ENVIRONMENT AND INTERDISCIPLINARITY: ENGINEERING, ENVIRONMENTAL HEALTH, SUSTAINABILITY

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ABSTRACT

Regarding the theme of the effect of pollutants on the epidemiology and outbreak of cancer, there are contradictions and disagreements in scientific research. The objective of this article was to present the most important information and aspects regarding the interference of environmental pollutants in health and the damage caused to the environment, due to the relevance of this topic to society in epidemiology, as it is still controversial and difficult to trace. The historical temporal evolution of tests carried out by an interdisciplinary team was presented to highlight contributions of different areas of engineering to environmental engineering itself, as well as potential applications in One Health. From the case study with qualitative temporal analysis of the information, once again the potential of a plant indicator for the marking of this environmental exposure was highlighted, both for early diagnosis and for potential phytoremediation in the face of the installed environmental damage, and thus the use of *Euphorbia tirucalli* was both proposed and justified. From this understanding that fulfilled the purposes of this stage of study, new biotechnological, ecophysiological and phytoremediation investigations are being carried out in the field for the continuation of the construction of analysis in consistent complexity aimed at resistance and sustainability.

Keywords: Environmental Pollutants. Phytoremediation. Euphorbia tirucalli. Biological indicator of traceability. Ecophysiological studies

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INTRODUCTION

Since the most remote times, that is, soon after the appearance of the human being on earth, the beginning of aggression to the environment has already occurred, either by cutting down trees or by the domination of fire which, in a way, contributed to the emission of polluting gases from the atmosphere. However, the aggression was so rudimentary and so slow that mother nature herself was able to adapt and self-recover (Sampaio, 1992).

However, after the industrial revolution, due to technological advances, through the design and execution of large industrial machinery by large economic groups, due to the lack of perception of the need for a posture in environmental education (not even thought of at that time), they began to use the technology achieved irresponsibly, which markedly accelerated the disastrous consequences for the environment we inhabit (Sampaio, 1992).

A problem that remained for a long time relegated to the background, since, only long after the eighteenth century, in the middle of the twentieth century, did people begin to question and take some action to preserve the environment in which we live. It is very difficult to define exactly when man realized the need to preserve his environment. In Brazil, the first legislative formulations disciplining the environment are found in the Portuguese legislation (Martins de Souza), which was in force until the advent of the Civil Code in 1916, where more accentuated ecological concerns appear (Civil Code - Law No. 3,071, of January 1, 1916 *In* Nigri, 2003).

In the following decades, the first legal diplomas emerged with specific rules and more direct norms on prevention and environmental degradation. However, the Stockholm Conference, held in 1972, was certainly the event that gave the greatest impetus and awareness on the issue of the environment. From the 80s onwards, legislation on the matter became more consistent, comprehensive and focused on this issue (Nigri, 2003).

With the advent of the Federal Constitution of 1988, the Brazilian legal system began to dedicate itself to the theme and offer the importance that the environment requires. It can be illustrated that international publications on the subject cite that if the generation of polluting gases to the quality of life of human beings continues, in two generations, it will be such that the survival of the species may be compromised (Guimarães, 2002).

Nowadays, the concern with the protection of the environment occupies a prominent place among those of greatest importance for the whole society. Increasingly, attention is turned to the unfeasibility of the idea of exploiting natural resources as if they were inexhaustible. Thus, it was realized that indiscriminate development can affect the

ecological balance, the quality of life and life itself, and ecology began to be increasingly discussed (Nigri, 2003).

The term "ecology" denotes the activist movement aimed at environmental protection, including with intellectual and artistic, social and political connotations. Within this framework of a wide variety of thoughts, interdisciplinarity, and mutual complementation, the whole society must be prepared to act in the face of the social call and current needs (Nigri, 2003).

In this context, the issue involving the interference of different types of pollutants emerges amid the implications arising from the defense of the environment and health, whose complexity involves the learning of interdisciplinary, sometimes transdisciplinary, teamwork (Nigri et al., 2017).

Theoretical contributions of this period experienced, in an interdisciplinary way, are in the field of potential participation in phytoremediation of the xerophyte and halophyte species *Euphorbia tirucalli.* In the practical part, the contribution lay in the search for methodologies that allow the proposal of chemical and biological indicators aiming at the traceability of the proposed activity, especially in the face of the challenging moment we are experiencing of sudden and unexpected climate changes that have repercussions on populations, especially those under conditions of vulnerability.

The study on *E. tirucalli* and its mechanisms of action evidences what occurred during its environmental adaptation over millennia on the planet amid severe, harsh and constant edaphoclimatic conditions in inhospitable environments of different continents, suggesting the wide potential of use of substances from the plant chemistry of this species, whose chemical production varies under certain conditions studied *in vitro* and in the field, as well as morphological adaptations to the environment. Both plant characteristics may serve as biological indicators that cooperate for the traceability, perhaps even for early diagnosis, of the extreme environmental variations already detected by the algorithms.

Such characteristics insert it in a new context, still very little explored for this species, that is, as a potential marker of edaphoclimatic variations. This hypothesis derives from its curious adaptability to extreme conditions in nature, which have been methodologically investigated by us since 2003, such as water stress (drought), saline, light (and electromagnetic) stress, temperature, among others.

This chapter aims to describe the steps carried out in a historical review regarding the theme of phytoremediation, bioindicators and sustainability, for the use of plant species as an indicator of pollution levels but also as a potential use as a phyto-remediator, aiming to minimize the persistence of polluting agents in the environment.

The sum of efforts in search of sustainable local solutions requires an interdisciplinary team in constant dialogue, to promote environmental health as a single primary health care strategy proposed by the Unified Health System (SUS) to mitigate preventable and avoidable environmental diseases.

METHODOLOGY

This is a Case Study, with a qualitative approach, with the object of the historical review of pollutants (waste, effluents and vapors) and health and the promotion of sustainability in environmental health through scientific investigations carried out by an interdisciplinary team through diversified methodological strategies in environmental technology, aiming at the adequacy of these practices for higher and secondary education. The Case Study is a type of qualitative research that consists of the systematic and detailed analysis of an individual or collective case, to investigate the phenomenon (object) of interest. Its use has been expanded to several areas of knowledge, with important phenomenological investigative potential (Ventura, 2007).

RESULTS

The authors describe the trajectory of the interdisciplinary team in the evolution and deepening of knowledge about potential plant species for preservation and environmental recovery of environments exposed to excessive concentration of pollutant particles, based on the scientific investigations recorded temporarily, as shown in Chart 1.

Table 1: Contributions of interdisciplinary engineering research to the environment and to single health.

Authors	**Type of Pollution Environmental/ Research**	**Title**	**Publication/ Year**	**Available at**
VARRICCHIO, M. C. B. N. *et al.,* 2004.	Environmental education	EDUCATIONAL BOOKLETS – a Proposal for Environmental Awareness.	**Annals of the II World Congress on Environmental Education - FIOCRUZ** (Abstract/Poster and oral presentation), RJ, 2004.	**-**
VARRICCHIO, M.C.B.N., 2005	Breast Cancer and Environment	Aveloz: from clinical to basic research.	Round Table. **Brazilian Congress of Onco-Mastology**, Rio de Janeiro.	-

VARRICCHIO, M.C.B.N.; et al., 2006.	Terpenoid exudation	Qualitative evaluation of the diterpenoid production of *Euphorbia tirucalli* (aveloz) under controlled conditions for medicinal purposes.	**Revista Anais da FERTBIO/EMBRAPA CENTRO-OESTE,** p. 20 -24. MS, September 2006.	-
VARRICCHIO, M.C.B.N.; et al., 2006.	Cytotoxicity of Ultradiluted and Dynamized Solutions in tumor cell line and Selectivity in normal cell line	Cytotoxicity And antitumoral Activity Of Extremely Diluted Solutions Of *Euphorbia tirucalli* L: An *In Vitro* Study.	**Improving the Success of Homeopathy: WHO/WHO. London.**	
VARRICCHIO et al., 2008, Oct.	Allelopathic action on the soil	Chromatographic analysis of Aveloz latex and the risks of non-standardized plant extracts.	**FOG Archives, Petrópolis, 5 (2): 113-136**	https://sites.google.com/view/lipat/sapb-artigos?authuser=1#h.p_p1DnrUrkjqlq
VARRICCHIO et al., 2008	*In vitro* Plant development	*Euphorbia tirucalli:* qualitative analysis of vegetable development during *in vitro* cultivation.	**BioFar.** 1983-4209 – V. 03 – N. 01 - p1-13.	
NIGRI et al., 2017, May	Electromagnetic (non-ionizing) radiation and neoplasms	Transmission Lines and Environment: Historical Perspective of Environmental Health Guidelines	**INFO-SAPB Support Magazine to SAPB-LIPAT Project /FF/UFRJ - Techn Art.** v.1 n.1.	https://sites.google.com/view/lipat/sapb-revista_info-sapb?authuser=0#h.p_Ao3lwclpMYL6
VARRICCHIO; PYRRHO, 2018	Environmental education	**Environmental Education: Research, Teaching and Assistance**	***E-book*** with ISBN.	https://sites.google.com/view/lipat/sapb-livros?authuser=0#h.p_fxCeIXY2qMnR
DELAUNAY & RANGEL, B. A., 2019.	Potential mechanisms for soil decontamination	Soil contamination via industrial and agricultural activities and their damage to human health.	Presentation: Nicole Delaunay – Geologist (UFRRJ).	Face-to-face class in the **Extension Course:** Geopharmacobotany and Bioproducts. FMPFase Cultural Center.----------
MUSMANNO et al., 2020	Studies and interdisciplinary actions in research aimed at promoting well-being	RESEARCH AND WELL-BEING	**INFO-SAPB Support Magazine to SAPB-LIPAT Project /FF/UFRJ - Techn Art.** V. 4 n1	https://sites.google.com/view/lipat/sapb-revista_info-sapb?authuser=0#h.p_HFWfQZtxGOBL
HANSEL-MARTINS et al., 2020.	Applications of Artificial Intelligence and Care	ARTIFICIAL INTELLIGENCE, HEALTH, HUMANIZATION.	Annals of the Scientific Week. Arthur Sá Earp Neto University Center, 2020. Petrópolis (RJ).	<https//www.even3.com.br/anais/SCUNIFASEFMP/281754-INTELIGENCIA-ARTIFICIAL-SAUDE-HUMANIZACAO

WASIM et al., 2022, May	Natural Products, Urban Ethnodevelopment and Eco-socio-environmental Technology	Natural Products, Homeopathy and Plant Acupuncture: Sustainable Development of Peoples and Eco-socio-environmental Technology	SEIVA Support Magazine to SAPB-LIPAT Project /FF/UFRJ - Techn Art. **Vol. 6 No. 1**	https://sites.google.com/view/lipat/sapb-revista_seiva?authuser=0#h.1c0zhynni7kz
GASPAR et al., 2022, May	Garden of Medicinal Plants and species for vector control of Environmental Diseases	HISTORICAL RECORD: REVITALIZATION OF GARDEN OF THE HOMEOPATHY SERVICE AT HGSCM IN THE CENTER FROM THE CITY OF RJ	SEIVA Support Magazine to SAPB-LIPAT Project /FF/UFRJ - Techn Art. **Vol. 7 n. 1**	https://sites.google.com/view/lipat/sapb-revista_seiva?authuser=0#h.enmmoxlwemka
KATHAR et al., 2023, Apr	Effluent Destination and Phytoremediation	*CONSTRUCTED WETLANDS: Technology for removing drug concentration from water*	**International Journal of Advanced Engineering Research and Science** ISSN: 2349-6495(P) | 2456-1908(O). Issue-4;	Article DOI: https://dx.doi.org/10.22161/ijaers.104.13.
GASPAR et al., 2023, May	Citizen actions in the face of climate emergencies	Strategies launched by the Environmental Health, Parasitology, Bioethics Project (SAPB)-LIPAT/FF/UFRJ in the face of climate emergencies	INFO-SAPB Support Magazine to SAPB-LIPAT Project **/FF/UFRJ - Techn** Art. **V. 7 – n.1**	https://sites.google.com/view/lipat/sapb-revista_info-sapb?authuser=0#h.3mbtxaqxp6d6
GASPAR et al., 2023a, Jun	Water use and soil phyto-recovery. Potential insecticidal action.	Environmental and Economic Values of salt tolerance. *Euphorbia tirucalli:* Phytoremediation potential	**International Journal of Advanced Engineering Research and Science** Peer-Reviewed Journal. ISSN: 2349-6495(P) | 2456-1908(O) Vol-10, Issue-6	Journal Home Page: https://ijaers.com/ Article DOI: https://dx.doi.org/10.22161/ijaers.106.5
DELAUNAY DE SOUZA et al. 2023.	Plastic digester potential	*Euphorbia tirucalli*: potential for plastic digester and bioeconomy.	**Brazilian Journal of Development**. v.9, n.9, p. 25662-25675.	ISSN 2525-8761. DOI: https://doi.org/10.34117/bjdv9n9-005. https://ojs.brazilianjournals.com.br/ojs/index.php/BRJD/issue/view/218
GOMES et al., 2023, Aug.	Chemistry of Natural Products and Bioproducts in the Cycles of Parasites of Neglected Diseases	Leishmaniasis, natural products, bioeconomy and sustainable development.	**Brazilian Journal of Development**, *9*(8), 25317–25333.	https://doi.org/10.34117/bjdv9n8-140

GASPAR et al., 2023b, Sep.	Antifungal action	Investigation of the antifungal action of natural products on seeds of *Euterpe oleraceae*: Bioproduct Potential.	Individual Chapter. ***E-book:*** **Uniting Knowledge Integrated Scientific Research for Global Development.**	ISBN: 978-65-84976-52-8. doi:10.56238/uniknowindevolp-120. Link at: https://sevenpublicacoes.com.br/index.php/editora/article/view/2707.
HANSEL-MARTINS et al., 2024, Jan.	Plants with environmental action on soil	*Medicinal intercultural plant garden: Homeopathy and Phyto-nutritional care.*	**Revista Contribuciones a Las Ciencias Sociales.** V.17, n.1, p.6173-6188.	ISSN 1988-7833. DOI: https://doi.org/10.55905/revconv.17n.1-371. Link at: https://ojs.revistacontribuciones.com/ojs/index.php/clcs/article/view/4319
VARRICCHIO et al., 2024	Vector Control of Endemic Diseases	Insecticidal and juvenilizing activity tests of *Euphorbia tirucalli* Latex on *Aedes aegypti* Larvae. Micropropagation and new potential for biological activity.	**Chapter 3. *E-book:* Impacts of Dengue, Zika and Chikungunya: a multidisciplinary analysis.** Seven Publicações Ltda. 2024, may.	ISBN: 978-65-6109-020-9. DOI: 10.56238/sevened2024.011-003. Link: https://sevenpublicacoes.com.br/index.php/editora/article/view/4363.
OLIVEIRA/GOYTAKÁ et al., 2024	Processes employed by the Native Peoples of Rio de Janeiro	CONTRIBUTIONS OF DEPARTMENT OF MEDICINE TRADITIONAL OF FEDERATION BRAZILIAN DE HOMEOPATHY: Attention to the historical rescue of Traditional Medicine and Ethnomedicine in an urban context in Rio de Janeiro	SEIVA Support Magazine to SAPB-LIPAT Project /FF/UFRJ - Techn Art. **Vol. 8 n. 2**	https://sites.google.com/view/lipat/sapb-revista_seiva?authuser=0#h.pvgytd220ruy
GASPAR et al., 2024, Apr.	Waste destination	Environmental impact of pollutants and the potential contribution to phytoremediation.	Individual chapter. ***E-book:*** **Engineering and its advancements**.	ISBN: 978-65-85932-09-7. DOI: 10.56238/sevened2024.004-012. Link: https://sevenpublicacoes.com.br/index.php/editora/article/view/4192.
BENTES LOPES et al., 2024, Apr.	Plant-mediated destinations of waste, effluents, insects and arachnids	Environmental potential of plant use: Resource management in the face of climate uncertainties	**Observatorio de La Economía Latinoamericana Journal**	DOI: https://doi.org/10.55905/oelv22n4-019; https://ojs.observatoriolatinoamericano.com/ojs/index.php/olel/issue/view/37

VARRICCHIO et al., 2024, May.	Phytoremedial potential of soil.	Insecticidal and juvenilizing activity tests of *Euphorbia tirucalli* Latex on *Aedes aegypti* Larvae. Micropropagation and new potential for biological activity.	Individual chapter. ***E-book***: **Impacts of Dengue, Zika and Chikungunya: a multidisciplinary analysis.**	ISBN: 978-65-6109-020-9. DOI: 10.56238/sevened2024.011-003. Link at: https://sevenpublicacoes.com.br/index.php/editora/article/view/4363.
NAGAMATSU et al., 2024, May.	Antimicrobial/phytonal and bioremedial potential	Algae, Green Halophyte Plants and Bacteria: A Brief Review.	**INFO-SAPB Support Magazine to SAPB-LIPAT Project /FF/UFRJ - Techn Art.** v.8 n.1.	https://sites.google.com/view/lipat/sapb-revista_info-sapb?authuser=0#h.u7zg2olemi1f
GASPAR, S.A. et al., 2024.	Planning and Management, Environmental Bioethics; Environmental Ethics.	SUSTAINABILITY AND ENVIRONMENTAL ETHICS (From the Environmental Primer to the Intercultural Garden).	**Contemporary Journal.**	https://doi.org/10.56083/RCV4N2-103. 2024. Link at: https://ojs.revistacontemporanea.com/ojs/index.php/home/article/view/3407
GASPAR, S.A. et al., 2024a	Environmental Bioethics; Environmental Ethics.	Environmental ethics at an intercultural Garden (Scientific initiation in sustainability).	***Ebook:*** **Exploring the Field of Agricultural and Biological Sciences**, Seven Publicações Ltda. ISBN: 978-65-981429-4-0.	10.56238/sevened2023.001-019. 04/04/2024a. https://sevenpublicacoes.com.br/index.php/editora/article/view/4052.
GAYER et al., 2024, Oct.	Smoke and Vapor Emissions	Smoking, Public Health and Environmental Health.	**INFO-SAPB Support Magazine to SAPB-LIPAT Project /FF/UFRJ - Techn Art.** v.8 n.2.	https://sites.google.com/view/lipat/sapb-revista_info-sapb?authuser=0#h.sewngkll2zj3
REBELO et al., 2025, Jan	Review of the Evidence for the Phytoremedial Potential of *E. tirucalli*	Environment: Health and Engineering - Interdisciplinarity in focus	**Pedagogical Notebook.** v.22, n.1	https://doi.org/10.54033/cadpedv22n1-141 https://ojs.studiespublicacoes.com.br/ojs/index.php/cadped/issue/view/134
TORRES et al., 2025, May	Exposure to types of radiation	NON-IONIZING AND IONIZING RADIATION: A REVIEW STUDY	**INFO-SAPB Support Magazine to SAPB-LIPAT Project /FF/UFRJ - Techn Art.** v.9 n.1.	https://sites.google.com/view/lipat/sapb-revista_info-sapb?authuser=0#h.thuy82sxd2os

Source: Prepared by the authors themselves.

DISCUSSION

Based on Singer (2003), after toxicological and pharmacological research (Varricchio, 2008), we turn our attention to the phytoremedial potential that secondary metabolites can offer during biotransformation into soil (one of the stages of phytoremediation), especially in

complex plant species such as those that produce latex, which exhibit numerous biological activities of interest, including economic and socio-environmental (Varricchio et al., 2008, a).

Plant biotechnology, by definition, through research and product technology, allows approximation to aspects of environmental engineering and socio-environmental technology (Varricchio, 2008). In this way, ethically, we work at the interdisciplinary intersection, living with professionals from other areas, enriching ourselves in technical knowledge, but much more in humanization, in the sense of respect, ethics, dialogue and appreciation of the other from their different perspective, different from that of the health professional, however, always with an eye directed to the dimension of environmental health and environmental bioethics (Musmanno et al., 2019; Pinto, 2019; Wendling da Silva, 2019).

Investigations were carried out based on scientific initiations, bringing undergraduate and residency students in medicine closer to the notions of environmental health and sustainability, thus learning to work from project-based learning (Freire Souza Silva et al., 2023; Cruz Filho et al., 2023).

Environmental Health is the study to reduce the impacts that the environment has on human health. The World Health Organization (WHO) defines environmental health as those aspects of human health that are determined by environmental factors: physical, chemical, biological, social, and psychological. Environmental health is an area of public health that studies and reduces the impacts of the environment on human health. Environmental health is important because the interaction between the environment and public health influences people's well-being (Koifman; Thériault, 1994; Koifman; Mattos, 1996; Koifman et al., 1998; BR, MS, Environmental Health. portal.gov). Their learning corresponds to contemporary demand.

Environmental and Sanitary Engineering studies environmental problems in an integrated way in their ecological, social, economic and technological dimensions to promote sustainable development. Therefore, both areas of research and intervention bring contributions to the concept of One Health, that is, measures based on the understanding that health promotion is for all living beings. The concept of One Health recognizes the connection and integrates human, animal, and environmental health (Thériault et al., 1994; BR, MS, Environmental Health. portal.gov). One health can be defined as a multidisciplinary collaborative effort, acting at the local, national and global levels to ensure optimal health for humans, animals and the environment (Guimarães; Carvalho In EMBRAPA DAIRY CATTLE, 2021).

Technological procedures through field studies in ecophysiology (outside the laboratory to carry out complexity analysis) were carried out, prioritizing the evaluation of

abiotic factors. They brought relevant evidence on mechanisms of action in the genus Euphorbia that have not yet been studied, as well as on the chemical markers of diversified biological activities of this plant species (Varricchio et al., 2008; Nigri et al., 2017; Delaunay & Rangel, 2019; Hansel-Martins et al., 2020; Gomes et al., 2023; Nagamatsu et al., 2024; Gayer et al., 2024).

For all the investigated so far, it was proposed that *E. tirucalli* suggests potential action as a bio-indicator also of excessive electromagnetic exposure, and this communication aims to arouse the interest of professionals with specific training in the area. This is an exotic species of wide adaptation and distribution on the planet. A producer of latex rich in diterpenoids, its chemical production varies due to oxidative stress induced by environmental variations, including luminosity, temperature and different types of electromagnetic field radiation (Varricchio, 2008; Varricchio, Da Silva & Varricchio, 2010 *In* Nigri et al., 2017).

Worthy of note, justifying this chapter, follows the discussion woven below about the use of the preliminarily generated information:

- Indicators of potential phytoremedial activities, consequently, bio-indicators that allow the monitoring of the mitigating potential of *Euphorbia tirucalli* on the impacts of environmental pollution from non-ionizing electromagnetic radiation (Nigri et al., 2017); soil corrections for activities against insects and pests (Hansel-Martins et al., 2024); of medicine and drug residues in water Kathar et al., 2023); accumulation of plastic waste, its digesting lysis with potential reuse and recirculation of the same (Delaunay de Souza et al. 2023); the potential phytoremediation of the soil, perhaps bioremediation (Gaspar et al., 2024); as well as the questioning of the phytoextractor potential of air pollutants and vapors (Gayer et al., 2024);

- As options in situations where sustainability is compromised in the face of drinking water reduction (Gaspar et al., 2023a);

- In the face of excesses triggered by climatic disturbances that abruptly overload the environment and demand solutions not previously thought of (Gaspar et al., 2023, b; Bentes Lopes et al., 2024; Varricchio et al., 2024).

As methodologies and products that serve the teaching of the team in professional and technological education, in addition to scientific initiation at the undergraduate and graduate levels (Wendling da Silva et al., 2019; Cler et al., 2025), for this stage that has

been concluded, our results were primarily focused on the identification of biological activities by investigating their mechanisms of action.

It was also aimed at the use or development of new research methodologies, to consistently check the potential for traceability of events in the production chain and environmental phenomena.

As known, traceability is the ability to track the location, application, or history of an item, based on data already recorded. Traceability is important to: ensure that products comply with current regulations; analyze issues such as environmental protection and public health; correct process failures, control and monitor all stages of the production process, ensure the origin and quality of the final product (ISO, 9001).

Health promotion via health education was also the focus of our interventions in primary health care and specific prevention, ranging from review studies (generally published by the supporting journals of the Environmental Health, Parasitology, Bioethics Project), through basic research in search of sustainable solutions evaluated among peers (shown in Chart 1), arriving at the health interventions practiced at the local level and circulated free of charge via smartphone applications (inserted in these publications).

CONCLUSION

Stages of research carried out in phytoremediation were described, through the use of the plant species *Euphorbia tirucalli as a* potential indicator of persistent residue and pollutant levels, as well as as a potential phyto-extractor mechanism, suggested from these tests prepared by the interdisciplinary team, whose aim was to promote a sustainable local solution, since 40% of chronic-degenerative diseases are of environmental origin in according to the DATA-SUS epidemiological surveillance system. In other words, to emphasize the relevance of this movement in applied basic biotechnological research: for every hundred patients, forty have a cause of disease of environmental origin, possibly preventable.

The objective of this article was, therefore, to weave an evolutionary case study, record and analyze the information generated and the most important aspects of it about the potential capacities of mitigation of environmental damage, aiming at the single health (health of all living beings with preservation/recovery of sources of nature as a whole) through the diagnosis of the environmental problem and the intervention through various plant species, here especially focused on the potential phytoremedial role of *E. tirucalli* in generating resistance and sustainability.

New biotechnological investigations are being carried out, since environmental problems never before faced require critical evaluation skills and planning for the establishment of methodologically adequate essays to the current epistemologies, where, however, creativity and reasoning for their adaptation should prevail in the face of the understanding of the complexity of nature among us, researchers.

While in biotechnology we continue the investigations of phyto-adaptogenic extracts and functional foods to modulate physiological responses via adaptive immunity in the face of the growing statistics of chronic-degenerative diseases of an environmental nature, in a broad thought that aggregates the ethical citizen participation of all, we share such observations, of interdisciplinary interest, regarding the species of the genus Euphorbia.

The theme that brings together research on bioindicators and phytoremediators is of increasing relevance in the face of climate uncertainties and socio-environmental accidents. Although still controversial, it aims at the well-being of the whole society when rational methodological solutions are sought with a global vision, collaborating with sustainable alternatives at the local level, to reduce this environmental impact and the dramatic migration of affected populations, also aiming to better qualify the environment offered to vulnerable populations.

STUDY LIMITATIONS

These essays presented here correspond to studies carried out in search of a methodology appropriate to the hypothesis formulated. Favorable evidence is guiding the team to plan new approaches, which will include methodological associations.

This type of qualitative evaluation must also bear in mind that the effects of an activity produced today at the local level may appear only after several years. It should be noted, however, that nowadays they can be scientifically proven, given the technological development achieved by observing complexity. However, many times, future damage cannot be proven immediately, thus effectively occurring *a posteriori*, without any measure to the contrary having been adopted.

FINAL RECOMMENDATIONS

Finally, flexibility is recommended to deal with both complexity and uniqueness. If professionals, who belong to that decision-making group, join the transdisciplinary local knowledge, new strategies can be better received, more effective for the entire population, and such a humanized partnership can be heartwarming in moments where resilience will need to be evoked, since everything in life has a limit.

To confirm the hypothesis regarding the phytoremedial action under conditions of dryness (water stress), excess of luminosity and temperature extremes, it is recommended to carry out a new study of plant micropropagation associated with botanical investigation to describe specific morphological characteristics that condition the action and/or participate during the dynamics of the phytoremedial adaptive activity. Then, they will be exposed to a certain undesirable pollutant condition to be investigated the phytoremedial response, initially, via anatomical stem sections.

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The authors declare the absence of conflict of interest.

REFERENCES

1. Brazil. Ministry of Health. (n.d.). National Health Council: Environmental Health. Retrieved from https://portal.gov

2. Civil Code. (1916). Art. 225. Retrieved from https://law.gov.br

3. Cler, J. da S., et al. (2025). The richness of inter-epistemological dialogue for comprehensive care: Humanities and social medicine by the environmental health, parasitology, bioethics project. Revista Aracê, 7(1), 241-259. https://doi.org/10.56238/arev7n1-014

4. Cruz Filho, F. C., et al. (2023). Bioproduct with plastic digester potential. The teaching of environmental ethics by the SAPB-LIPAT/UFRJ & UNIFASE-FMP Project. In Interdisciplinarity and Innovation in Scientific Research (pp. xx-xx). Seven Publicações Ltda.

5. Freire Souza Silva, F., et al. (2023). Professional ethics and bioethics: Contributions of teaching homeopathy and phytotherapy in a medical student league for the development of humanities and cultural competence. Brazilian Journal of Development, 9(10), 28685-28699. Retrieved from https://ojs.brazilianjournals.com.br/ojs/index.php/BRJD/issue/view/220

6. Guimarães, S. de A. B. (2002). O dano ambiental. Jus Navigandi, 6(58). Retrieved from http://www1jus.com.br/doutrina/texto.asp?id=3055

7. Guimarães, A. S., & Carvalho, B. C. de. (2021). One health: The comprehensive and definitive concept. Biosafety - EMBRAPA Dairy Cattle, 36-37. Retrieved from https://www.infoteca.cnptia.embrapa.br/infoteca/bitstream/doc/1134841/1/Saude-unica.pdf

8. Koifman, S., & Thériault, G. (1994). 50-60 Hz electric and magnetic fields and cancer: The use of field exposure measurements in epidemiological studies. In D. O. Carpenter & S. Ayrapetyan (Eds.), Biologic effects of electric and magnetic fields (pp. 201-231). Academic Press.

9. Koifman, S., & Mattos, I. E. (1996). Electromagnetic fields of extremely low frequency (50-60 Hz) and cancer: Commented literature review – Work prepared for ELETROBRAS.

10. Koifman, S., et al. (1998). Cancer cluster among young Indian adults living near power transmission lines in Bom Jesus do Tocantins, Pará, Brazil. Cadernos de Saúde Pública, 14(suppl. 3). https://doi.org/10.1590/S0102-311X1998000700016

11. Martins de Souza, M. C., Abreu Neves, A., & Terneiro Cangani, M. (n.d.). A política nacional do meio ambiente de Portugal.

12. Musmanno, P., et al. (2019). Euphorbia tirucalli and germination of Vigna unguiculata: Bioproduct and biotechnological potential [Conference presentation]. FMPFase Extension Course: Semiology: Care, Inter/Transdisciplinarity, Bioethics and Spirituality.

13. Nigri, A. I. (2003). Influence of high voltage transmission lines on the environment (Undergraduate monograph). Estácio de Sá University.

14. Nigri, A. I., et al. (2017). Transmission lines and environment: Historical perspective of guidelines in environmental health. INFO-SAPB/SAPB-LIPAT/UFRJ Support Magazine to SAPB-LIPAT Project - Technical Article, 1(1). Retrieved from https://sites.google.com/view/lipat/sapb-revista_info-sapb?authuser=0#h.p_Ao3lwclpMYL6

15. Pinto, M. D. D. C. de A. (2019). Comparison of the effect of E. tirucalli extracts on the germination of Vigna unguiculata. Testing fermented bioproducts on materials persistent in nature (plastics) [Conference presentation]. I Natural Products and Bioproducts Day for Undergraduate and Extension Students at the FMPFase Cultural Center, Petrópolis, RJ.

16. Sampaio, F. J. M. (1992). Environmental damage and responsibility. Revista Forense, 317, 115.

17. Singer, A. C., et al. (2003). Secondary plant metabolites in phytoremediation and biotransformation. Trends in Biotechnology, 21(3), 123-130.

18. Thériault, G., et al. (1994). Cancer risks associated with occupational exposure to magnetic fields among utility workers in Ontario and Quebec, Canada, and France, 1970-89. American Journal of Epidemiology, 139, 550-572.

19. Varricchio, M. C. B. N. (2008). Euphorbia tirucalli L.: Special metabolites, biotechnology, toxicology, antitumor and adaptogen activities (Doctoral dissertation). Federal University of Rio de Janeiro.

20. Varricchio, M. C. B. N., et al. (2008). Euphorbia tirucalli: Qualitative analysis of vegetable development during in vitro cultivation. BioFar, 3(1), 1-13.

21. Varricchio, M. C. B. N., et al. (2008a). Chromatographic analysis of Aveloz latex and the risks of non-standardized plant extracts. FOG Archives, 5(2), 113-136. Retrieved from https://sites.google.com/view/lipat/sapb-artigos?authuser=1#h.p_p1DnrUrkjqlq

22. Ventura, M. M. (2007). The case study as a research modality. SOCERJ Magazine, 20(5), 383-386. Retrieved from http://sociedades.cardiol.br/socerj/revista/2007_05/a2007_v20_n05_art10.pdf

23. Wendling Silva, A. V. da. (2019). Euphorbia tirucalli, bioproduct and resinous biotechnological potential: Preliminary results [Conference presentation]. Round Table: Neglected Diseases and Oncology & Bioproducts of Euphorbia tirucalli, Faculty of Pharmacy, UFRJ.