria such as *Salmonella enterica*, *Campylobacter jejuni*, *Escherichia coli*, *Staphylococcus aureus*, *Clostridium tetani*, *Listeria* (along with their forms insensitive to antibiotics), and for polio viruses, influenza A, bacteriophage T7, etc. [1-14]. These properties of metallic copper and its alloys were usually associated with the direct effect of copper ions on biological molecules, as well as with the indirect effect of ROS that occurs upon contact with metallic copper and its alloys [2, 15-21].

Although these explanations have become generally accepted, their universality is questionable, since the application of corrosion-resistant copper alloys, which are not capable of releasing copper ions, to human skin also produces an anti-inflammatory effect [22]. In addition, these explanations do not take into account the fact that it is ROS that contribute to various human diseases, including inflammatory diseases [23-25], as well as the fact that the contact of copper metal and copper alloys with human skin is beneficial for humans [22]. Taking all this into account, it was suggested that the healing properties of metallic copper and its alloys are due to their electron-donating ability in relation to aqueous media.

It is worth noting here that this assumption was based on Kyon's rule: when two phases come into contact, the phase with a higher dielectric permeability acquires a positive charge, and the phase with a lower dielectric permeability acquires a negative charge [26]. So, since the dielectric permeability of water is ~ 81 at room temperature and ~ 75 at 37 ^{0}C [26-28], while the dielectric permeability of metals is usually taken equal to ∞ [28], all corrosion-resistant metals, i.e. not releasing the corresponding ions into aqueous environments must acquire a positive charge, and their aqueous environment must acquire a negative charge. At the same time, this assumption took into account the fact that copper is located immediately after hydrogen in the electrochemical voltage series and, therefore, gives up electrons more easily than other corrosion-resistant metals [26].

Thus, an explanation for the antifungal, antibacterial and antiviral properties of metallic copper and its alloys was proposed that differs from the generally accepted one. Given the unusual nature of this explanation, it needed obvious evidences. Taking this into account, experiments were carried out, the results of which can be considered as necessary evidence. I hope that the presented results and their interpretation will be useful to doctors of various specialties.

Materials and methods

Firstly, the previously established dependence of the shape of salt crystals on the electrical potential of the water used to dissolve it was used here (Figures 1-3).

Figure 1. It is the crystals that formed after the drying of solutions of KH_2PO_4 prepared on the water with potentials of +250 mV (left) and –250 mV (right) [29].

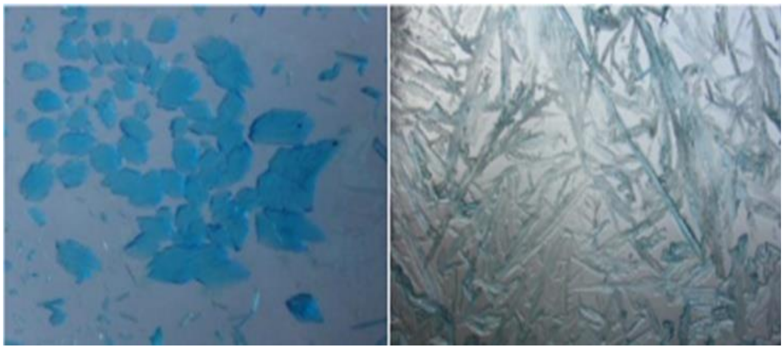

Figure 2. Left: intensely blue (i.e. more hydrated [26, 27]) prismatic crystals formed in a $CuSO_4$ solution prepared with positively charged water. Right: pale blue or colourless (i.e. less hydrated or completely dehydrated [26, 27]) vegetable crystals formed in a $CuSO_4$ solution prepared with negatively charged water).

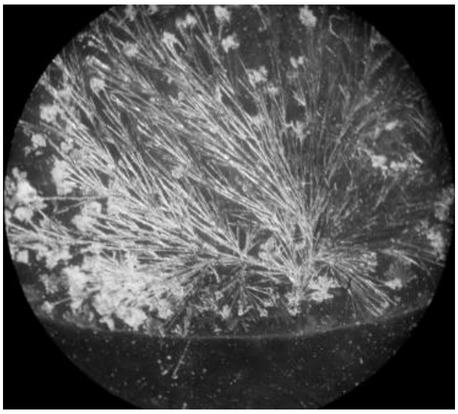

Figure 3. Real "bouquets of flowers" are formed in drying NaCl solutions prepared in negatively charged water [30].

Apparently, all these results (Fig. 1-3) may be of interest to doctors who use phenomena known as “arborization” or “ferning” for diagnostic purposes [31-36].

In addition, the previously established dependence of the UV absorption spectra of DNA on the electrical potential of the water used to prepare DNA solutions [29, 30, 37, 38] was used here.

Sodium salt of DNA was purchased from Fluka (Switzerland); the remaining reagents were purchased from the “Ukrrekhim” (Ukraine).

Since contact with “copper” coins, which are not actually made of pure metallic copper, but of corrosion-resistant copper alloys, cannot a priori be harmful to humans, they were used in this study.

UV absorption spectra of aqueous DNA solutions were recorded using Specord UV VIS (Carl Zeiss Jena, Germany).

Results

Negative electrization of aqueous media in contact with coins.

The results of numerous experiments have made it possible to verify that coins cause arborization in aquatic environments (Figures 4 – 8).

Figure 4. This is a "copper" coin surrounded by a dried K_2CO_3 solution prepared in uncharged water; in this case, distinct needle-shaped crystals form around the coin [39].

Figure 5. This is a "copper" coin surrounded by a dried $MgSO_4$ solution prepared in uncharged water; in this case, needle-shaped crystals also form around the coin.

Figure 6. This is a "copper" coin surrounded by a dried $CuCl_2$ solution prepared in uncharged water; in this case, distinct plant-type crystals are formed [39].

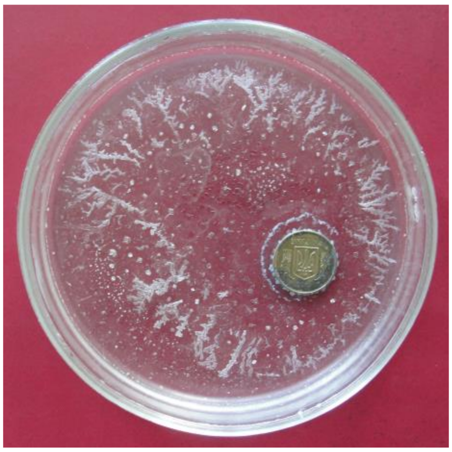

Figure 7. This is a "copper" coin surrounded by a dried collagen solution containing KCl, prepared in uncharged water; in this case, plant-like crystals also form around the coin.

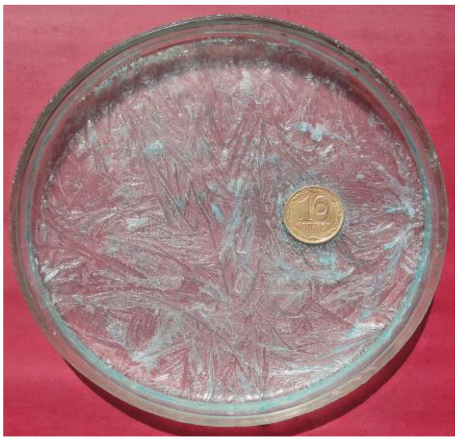

Figure 8. This is a "copper" coin surrounded by a dried collagen solution containing $CuSO_4$, prepared in uncharged water; in this case, both needle-like and plant-like crystals form around the coin.
It appears that the results presented in Figures 7 and 8 are worth comparing with the result presented in Figure 9.

Figure 9. These are branches on the inner surface of the test tube formed during the drying process of a collagen solution prepared in negatively charged water.
So, the obtained results (Figures 4 – 8) make it possible to verify the arborization of aqueous media in contact with coins. Considering the results presented above (Figures 1 – 3), this means that the coins cause negative electrization in their aquatic environment.

UV absorption of aqueous DNA solutions in contact with coins
The UV absorption of aqueous solutions of DNA in contact with “copper” coins was also studied. Thus, it was found

that there was not only a noticeable decrease in the UV absorption of aqueous solutions of DNA in contact with “copper” coins, but also a complete disappearance of peaks at a wavelength of 260 nm in the UV absorption spectra of such solutions (Figure 10).

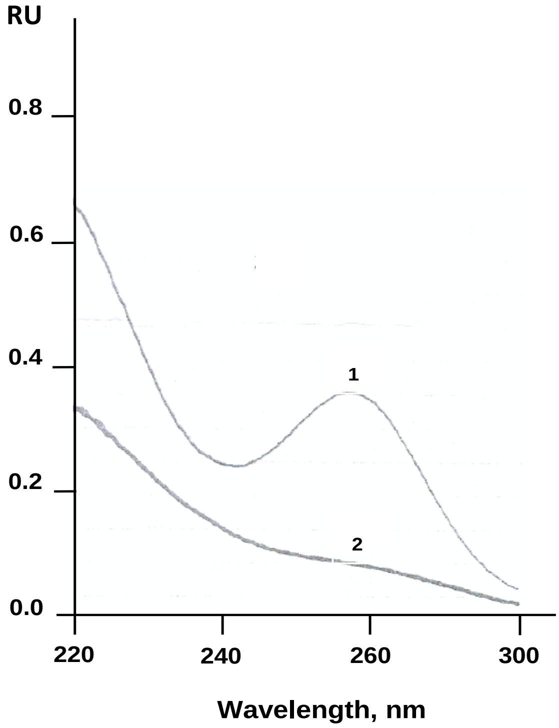

Figure 10. UV absorption spectra of aqueous solutions with the same DNA concentration (~20 °C): 1 – solution not in contact with the “copper” coin (control); 2 – solution that was in contact with a “copper” coin for 48 hours.
Both spectra were recorded against air and were not processed after recording.

Both of these spectra (Figure 10) should be compared with previous results, which showed that bubbling aqueous DNA solutions with oxygen gas is accompanied by an increase in their A_{260}, while bubbling aqueous DNA solutions with nitrogen gas is accompanied by a decrease in their A_{260} [40, 41]. Apparently, it is precisely this comparison that indicates that the decrease in A_{260} of aqueous DNA solutions upon contact with “copper” coins (Figure 10) cannot be associated with the appearance of ROS in these solutions. At the same time, a comparison of both of these spectra (Figure 10) with the UV absorption spectra of aqueous DNA solutions prepared in oppositely charged waters [29, 37], as well as with the UV absorption spectra of aqueous suspensions of lymphocytes in healthy people and patients with B-cellular chronic lymphocytic leukemia [38] indicates negative electrization of aqueous solutions of DNA upon contact with “copper” coins.

Discussion

Thus, there are enough results (Figures 4 – 8, 10) indicating the ability of “copper” coins to negatively electrify the aquatic environment. This, accordingly, allows assuming that it is this ability of metallic copper and its alloys that provides their anti-inflammatory properties. Since this assumption does not seem obvious, it deserves separate discussion.

So, it is believed that it is the proton motive force (PMF) that ensures the active transport of glucose into bacteria, the synthesis of ATP in bacteria, and, finally, the motility of bacteria [42]. It is also believed that the existence of PMF is ensured by the extracellular concentration of protons, which determines the steepness of proton gradients around bacterial membranes [43 – 45]. Therefore, it is quite expected that a decrease in this steepness will weaken the PMF with all the expected consequences. Taking all this into account, it seems quite reasonable to assume that the anti-inflammatory effect of “copper” coins is determined by their ability to enrich the bacterial environment with electrons that can neutralize the protons present there:

$$H^+ + e \rightarrow H^\bullet \quad (1).$$

(It is worth noting here that assumption fits well with the idea that bacterial antimicrobial resistance is controlled by bacterial PMF [42].)

It is also worth considering that the human body has a buffer system based on the chemical properties of bicarbonates [46 – 48], which allows the irreversible removal of protons from the human body:

$$H^+ + HCO_3^- \rightarrow H_2CO_3 \rightarrow H_2O + CO_2\uparrow \quad (2).$$

Thus, “copper” coins can be perceived as a means of helping a person’s bicarbonate buffer system rid his body of excess protons and thereby complicate the life of bacteria.

At the same time, all of the above allows expecting that “copper” coins are capable of reproducing the therapeutic effects of dimethyl sulfoxide (DMSO) [49 – 51], based mainly on its ability to attach aqueous protons [26], in

particular those that are pathogenic to humans [52, 53].
On the other hand, equation (1) allows perceiving "copper" coins in contact with the human body as a source of hydrogen gas, the anti-inflammatory properties of which are well known [54 – 57]. Moreover, the same equation (1) allows considering "copper" coins as substitutes for hydrogen therapy, in particular anti-cancer therapy [58 – 66].

Conclusion

Recognizing the fact that the proton gradient around bacterial membranes determines the intensity of bacterial metabolism, including energy metabolism [42 – 45], it can be foreseen that the destruction of such a gradient will reduce bacterial pathogenicity. Therefore, the destruction of such a gradient with the help of negative electrization of the bacterial environment seems quite desirable both for patients and for their doctors. Thus, "copper" coins, which combine pronounced electron-donating properties in relation to aqueous environments (Figures 4 – 8, 10) and corrosion resistance, seem to be a completely acceptable antibacterial agent.
Taking into account all these considerations, one can expect from "copper" coins the same antiviral properties that are inherent in metallic copper [9], assuming, of course, that any antiviral activity is based on negative electrization [67]. Thus, it is likely that any anti-inflammatory effect of "copper" coins is associated with their ability to electrify the human body as negatively as any aquatic environment. This, in turn, suggests that copper coins used as anti-inflammatory agents need to restore their electron-donating abilities; experience shows that this restoration occurs quite successfully in water-ethanol solutions of citric acid stored in the dark. Apparently, it is also worth noting that the anti-inflammatory effect of "copper" coins can be enhanced by geomagnetic forces that direct electrons downward [58, 68]; thus, the location of the "copper" coins on the patient's body also matters. (Naturally, all this must be taken into account when expecting the restorative effect of "copper" coins on neurons [39], in particular, those damaged during surgery.)

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