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Journal of Cancer Research and Cellular Therapeutics
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Research Article

Catalytic Properties of Positively Charged Water Promoting Tumor Growth

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Received date: September 18, 2023; Accepted date: October 03, 2023; Published date: October 13, 2023

Citation: Yuri Pivovarenko, (2023), Catalytic properties of positively charged water promoting tumor growth, *J Cancer Research and Cellular Therapeutics*, 7(5); **DOI:10.31579/2640-1053/161**

Abstract

It has previously been shown that positively electrized water has exceptional high both hydrating and penetrating abilities. Based on both of these properties of positively charged water, it has been suggested that such water easily penetrates into cells and accumulates in them, which causes an increase in cell volume and, accordingly, stimulates cell proliferation. Therefore, it was suggested that it is positively charged water that stimulates the growth of any tumors, including malignant ones. When substantiating such suggestions, special attention was paid to the ability of positively charged water to enrich the environment outside cells with protons and thereby stimulate their proton-motive force, which delivers glucose to cells; in this case, naturally, it was taken into account that glucose is the main supplier of chemical energy for the cell. Over time, some of these suggestions were confirmed experimentally. In particular, it has been shown that positively charged water can increase the fluidity of biological membranes, thereby not only increasing their permeability, but also facilitating cell division. Over time, it became clear that it is the ability of positively charged water to oxidize lipids, both directly and indirectly, that determines its exclusivity. Accordingly, it has been suggested that the therapeutic effect of some anticancer drugs is due to their ability to neutralize positively charged water and thereby inhibit its chemical activity; analysis of specific drugs showed that this assumption correlates well with reality.

Keywords: water; cell proliferation; cancer; tumor; hydrogen therapy; ROS

Introduction

It was previously established that positively charged water has exceptionally high hydrating and penetrating abilities [1, 2], which, in turn, suggested that it is positively charged water that stimulates cell proliferation [2] and, thus, tumor growth [3 – 5]. In particular, it has been suggested that it is positively charged water that increases the fluidity of cytoplasmic membranes, thus facilitating cell division [2 – 5]. At the same time, it was assumed that it is the increased fluidity of cytoplasmic membranes that facilitates the entry into cells of glucose, which is the main supplier of chemical energy for cells (this, accordingly, gave rise to a revision of the generally accepted mechanism of supplying cells with glucose using the proton motive force [6 – 9]).

Later it became clear that in order to better understand this effect of positively charged water on cytoplasmic membranes, it is necessary to take into account the ability of protons to catalyze the addition of water molecules to the double bonds of organic molecules [10, 11], thereby increasing their hydrophilicity and, accordingly, permeability for all water-soluble substances, including glucose. It was also concluded that it is necessary to take into account the participation of protons in the conversion of molecular oxygen into hydrogen peroxide [12], a source of hydroxyl radicals that can attach to the lipid components of cytoplasmic membranes, increasing their hydrophilicity [13].

Accordingly, it is proposed here to verify that it is precisely these properties of positively charged water that can explain its ability to

stimulate both cell proliferation and tumor growth. In addition, it is shown here that knowledge of these same properties of positively charged water allows us to understand the anti-cancer effects of certain drugs.

Materials and Methods

Charged waters were obtained as in [1].

Cod liver oil from “De Luxe” (Iceland) was used; refined sunflower oil from “Svoja Linija” (Ukraine) was also used.

Results

First, it was found that positively charged water quickly turns oil droplets into films (Figure 1), while negatively charged water does not interact with oils at all (Figure 2) [4, 5]

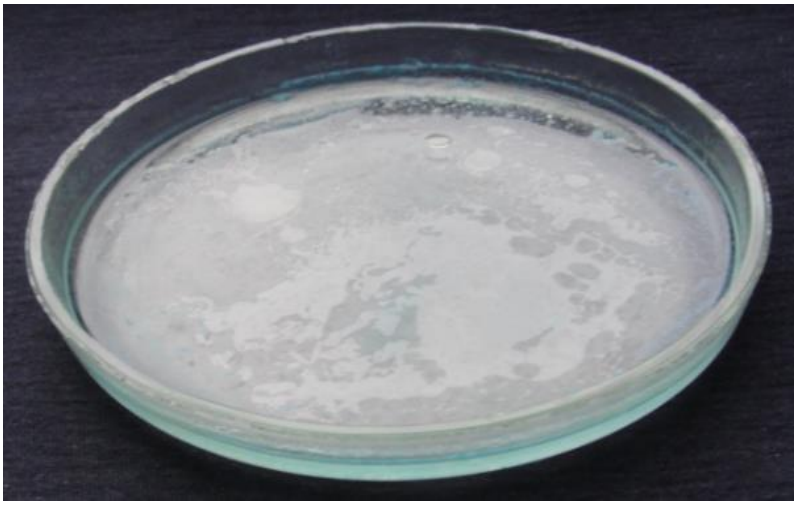

Figure 1: This is what a film formed from an oil drop on the surface of water with a potential of +500 mV looks like [4, 5]

Figure 2: Left: a small oil drop on the surface of water with a potential of –500 mV looks like this. **Right:** a large oil spot on the surface of water with a potential of –500 mV looks like this.

The constant shape of both of these stains indicates that there is no interaction between the oils and the sufficiently negatively charged water [4, 5].

It was then found that oil suspensions with positively charged water formed stable emulsions (Figure 3, left), while oil suspensions with negatively charged water did not form stable emulsions (Figure 3, right) [4, 5].

Naturally, all these results (Figures 1 – 3) led to the conclusion that it is positively charged water that interacts with oils; in particular, from the fact that it is positively charged water that forms stable emulsions with oils (Figure 3, left), it became clear that it is this water that hydrates oils. Over time, it was assumed that the interactions between positively charged water and oils were more chemical in nature than physical, contrary to established beliefs [14, 15]. First of all, this assumption took into account the ability of protons to catalyze the addition of water molecules to double bonds of organic molecules [10, 11], thereby increasing their hydrophilicity.

One way or another, it was precisely this assumption that made it possible to take into account the participation of reactive oxygen species (ROS) both in the positive electrization of water (Figure 4, right) and in increasing the hydrophilicity of the lipid components of biological membranes; Naturally, all this was considered taking into account the undoubted participation of ROS in the occurrence of cancer [16 – 22]

Figure 3: Suspensions formed by intensively mixing oils with positively charged water do not separate for hours, maintaining a milky white or yellowish color (**left**); suspensions formed by intensive mixing of the same oils with negatively charged water stratify within a few minutes (**right**) [4, 5]

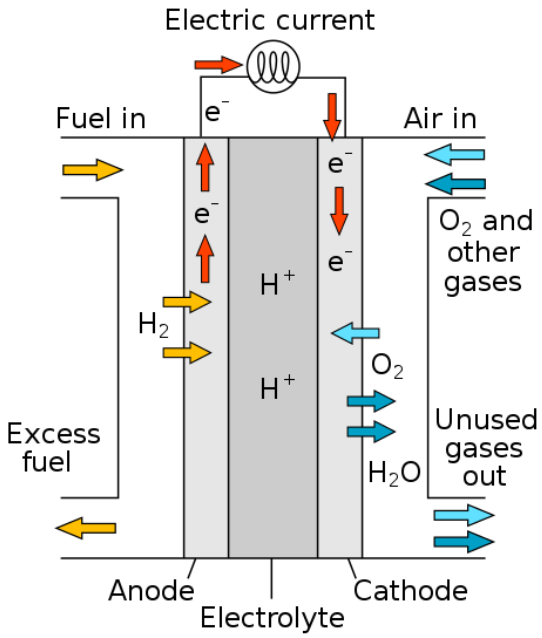

Figure 4: This is a diagram of an air-hydrogen electrochemical cell. The red arrows indicate the movement of electrons from a compartment containing an aqueous solution bubbled with hydrogen gas to a compartment containing an aqueous solution bubbled with air.

Since in aqueous media both atomic and molecular hydrogen exhibit electron-donating properties [23], hydrogen gas charges water negatively (left) [5].

Since in aqueous media both atomic and molecular oxygen exhibit electron-withdrawing properties [23], oxygen in the air charges water positively [5].

One way or another, it makes sense to discuss all these assumptions; It is likely that this discussion is necessary to ensure that the therapeutic effects of a number of anticancer drugs are due to their ability to both neutralize positively charged water and inhibit its catalytic activity.

Dicussion

Positively Charged Water as a Stimulator of Alkenes Hydration

It is well-known that various mineral acids catalyze the attachment of water molecules to double bounds of alkenes:

$$–CH=CH– + H_2O \rightarrow –HCOH–CH_2– \quad (1)$$ [10, 11].

Since the common property of mineral acids is that they dissociate with release of protons, this suggests that it is the protons that determine these catalytic properties of aqueous mineral acids.

It should be noted right here that this suggestion is in full accordance with both the acid-base theory of Brønsted-Lowry, also called proton theory of acids and bases, and modern views on the role of protons in acidic catalysis, both specific and general [11].

Thus, both the above theory and existing views on acidic catalysis suggest that the hydration of alkenes should occur in positively charged water as well as in aqueous solutions of mineral acids. This, in turn, suggests that positively charged water promotes the conversion of alkenes into

alcohols, i.e. less hydrophilic compounds into more hydrophilic ones; this, accordingly, gives grounds to assert that unsaturated lipids of biological membranes, including cytoplasmic ones [24], are hydrated upon contact with positively charged water. Naturally, all this allows expecting that positive electrization of the extracellular environment promotes cell swelling, which is a necessary condition for their division (natural, given that water is the main "building component" of all living cells [3 – 5]). At the same time, it can be expected that external contact of cells with positively charged water increases the hydrophilicity of their cytoplasmic membranes and, consequently, their permeability to aqueous solutions of glucose, which is the main source of chemical energy for all living cells, including tumors. All this, in turn, allows concluding that it is positively charged water that promotes both cell proliferation and tumor growth. Thus, the statement that positively charged water stimulates the proliferation of cells, in particular cancer cells [3 – 5], has an undeniable chemical basis and more than one, as will be shown below.

Participation of Protons in the Conversion of Molecular Oxygen into Hydrogen Peroxide

So, it is known that protons are directly involved in the formation of hydrogen peroxide from molecular oxygen:

$$O_2 + 2e + 2H^+ \rightarrow H_2O_2 \ (2)\ [12].$$

It is also known that alkenes are able to attach hydrogen peroxide, turning into diatomic alcohols:

$$–CH=CH– + H_2O_2 \rightarrow –HCOH–HCOH– \ (3)\ [10, 11].$$

Thus, both of these reactions, (2) and (3), additionally indicate the possible participation of protons in the transformation of hydrophobic components of biological membranes, the same alkenes, into more hydrophilic ones, namely diatomic alcohols, with all the above consequences, both for permeability outer cell membranes and for cellular development.

Probably, the involvement of hydrogen peroxide in the formation of alkyl peroxides should be considered in the same aspect:

$$–CH_2–CH=CH–CH_2– + H_2O_2 \rightarrow –HCOOH–CH=CH–CH_2– \ (4)\ [10, 11].$$

Of course, one should not lose sight of the acidic properties of the latter, due to which they are able to dissociate with the formation of hydrophilic anions and the same protons [10, 11], which stimulate the reaction (2) [12].

Protons as Stimulators of the Formation of Atomic Oxygen from Hydrogen Peroxide

On the other hand, it is believed that an acidic environment promotes the decomposition of hydrogen peroxide with the release of atomic oxygen:

$$H_2O_2 \rightarrow O^* + H_2O \ (5)\ [23].$$

Naturally, this same atomic oxygen is also capable of positively charging water (Figure 4, right) with all the above consequences for cells.

Protons as Stimulators of one of the Fenton Reactions

For completeness, it is necessary to add the ability of protons to stimulate the formation of hydroxyl radicals from hydrogen peroxide in the most famous Fenton reaction:

$$Fe^{2+} + H_2O_2 \leftrightarrow Fe^{3+} + HO^* + HO^- \ (6)\ [13].$$

Apparently, it is quite obvious that neutralization of hydroxyl ions (6) formed during this reaction with protons ($H^+ + HO^- \rightarrow H_2O$) stimulates the formation of hydroxyl radicals; it should also be added that reaction (6) undoubtedly occurs in the human body, rich in non-heme iron [24].

Obviously, this is where it is appropriate to recall the supposed participation of hydroxyl radicals in the formation of 8-OH-Guanine (Figure 5), which is an indicator of many diseases, including cancer [16, 25].

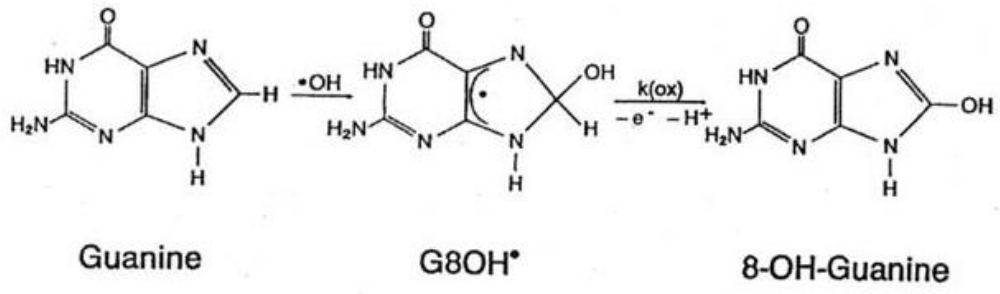

Figure 5: This scheme illustrates traditional ideas about the participation of hydroxyl-radicals in the formation of 8-OH-Guanine [16]; it is likely that this formation only reflects the positive electrization of the aqueous environment of DNA.

Some Anticancer Drugs in Terms of the Proposed Assumptions

Thus, there are many chemical reactions that support the assumption that it is the chemical modification of lipids that increases their hydrophilicity. In turn, this suggests that the observed interactions between positively charged water and oils (Figures 1 and 3, left) are also chemically determined. At the same time, all this convincingly shows that it is the oxidation of cytoplasmic membranes, which occurs in positively charged water that increases their permeability to both water and aqueous glucose solutions, thereby creating favorable conditions for both cell proliferation and tumor growth. Naturally, all of the above allows expecting that the action of some anticancer drugs is based both on their ability to neutralize positively charged water and to suppress all of the above reactions. The analysis below shows that this expectation is not unfounded.

Dimethyl Sulfoxide (DMSO)

Thus, it is very likely that it is the ability of DMSO, namely its oxygen, which is part of the O=S-group, to bind protons that determines its antitumor effect [26, 27]; of course, the ability of DMSO to destruct water [23] and thereby promote its removal from cells should also be taken into account. In this regard, the result presented in Figure 6 deserves attention.

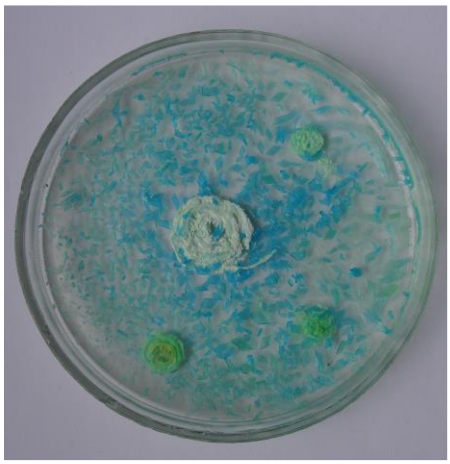

Figure 6: This is a Petri dish with a dried aqueous solution of copper sulphate, onto the surface of which individual drops of DMSO were applied.

The blue colour of the crystals indicates that they are completely hydrated and form crystal hydrates CuSO4•5H2O [23]; it is also worth noting that it is rhombic crystals that form in positively charged water [1]. The white spot in the centre of the Petri dish corresponds to completely dehydrated copper sulphate CuSO4 [23]; this spot formed at the site where 20 ml of DMSO was applied to the surface of the original solution of copper sulphate. Pale green spots along the periphery of the Petri dish correspond to partially hydrated copper sulphate, namely CuSO4•3H2O [23]; these spots formed at the sites where 5 ml of DMSO was applied to the surface of the original solution of copper sulphate.

Apparently, it is this photo that exhaustively proves the high dehydrating ability of DMSO, due to its ability to remove protons from water.

One should also take into account the possible epigenetic effects of negative electrization of the aqueous environment of DNA [28], which undoubtedly occurs in the presence of DMSO. At the same time, we should not forget about the possible direct epigenetic effects of DMSO, due to its ability to replace its own H_3C-radicals with OH-radicals [29, 30], in particular those that are part of 8-OH-Guanine (Figure 5) [16]. One should also take into account the possible addition of H_3C-radicals contained in DMSO to cytosines complementary to guanines, forming 5-H_3C-cytosines that can block gene expression [31]; therefore, it can be expected that this very methylation is capable of preventing both cellular DNA reduplication and cell division.

(In the context of the topic under discussion, one should also take into account the fact that DMSO promotes the differentiation of pluripotent stem cells [32], the unlimited proliferation of which leads to the growth of tumors, at least solid ones.)

It is probably appropriate to add here that the antitumor effect of ethanol [33] can also be explained by its dehydrating effect; at the same time, it is advisable to take into account that DMSO enhances the physiological effects of ethanol [23]. Thus, there are many reasons for the use of DMSO in anticancer therapy.

Squalene

Apparently, the proposal to reduce the risk of cancer using squalene from olive oil [34] also seems reasonable, since squalene is able to bind both active oxygen and its radicals [35], i.e. various ROS. Thus, it is squalene that is able to simultaneously prevent both the positive electrization of body tissues with oxygen, similar to that which occurs in an air-hydrogen electrochemical cell (Figure 4, right), and reduce the possibility of interaction of OH-radicals with membrane lipids and with guanine (Figure 5). The fact that squalene is a normal human metabolite [24] also supports its medical use.

Peroxidases

Apparently, the antitumor effect of peroxidases [36 – 38] can be fully explained by their ability to reduce the concentration of hydrogen peroxide in the human body [24], thereby preventing reactions (3) – (6). Here it is worth taking into account the antitumor effect of diets enriched with unsaturated oils [39 – 41], which are capable of adding hydrogen peroxide, as in reactions (3) and (4), and, therefore, are potential substrates of peroxidases.

Apparently, tumor-related hyponatremia in cancer patients [42, 43], which may be accompanied by a simultaneous decrease in the content of chloride anions (myeloperoxidase substrate [24]) in their bodies, should be considered in the same aspect. This, in particular, means that the popular salt-free diet, which excludes sodium chloride from food, does not allow myeloperoxidases to realize their antitumor effect.

Thus, the use of peroxidases as anticancer agents is quite justified, especially in combination with unsaturated oils and a sufficient amount of table salt.

Urea

There is also no doubt about the proposal to use urea in anticancer therapy [44], given its ability to form a complex with hydrogen peroxide and thereby prevent the reactions (3) – (6). In view of this, hypouricemia in cancer patients [45] should be considered as a disorder that contributes to the retention of hydrogen peroxide in their bodies and, accordingly, as the root cause of their disease.

Anticancer Hydrogen Therapy

Apparently, this same concept of cancer also quite satisfactorily explains the successful use of hydrogen gas by oncologists [46, 47]. Thus, even the ability of hydrogen gas to negatively electrify water (Figure 4, left) is quite enough to explain this success. So, it is likely that the permeability of oxidized cytoplasmic membranes (both for water and aqueous solutions of glucose) decreases due to the reaction of their lipid components with atomic hydrogen:

$$R–HCOH–R + 2H^* \rightarrow R–CH_2–R + H_2O \quad (7).$$

This refers to atomic hydrogen that undoubtedly appears in negatively charged water as a result of the reaction: $H^+ + e \rightarrow H^*$ (8) [48], where H^+ is the product of water dissociation [23].

It is no less likely that this same atomic hydrogen can also annihilate OH-radicals:

$$OH^* + 2H^* \rightarrow H_2O \quad (9),$$

thereby preventing their carcinogenic effects [16 – 22].

Thus, the therapeutic effects of anticancer hydrogen therapy seem quite understandable from the point of view of the concept of carcinogenesis presented here.

However, some nuances of hydrogen therapy need to be discussed. So, when analyzing the antitumor effect of hydrogen gas, one should also take into account its ability to reduce pyruvic acid to lactic acid [49], which is believed to nourish cancer cells [50, 51]. It should also be taken into account that it is precisely this conversion of pyruvate into lactate that can completely block the Krebs cycle [49], the slowdown of which is considered a hallmark of tumor cells [52 – 55]. At the same time, nothing prevents the direct addition of hydrogen atoms and molecules to NAD and FAD to form the main products of the Krebs cycle, namely NADH and $FADH_2$ [24]. All this, accordingly, suggests that the saturation of the human body with atomic and molecular hydrogen (which undoubtedly occurs with any type of hydrogen therapy) deprives its cells of the need for the Krebs cycle. Of course, all these considerations are based on the exceptionally high penetrating power of hydrogen gas [48, 49].

One way or another, during hydrogen therapy it is necessary to constantly monitor the hydrogen content in the patient's body; the ability of atomic hydrogen to fluoresce in aqueous media [49] can be effectively used for this purpose

Conclusion

Thus, the proposed concept of the occurrence of cancer has both physicochemical and medical justification. Analyzing medical data, it should be noted that it is the proposed concept that makes it possible to explain the antitumor effects of drugs, the chemical nature of which is radically different; apparently, it is this ability of the proposed concept that conclusively confirms its adequacy.

One way or another, the proposed concept seems quite productive and, as a result, can be successfully developed. Thus, it is this concept that is fully consistent with the sensitivity of cancer cells to elevated temperatures [56], since it allows associating this very sensitivity with a decrease in the heat capacity of water, which accompanies its positive electrization [1]. In addition, it is this concept that eliminates the need to destroy cancer cells using oxidative stress (this method of "treating" cancer is called "oxidative therapy") [57]; in any case, the desire to kill cancer cells seems dubious [58].

At the same time, it is the idea that positively charged water increases the permeability of cytoplasmic membranes for both water and aqueous solutions that creates the basis for revising the generally accepted ideas about how exactly the proton-motive force supplies cells with glucose and redistributes ions around cytoplasmic membranes (in particular, this very idea calls into question the absolute requirement for the corresponding transport proteins, which are currently considered necessary for any transmembrane transport [6 – 9, 24]). Instead, it is probably worth considering that potassium salts are much more soluble in hydrogen peroxide than in water, while sodium salts are the opposite [23]. This suggests that the ratio of these cations on both sides of the cytoplasmic membrane allows judging the corresponding ratio of hydrogen peroxide concentrations. Be that as it may, it is advisable to take all this into account when explaining the reduced concentration of sodium ions in the blood plasma of cancer patients [42, 43].

Finally, this idea fits well with the evidence that cancer is often associated with thrombosis [59], which has been shown to be promoted by positive electrization of the blood and vessel walls [60].

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DOI:10.31579/2640-1053/161