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Editorial

Selected Papers from the XXI SPB National Congress of Biochemistry 2021

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1. Introduction and Scope

The XXI SPB National Congress of Biochemistry 2021 was held at the University of Évora in Portugal on 14–16 October 2021. Under challenging conditions, due to the COVID-19 pandemic, we managed to organize the National Congress of Biochemistry in a hybrid format, where at least 2/3 of the participants (130) came to Évora in person. With the pandemic under control, we carried out the Congress both successfully and safely. This was the main meeting point for Portuguese Biochemistry Society (SPB), fostering the discussion and dissemination of high-quality research in biochemistry, both fundamental and applied, taking place in Portugal. The scientific program under the title "Tuning Biochemistry with Life Sciences and Society" covered a broad range of boundaries, ranging from molecular mechanisms of diseases to drug discovery, as well as innovative biochemistry projects. Science and innovation were promoted through dialogue, sharing, and healthy confraternization.

Biochemistry represents an interdisciplinary science that, in the 1980s, used strategies and methods of exact and natural sciences such as chemistry (analysis and synthesis), mathematics (statistics and calculus), physics (spectroscopy), biology (physiology, genetic, microbiology), and pharmacology (xenobiotics). However, its boundaries were always hard to define not only because they are constantly changing but also because they are dependent on the specificities of each environment (country, university, industry, and technology). Accordingly, the SPB XXI meeting in Évora University extended its biochemistry boundaries by absorbing several topics, namely molecular mechanisms of disease; plant biology and biotechnology; toxicology and environmental biochemistry; structural biology and molecular modeling; neurobiology of aging and stress; functional genomics and systems biology; membranes and cell biophysics; proteins in health and environment; chemical biology, drug discovery, and development; and art, biochemistry, and innovation in life sciences, as well as a COVID-19 special session, because of the pandemic circumstances (Figure 1).

This Special Issue, organized within the scope of the XXI SPB National Congress of Biochemistry, included six reviews, three papers, and one communication. In the reviews, a wide range of topics were addressed, including polyoxometalate (POM) applications in environmental science and in biomedicine [1], heme-based gas sensors in nature and their chemical and biotechnological applications [2], translating biochemistry concepts into cartoons and graphic narratives [3], the biological activity of gold compounds against

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viruses and parasitosis [4], metalloenzymes as relevant targets for the design of artificial biocatalysts [5], and the role of Mob4 in cell proliferation and neurogenesis [6]. The three original papers described a mobile laboratory taking molecular genetics to schools, even during the COVID-19 pandemic period [7], and presented cEpiderm as a promising canine skin model for the non-animal safety testing of veterinary pharmaceuticals and/or cosmetics [8] and nitric oxide production from nitrite plus ascorbate during ischemia upon hippocampal glutamate N-methyl-D-aspartate (NMDA) receptor stimulation [9], while the communication paper focused on the project UALGORITM, a journal freely accessible online, written in Portuguese by researchers at the University of Algarve and revised by school students [10]. Note that four of these contributions were chosen for the cover of *BioChem* issues (Figure 2). Until now (27 March 2025), these 10 contributions have gathered a total of 60 citations and 39415 views, indicating an average of 6 citations and 3942 views per publication.

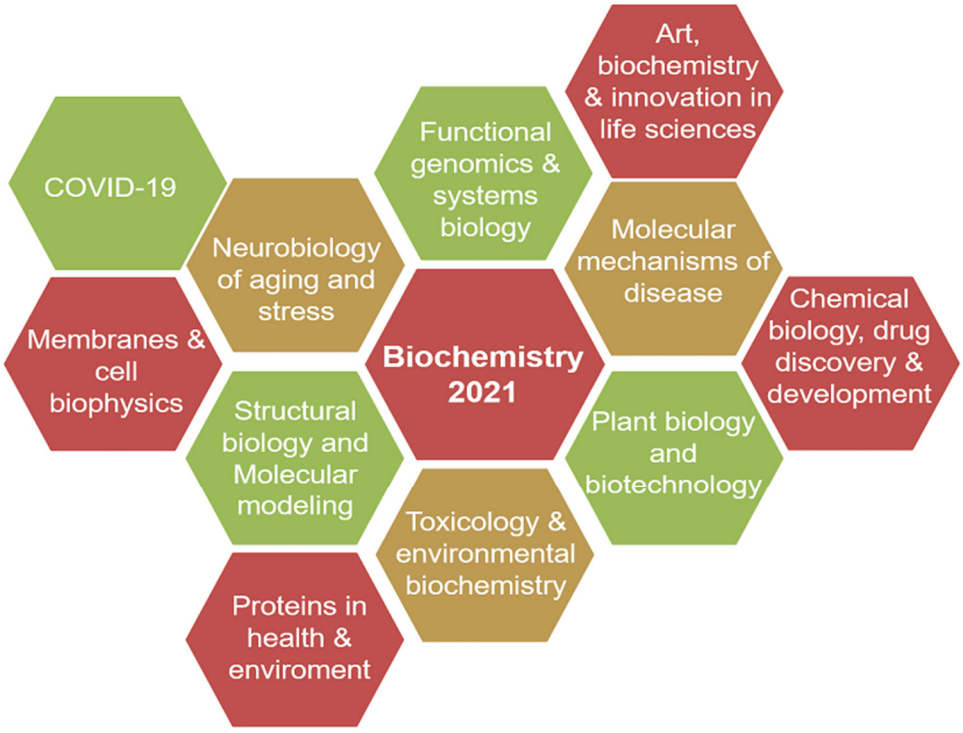
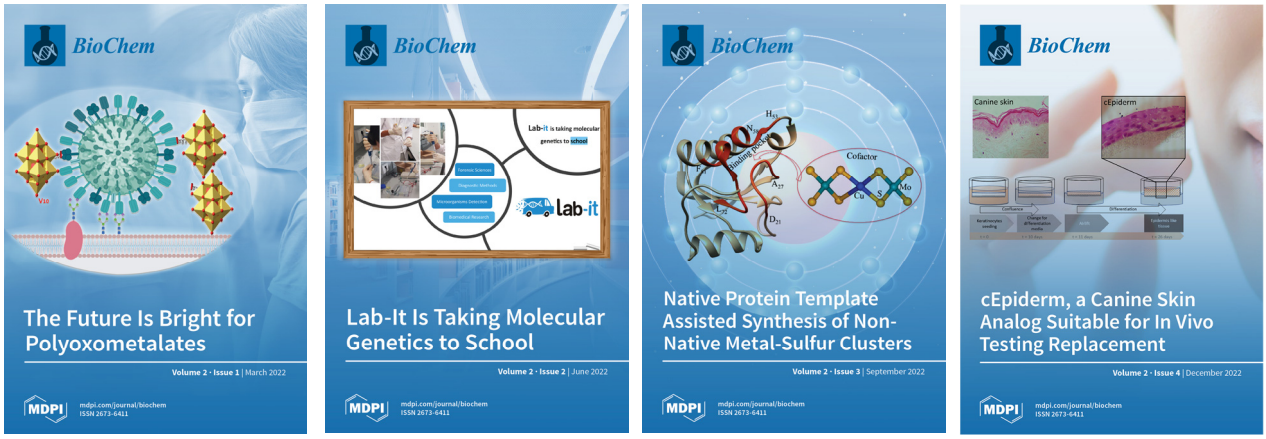


Figure 1. Biochemistry interfaces in the 21 century.



(**a**) Volume 2, Issue 1, March 2022 (**b**) Volume 2, Issue 2, June 2022 (**c**) Volume 2, Issue 3, September 2022 (**d**) Volume 2, Issue 4, December 2022

Figure 2. Four contributions from the XXI SPB National Congress of Biochemistry Special Issue were selected, in 2022, for covers of Vol. 2 *Biochem* issues.

2. Contributions

The first paper published in the present Special Issue is entitled "The future is bright for polyoxometalates" [1]. So far (31 March 2025), this review paper has gathered a total of 41 citations and 6301 views. Professor Aureliano's research group and its collaborators have carried out, since 1999, several projects about the biological properties of polyoxometalates (POMs), particularly decavanadate (V_{10}), to assess POMs' biomedical and environmental applications. Those studies include interactions with proteins [11,12], as well as the investigated POMs' anticancer potential [13,14], among other issues [15–18]. Behind the biomedical POM effects described in the review, it was emphasized that these compounds have potential applications in the degradation of emergent pollutants [1]. The second review paper published in the present Special Issue is entitled "Heme-Based Gas Sensors in Nature and Their Chemical and Biotechnological Applications" [2], written by the research group of Professor Eduardo Sousa from the Federal University of Ceara, Fortaleza, Brazil. Professor Eduardo Sousa is a well-known researcher in our bioinorganic scientific community, in particular for publishing, among others, several studies about heme-based sensors in *Mycobacterium tuberculosis* and metallodrugs such as ruthenium complexes as promising antimicrobial agents [19,20]. As suggested by Eduardo Sousa and coworkers, biphosphinic ruthenium complexes represent novel therapeutic candidates for treating bacterial infections caused by *Staphylococcus* biofilms [21].

The third review paper published in the present Special Issue is entitled "Translating Biochemistry Concepts into Cartoons and Graphic Narratives: Potential and Pitfalls" [3], written by the research group of Professor João Ramalho-Santos from Coimbra University. Professor João Ramalho-Santos is a well-known professor in the Portuguese biochemist scientific community in the field of reproductive biology and metabolism, aging, and disease, studying, among other topics, aging and oocyte competence [22]. Moreover, Professor Ramalho-Santos and collaborators promoted several papers using comics for science communication with recognized success [23]. From Professor Custódia Fonseca, Algarve University, we received the publication entitled "Biological Activity of Gold Compounds against Viruses and Parasitosis: A Systematic Review" [4]. Previous studies from the same group have shown that gold compounds are high-affinity inhibitors of Ca^{2+}-ATPase activity in purified plasma membrane Ca^{2+} ATPase (PMCA) fractions, and they exert strong cytotoxic effects in human neuroblastoma cells [24]. Herein, it is also emphasized that certain gold drugs already used against rheumatoid arthritis have also been tested, with promising results, against virus and parasites [4].

The fifth contribution is an article entitled "S Native Protein Template Assisted Synthesis of Non-Native Metal-Sulfur Clusters" [5] from Professor José Moura, NOVA University of Lisbon, Lisbon. Professor José Moura has dedicated most of his research to Mo-containing enzymes, such as xanthine oxidoreductase and aldehyde oxidoreductase, and to the design of bioinorganic models of metalloproteins and artificial enzymes, using metal-substituted proteins [25,26]. In their paper, three native protein scaffolds, [1Fe-4Cys] (rubredoxin), [3Fe-4S] (ferredoxin), and [$S_2MoS_2CuS_2MoS_2$]-ORP (orange protein), are used as case studies for describing templates for the synthesis of non-native monomeric to mixed metal–sulfur clusters, which mimic native Ni-containing metalloenzymes including [Ni-Fe] Hydrogenase and [Ni-Fe] CO Dehydrogenase. It was suggested that non-native metal-substituted metalloproteins are not only useful for catalysis but also as spectroscopic probes [5]. The sixth review paper is entitled "Role of MOB4 in Cell Proliferation and Neurogenesis" [6], supplied from the research group of Professor Álvaro Tavares, Algarve University. Their study highlights recent advances unravelling Mob4 cellular functions, a highly conserved non-catalytic protein that plays a diversity of roles in cell proliferation and sperm cell differentiation and is simultaneously involved in synapse formation and

neural development [27]. Other studies from the group include those covering the role of polo-like kinases in regulating mitosis using *Drosophila* as a model [28].

In addition to the six review papers referred above, this Special Issue also contains three original papers and one communication. The seventh contribution is a paper received from the research group of Professor Leonor Cancela entitled "Lab-It Is Taking Molecular Genetics to School" [7]. Like the above review paper about the usage of cartoons in the comprehension and dissemination of biochemistry concepts [3], these types of subjects are not usually described in scientific journals. However, this is an outstanding contribution, and despite the COVID pandemic situation in 2020 and 2021, 9 schools and 379 students were involved in Lab-it practical sessions and 99% of them considered the activity to contribute to better understanding the molecular biology methods approached in theoretical classes, and they expressed high interest in those sessions [7]. Professor Leonor Cancela is a well-known researcher who has been involved in many projects with a biochemical approach; she is a regular member of SPB meetings and was also previously a President of the Society. Professor Leonor Cancela has dedicated most of her research to molecular, environmental, and epigenetic determinants of skeletogenesis in health and disease [29] and the use of zebrafish as a model for human pathologies [30].

From the research group of Professor Célia Antunes, University of Évora, we received a contribution entitled "cEpiderm, a Canine Skin Analog Suitable for In Vivo Testing Replacement". It states that cEpiderm tissue exhibited the normal morphological and functional characteristics of the epidermis, namely impermeability and an adequate response to stressors. It was suggested that cEpiderm is a promising canine skin model for the non-animal safety testing of veterinary pharmaceuticals and/or cosmetics, significantly contributing to reducing the use of undesirable in vivo approaches [8]. Professor Célia Antunes has been Vice-President of the SPB since 2022. Her research interests focus on pathophysiology and environmental and public health, particularly on environmental health determinants and signaling pathways and biomarkers in allergies [31]. From the University of Coimbra, Professor João Laranjinha provided a study entitled "Nitric Oxide Production from Nitrite plus Ascorbate during Ischemia upon Hippocampal Glutamate NMDA Receptor Stimulation" [9]. The study emphasizes the critical role of NO as the direct mediator of neurovascular coupling that represents a key physiological mechanism via which •NO production for cerebral blood flow responses to neuronal activation is sustained under hypoxic/acidic conditions in the brain. Professor João Laranjinha is a well-known scientist in our scientific community not only because he was President of the SPB but also because he has dedicated most of his research to ROS and RNS, that is, to studying the roles of oxidative and nitrosative stress as triggers of diseases that can be corrected via antioxidant therapy [32,33].

Lastly, Professor José Bragança, Algarve University, submitted a special communication entitled "UALGORITMO, a New Instrument of the University of Algarve for Scientific Outreach" [10]. UALGORITMO, now at its 7th Edition (2025), is a journal freely accessible online since 2019, written in Portuguese by researchers of the University of Algarve, designed to summarize recent communications published in peer-reviewed journals. After submission, the manuscripts are revised by high school students from the Algarve, under the guidance of a schoolteacher, for further simplification of the language and general improvement of the manuscript and figures. The manuscripts written by the authors are then edited and published, with an acknowledgment and of the reviewers at the end of each article. Professor José Bragança's research interests include stem cells and the cardiovascular system [34].

Altogether, the present Special Issue reflects, in the 21 century, distinct and emergent biochemical contributions crossing several biochemical interfaces and applications and

tuning biochemistry with life sciences and society. Within this Special Issue, 40 authors from 5 universities and 2 countries were involved, with the large majority being young researchers, thus highlighting a new generation of scientists in the field. In fact, the future is dynamic and bright for biochemistry.

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References

1. Aureliano, M. The Future Is Bright for Polyoxometalates. *BioChem* **2022**, *2*, 8–26. [CrossRef]
2. Gondim, A.C.S.; Guimarães, W.G.; Sousa, E.H.S. Heme-Based Gas Sensors in Nature and Their Chemical and Biotechnological Applications. *BioChem* **2022**, *2*, 43–63. [CrossRef]
3. Alemany-Pagès, M.; Tavares, R.; Azul, A.M.; Ramalho-Santos, J. Translating Biochemistry Concepts into Cartoons and Graphic Narratives: Potential and Pitfalls. *BioChem* **2022**, *2*, 104–114. [CrossRef]
4. Fonseca, C.; Aureliano, M. Biological Activity of Gold Compounds against Viruses and Parasitosis: A Systematic Review. *BioChem* **2022**, *2*, 145–159. [CrossRef]
5. Maiti, B.K.; Moura, J.J.G. Native Protein Template Assisted Synthesis of Non-Native Metal-Sulfur Clusters. *BioChem* **2022**, *2*, 182–197. [CrossRef]
6. Santos, I.B.; Garrido-Maraver, J.; Gonçalves, C.; Oliveira, B.I.; Tavares, Á.A. Role of MOB4 in Cell Proliferation and Neurogenesis. *BioChem* **2023**, *3*, 182–196. [CrossRef]
7. Simão, M.; Conceição, N.; Imaginário, S.; Amaro, J.; Cancela, M.L. Lab-It Is Taking Molecular Genetics to School. *BioChem* **2022**, *2*, 160–170. [CrossRef]
8. Marques, M.; Nunes, J.; Ustymenko, B.; Fialho, L.; Martins, L.; Burke, A.J.; Filho, C.; Craveiro, A.C.; Costa, A.R.; Branco, S.; et al. cEpiderm, a Canine Skin Analog Suitable for In Vivo Testing Replacement. *BioChem* **2022**, *2*, 215–220. [CrossRef]
9. Nunes, C.; Laranjinha, J. Nitric Oxide Production from Nitrite plus Ascorbate during Ischemia upon Hippocampal Glutamate NMDA Receptor Stimulation. *BioChem* **2023**, *3*, 78–90. [CrossRef]
10. Bragança, J.; Figueiredo, S.; Rego, C.A.; dos Reis Conceição, F.; Neves de Jesus, S. UALGORITMO, a New Instrument of the University of Algarve for Scientific Outreach. *BioChem* **2022**, *2*, 93–103. [CrossRef]
11. Aureliano, M.; Gumerova, N.I.; Sciortino, G.; Garribba, E.; McLauchlan, C.C.; Rompel, A.; Crans, D.C. Polyoxidovanadates' interactions with proteins: An overview. *Coord. Chem. Rev.* **2022**, *454*, 214344. [CrossRef]
12. Sciortino, G.; Aureliano, M.; Garribba, E. Rationalizing the Decavanadate(V) and Oxidovanadium(IV) Binding to G-Actin and the Competition with Decaniobate(V) and ATP. *Inorg. Chem.* **2021**, *60*, 334–344. [CrossRef]
13. Amante, C.; De Sousa-Coelho, A.L.; Aureliano, M. Vanadium and Melanoma: A Systematic Review. *Metals* **2021**, *11*, 828. [CrossRef]
14. Aureliano, M.; Gumerova, N.I.; Sciortino, G.; Garribba, E.; Rompel, A.; Crans, D.C. Polyoxovanadates with emerging biomedical activities. *Coord. Chem. Rev.* **2021**, *447*, 214143. [CrossRef]
15. De Sousa-Coelho, A.L.; Aureliano, M.; Fraqueza, G.; Serrão, G.; Gonçalves, J.; Sánchez-Lombardo, I.; Link, W.; Ferreira, B.I. Decavanadate and metformin-decavanadate effects in human melanoma cells. *J. Inorg. Biochem.* **2022**, *235*, 111915. [CrossRef]
16. Marques-da-Silva, D.; Fraqueza, G.; Lagoa, R.; Vannathan, A.A.; Mal, S.S.; Aureliano, M. Polyoxovanadate inhibition of Escherichia coli growth shows a reverse correlation with Ca^{2+}-ATPase inhibition. *New J. Chem.* **2019**, *43*, 17577–17587. [CrossRef]
17. Pimpão, C.; da Silva, I.V.; Mósca, A.F.; Pinho, J.O.; Gaspar, M.M.; Gumerova, N.I.; Rompel, A.; Aureliano, M.; Soveral, G. The Aquaporin-3-Inhibiting Potential of Polyoxotungstates. *Int. J. Mol. Sci.* **2020**, *21*, 2467. [CrossRef] [PubMed]

18. Faleiro, L.; Marques, A.; Martins, J.; Jordão, L.; Nogueira, I.; Gumerova, N.I.; Rompel, A.; Aureliano, M. The Preyssler-Type Polyoxotungstate Exhibits Anti-Quorum Sensing, Antibiofilm, and Antiviral Activities. *Biology* **2022**, *11*, 994. [CrossRef]
19. Barreto, G.A.; Carepo, M.S.P.; Gondim, A.C.S.; Guimarães, W.G.; Lopes, L.G.F.; Bernhardt, P.V.; Paulo, T.F.; Sousa, E.H.S.; Diógenes, I.C.N. A spectroelectrochemical investigation of the heme-based sensor DevS from Mycobacterium tuberculosis: A redox versus oxygen sensor. *FEBS J.* **2019**, *286*, 4278–4293. [CrossRef]
20. de Sousa, A.P.; Gondim, A.C.; Sousa, E.H.; de França Lopes, L.G.; Teixeira, E.H.; Vasconcelos, M.A.; Martins, P.H.; Medeiros, E.J.; Batista, A.A.; Holanda, A.K. Biphosphinic ruthenium complexes as the promising antimicrobial agents. *New J. Chem.* **2020**, *44*, 21318–21325. [CrossRef]
21. Andrade, A.L.; de Vasconcelos, M.A.; Arruda, F.V.; do Nascimento Neto, L.G.; Carvalho, J.M.; Gondim, A.C.; Lopes, L.G.; Sousa, E.H.; Teixeira, E.H. Antimicrobial activity and antibiotic synergy of a biphosphinic ruthenium complex against clinically relevant bacteria. *Biofouling* **2020**, *36*, 442–454. [CrossRef] [PubMed]
22. Ferreira, A.F.; Soares, M.; Almeida-Santos, T.; Ramalho-Santos, J.; Sousa, A.P. Aging and oocyte competence: A molecular cell perspective. *WIREs Mech. Dis.* **2023**, *15*, e1613. [CrossRef]
23. Alemany-Pagès, M.; Azul, A.M.; Ramalho-Santos, J. The use of comics to promote health awareness: A template using nonalcoholic fatty liver disease. *Eur. J. Clin. Investig.* **2022**, *52*, e13642. [CrossRef] [PubMed]
24. Berrocal, M.; Cordoba-Granados, J.J.; Carabineiro, S.A.C.; Gutierrez-Merino, C.; Aureliano, M.; Mata, A.M. Gold Compounds Inhibit the Ca^{2+}-ATPase Activity of Brain PMCA and Human Neuroblastoma SH-SY5Y Cells and Decrease Cell Viability. *Metals* **2021**, *11*, 1934. [CrossRef]
25. Maia, L.B.; Moura, I.; Moura, J.J.G. *Molybdenum and Tungsten-Containing Enzymes: An Overview*; The Royal Society of Chemistry: Cambridge, UK, 2017; Volume 5, pp. 1–80. [CrossRef]
26. Maia, L.B.; Maiti, B.K.; Moura, I.; Moura, J.J.G. Selenium—More than Just a Fortuitous Sulfur Substitute in Redox Biology. *Molecules* **2024**, *29*, 120. [CrossRef]
27. Santos, I.B.; Wainman, A.; Garrido-Maraver, J.; Pires, V.; Riparbelli, M.G.; Kovács, L.; Callaini, G.; Glover, D.M.; Tavares, Á.A. Mob4 is essential for spermatogenesis in Drosophila melanogaster. *Genetics* **2023**, *224*, iyad104. [CrossRef] [PubMed] [PubMed Central]
28. do Carmo Avides, M.; Tavares, A.; Glover, D. Polo kinase and Asp are needed to promote the mitotic organizing activity of centrosomes. *Nat. Cell Biol* **2001**, *3*, 421–424. [CrossRef] [PubMed]
29. Varela, D.; Varela, T.; Conceição, N.; Cancela, M.L. Epigenetic Regulation of ZNF687 by miR-142a-3p and DNA Methylation During Osteoblast Differentiation and Mice Bone Development and Aging. *Int. J. Mol. Sci.* **2025**, *26*, 2069. [CrossRef]
30. Varela, T.; Varela, D.; Martins, G.; Conceição, N.; Cancela, M.L. Cdkl5 mutant zebrafish shows skeletal and neuronal alterations mimicking human CDKL5 deficiency disorder. *Sci. Rep.* **2022**, *12*, 9325. [CrossRef]
31. Gastalho, C.M.; Sena, A.M.; López, Ó.; Fernández-Bolaños, J.G.; García-Sosa, A.T.; Pereira, F.; Antunes, C.M.; Costa, A.R.; Burke, A.J.; Carreiro, E.P. Assessing the Potential of 1,2,3-Triazole-Dihydropyrimidinone Hybrids Against Cholinesterases: In Silico, In Vitro, and In Vivo Studies. *Int. J. Mol. Sci.* **2024**, *25*, 11153. [CrossRef]
32. Gago, B.; Lundberg, J.O.; Barbosa, R.M.; Laranjinha, J. Red wine-dependent reduction of nitrite to nitric oxide in the stomach. *Free. Radic. Biol. Med.* **2007**, *43*, 1233–1242. [CrossRef] [PubMed]
33. Paiva, B.; Laranjinha, J.; Rocha, B.S. Do oral and gut microbiota communicate through redox pathways? A novel asset of the nitrate-nitrite-NO pathway. *FEBS Lett.* **2024**, *598*, 2211–2223. [CrossRef] [PubMed]
34. García-Ortega, M.B.; Aparicio, E.; Griñán-Lisón, C.; Jiménez, G.; López-Ruiz, E.; Palacios, J.L.; Ruiz-Alcalá, G.; Alba, C.; Martínez, A.; Boulaiz, H.; et al. Interferon-Alpha Decreases Cancer Stem Cell Properties and Modulates Exosomes in Malignant Melanoma. *Cancers* **2023**, *15*, 3666. [CrossRef] [PubMed]