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Jaime A. Teixeira da Silva

ORCID 0000-0003-3299-2772
Independent researcher (Kagawa, Japan)
jaimetex@yahoo.com

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The Misrepresentation of Petri Dish, as "petri" Dish, in the Scientific Literature

Abstract

The Petri dish is, without a doubt, a very basic, yet important and popular tool in microbiological and other biomedical experiments. It serves primarily as a support or structural platform for placing, growing or testing biological specimens, whether these be microbiological, animal, plant or human. Given its size, usually about 10 cm in diameter, the Petri dish is an ideal platform for cellular and tissue cultures. Despite the commonality of Petri dishes, quite surprisingly, there is a pervasive error throughout the biomedical literature, namely its misspelling as "petri" dish. This is not a trivial issue since this dish is named after a scientist, Julius Richard Petri (1852–1921), so the upper-case "P" should not be represented as a lower-case "p". It is important to alert students and seasoned biomedical researchers, as well as the wider public, who might use this term, about the need to use the term Petri accurately, in order

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to respect its historical foundation. To garner some appreciation of the extent of this error in the biomedical literature, a 2022 search on PubMed for either "Petri dish" or "petri dish" revealed 50 search results, 24 (or 48%) of which were of the latter, erroneous form in titles or abstracts. This suggests that the indicated error, which is in need of correction, may be widespread in the biomedical literature.

Keywords: *basic and applied biology*, *cell*, *tissue and organ culture*, *microbiology*, *synthetic meat*

Fałszywe przedstawienie w literaturze naukowej "szalki Petriego" jako "szalki petriego"

Abstrakt

Szalka Petriego jest bez wątpienia bardzo podstawowym, ale ważnym i popularnym narzędziem w eksperymentach mikrobiologicznych i innych biomedycznych. Służy przede wszystkim jako platforma wspierająca, na której można umieszczać, hodować lub testować próbki biologiczne, mikrobiologiczne, zwierzęce, roślinne lub ludzkie. Biorąc pod uwagę jej rozmiar, zwykle około 10 cm średnicy, szalka Petriego jest idealna do kultur komórkowych i tkankowych.

Pomimo powszechności szalek Petriego, co zaskakujące, istnieje błąd, który jest wszechobecny w całej literaturze biomedycznej, a mianowicie błędna pisownia jako „szalka petriego". To nie jest trywialna kwestia, ponieważ ta szalka nosi imię naukowca Juliusa Richarda Petri, więc wielka litera „P" nie powinna być reprezentowana jako mała litera „p".

Ważne jest, aby ostrzec doświadczonych badaczy biomedycznych, a także szerszą opinię publiczną, która może używać tego terminu, o potrzebie dokładnego używania terminu Petri, aby uszanować jego historyczne podstawy. Aby docenić zakres tego błędu w literaturze biomedycznej, wyszukiwanie w PubMed w 2022 r. pod kątem szalki Petriego lub szalki Petriego ujawniło 50 wyników wyszukiwania, z których 24 (lub 48%) dotyczyło tej drugiej, błędnej formy w tytule lub abstrakcyjne. Sugeruje to, że ten błąd, który wymaga korekty, może być szeroko rozpowszechniony w literaturze biomedycznej.

Słowa kluczowe: *biologia podstawowa i stosowana*, *komórka*, *hodowla tkanek i organów*, *mikrobiologia*, *mięso syntetyczne*.

1. Introduction

Biomedical researchers might take some very basic tools for granted in the laboratory, not because they are not important, but because they are so commonly used that they have become almost common place. One of those tools is the Petri dish (sometimes Petri plate), a plastic or glass dish, typically about 10 cm in diameter, but with varying diameters, that is most frequently used for growing a culture of microbial, plant, animal, or human cells, or tissues and organs in the latter three groups, in order to study wide-ranging hypotheses in biomedicine. Experiments in basic and applied biology often require Petri dishes, and in most instances, except for rare exceptions, they need to be sterile in order to avoid microbial contamination. Pre-ordered plastic Petri dishes are often packaged and pre-sterilized because they cannot be autoclaved since they melt, so they tend to serve only once, whereas glass Petri dishes can be easily autoclaved and reused multiple times. The gap between the base and lid can be sealed with a gas-permeable membrane such as Parafilm®, making it suitable for the culture of living cells and tissues. These characteristics make Petri dishes practical and versatile. In contrast to literal and tangible Petri dishes, figurative Petri dishes or experimental sand-pits where ideas are theoretically tested and explored (Wei *et al.* 2021)[1], are not covered in this paper.

The origin of the word "Petri dish" is historically ascribed to a German scientist, a microbiologist, Julius Richard Petri, hence the use of his last or family name in Petri dish (Grote, 2018). The self-attribution of the name to a single scientist has been the subject of some challenge and controversy, the main argument being that other deserving scientists also contributed to the use and popularization of these dishes, and not only Petri (Shama, 2019). Placing that controversy aside, the name of the Petri dish should be revised to something else,

[1] Of eight mentions in this paper, only one (in the title) was as "Petri dish", the remaining were spelled "petri dish".

such as "culture dish", in order to reflect a more historically neutral name. In the context of this paper, the correct term, with an upper-case "P", i.e., Petri dish, is assumed. Consequently, the spelling as "petri" dish, with a lower-case "p", is considered an error. This issue is not limited to academic research. Recently (May 30, 2022), a US Republican politician, Marjorie Taylor Greene, referred to Petri dishes as "peach tree dishes", while attempting to describe the artificial culture of meat cells[2].

This paper has two objections. First, to provide an appreciation of the use of Petri dishes in a wide range of recent (2021–2022) research applications. Second, given that "petri" dish is a *de facto* erroneous form of Petri dish, PubMed was consulted in order to gain some appreciation of the extent of this error by assessing the frequency of this error in 2022 indexed literature.

2. The wide use of Petri dishes in biomedical – and other – research

A search (June 4, 2022) for "Petri dish" on some popular openly available databases[3], namely PubMed, Elsevier's sciencedirect.com, Springer Nature's Springerlink and Google Scholar revealed 1880, 107,649 123,168 and 588,000 hits, respectively. Evidently, even though many results are likely to be false positives, these findings point towards a popular topic and/or tool, primarily in the biomedical literature. In order to identify papers that would exemplify the wide-ranging use of Petri dishes in the biomedical literature, the Google Scholar search was limited to 2021–2022, i.e., relatively new literature, to identify studies that represented the use of Petri dishes in a wide range of experimental settings. Some papers, including those that are cited, employed the erroneous spelling "petri", as indicated in Table 1, and whereas this error exists in the original title, the error is faithfully transcribed as such

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[2] "…a cheeseburger which is very bad because Bill Gates wants you to eat his fake meat that grows in a peach tree dish, so you'll probably get a little zap inside your body and that say "no, no", don't eat a real cheeseburger, you need to eat the fake, the fake burger, the fake meat from Bill Gates" (Kaonga 2022, at 13/14 seconds; transcribed by the author after listening carefully to the video transcript).

[3] Scopus and Web of Science were not consulted since they are proprietary and thus not free to access or search.

in the reference list, but is labelled with "[sic]" (e.g., Singh *et al.* 2022), to indicate this error.

This section is neither a review, nor a comprehensive or exhaustive exploration of the application of Petri dishes in biomedical and other research, but serves only to highlight a wide range of studies that showcase their application. Generally, Petri dishes are used either as a solid base or with a liquid. In the latter case, typically, shake flasks would likely be used for liquid-based cell cultures. In the case of solid use, Petri dishes may be dry, with a solidified medium, such as agar, or with a moistened base, such as filter paper, directly on the base of the dish, or overlaying the medium. In several cases shown in Table 1, Petri dishes are used for very simplistic – yet important, standard and convenient – purposes, such as a platform on which to place experimental samples. In such cases, they are almost essential materials. Petri dishes also serve as a useful tray to weigh reagents on a scale. Petri dishes are popular containers for studying the behavior of organisms because they are transparent, so biological samples can be observed at least clearly from the top and bottom, and can also be photographed under a light microscope. A wide range of applications across several fields of study, often multidisciplinary in nature, are presented in Table 1. Even though several (16/38, or 42%) of these studies employed the erroneous version of Petri dish (i.e., petri dish), as indicated by an asterisk in Table 1, readers are cautioned that the existence of this error alone should not exclude the use and citation of such studies, i.e., this typographic error does not invalidate these studies' scientific merit.

3. Petri dish-related errors in PubMed

As briefly mentioned above, a search on PubMed revealed 1880 results, including all fields (title, abstract, etc.). Curiously, a search for "Petri dish" and "petri dish" revealed identical search results, suggesting that PubMed does not recognize, or differentiate, this error. This compounds prior concerns about errors, inaccuracies and scientifically suspect literature present in this popular biomedical database (Teixeira da Silva 2023).

Limiting the search to 2022, revealed a total of 50 hits, the entries of which were manually examined to ascertain where the error existed (i.e., in the title or abstract), or not. The full texts, several of which could not be accessed, were not examined, also because full texts do not form part of the indexing in PubMed. That assessment revealed that out of 50 hits, 24 (48%) contained the erroneous "petri dish". Strictly speaking, in a biomedical literature that strives to be as accurate and error-free as possible, such errors would need to be corrected (Teixeira da Silva 2016). The reason being that a biomedical researcher, that unsuspectingly uses a paper that employs the erroneous form of "Petri dish", may unwittingly carry this error forward in their own scientific paper, thereby propagating the error downstream in the information flow, i.e., in citing papers (Teixeira da Silva 2016). Finally, some may argue that if such errors would be corrected every time that an error was detected, for example during post-publication peer review, especially those, who may argue that such errors are minor or trivial, that the literature would be awash with errata. This suggests that current models for correcting the literature are insufficiently robust or unsustainable (Teixeira da Silva 2022). It is precisely for this reason that the dual-DOI-based "publication history" was devised, in order for the publication record to be continually updated without disrupting the flow of information caused by intrusive or obtrusive errata, or other literature updates (Teixeira da Silva, Nazarovets 2022).

4. Conclusion and limitations

The Petri dish is, as has been appreciated in this paper and given, how widely it appears in some major databases, it shows how popular, useful, and versatile a tool and support structure in basic and applied biomedical research it is. In some cases, given its application to technologies and scientific discoveries that may find applications in society, it is a term that might appear in public, and thus be the subject of public and even political debate. The "petri dish" error is thus not only limited to biomedical researchers, but also to the wider public. In that sense, this paper serves informative, educational and corrective purposes. Finally, the argument is made that since "petri" dish is a *de facto* erroneous form of Petri dish, that scientific literature, especially that, which is indexed in leading scientific platforms such as Scopus, Web of Science, PubMed, and Google Scholar, is in the need of correction. It can be argued that journals or publishers that derive benefit (e.g., citations, sales, etc.) from erroneous literature, and who turn a blind eye to errors in literature that they distribute and sell, derive such benefit unfairly (Teixeira da Silva, Vuong 2021).

In the third section of this paper, a small analysis is shown, which has been conducted using only PubMed, because Web of Science and Scopus are proprietary and thus the databases are not freely accessible. In PubMed, to gain a crude appreciation of the level of this error, 2022 data was examined in detail, revealing a 48% error rate (title or abstract), or 42% in the sample set examined separately, as shown in Table 1 (whole texts). Scientific sleuths with advanced bibliometric and informatics skills that are interested in this topic would do well to explore PubMed and other major databases in greater detail to appreciate if these values are consistent over several years, or if there are country-, journal-, or publisher-based patterns of errors.

5. Conflicts of interest

The author declares no conflicts of interest of relevance to this topic.

6. Author contributions

The author contributed fully to the intellectual discussion underlying this paper, literature exploration, writing, reviews and editing, and accepts responsibility for the content, analyses and interpretation herein.

Table 1. Wide range of uses of Petri dishes in biomedical – and other – research, pure and applied

Broad field of research (sub-field)	Brief description of application of Petri dishes	Reference*
Algology	To assess the impact of dehydration on photochemical efficiency of a red alga (*Neopyropia yezoensis*)	Terada *et al.* 2021*
Biocontrol (insect)	For rearing, and assessment of the development, reproduction, and oviposition of pests (thrips, whiteflies and spider mites)	San *et al.* 2021
Biocontrol (plant)	To expose aphids to companion plant (leek; *Allium porrum*) volatile organic compounds to assess impact of colonization of host plants (sweet pepper; *Capsicum annuum*)	Baudry *et al.* 2021

Tabela 1 cd.

Broad field of research (sub-field)	**Brief description of application of Petri dishes**	**Reference***
Biocontrol (plant)	To assess phytopathological potential of two plant (*Parthenocissus quinquefolia* and *Plectranthus neochilus*) extracts to control tomato early blight (*Alternaria solani*)	Mohamed *et al.* 2021
Development	To grow *Dictyostelium discoideum* cells with *cln5*-deficiency in various assays to assess cellular growth and development	McLaren *et al.* 2021
Ecology (arthropod)	To place arthropod samples whose images were captured, and applied, using computer vision-aided deep learning, to appreciate arthropod abundance, biomass and diversity	Schneider *et al.* 2022*
Ecology (climate change)	To rear two marine invertebrates (*Pyura herdmani*, *Pyura stolonifera*), and assess the performance of parental and hybrid crosses under different climate change scenarios	Hudson *et al.* 2021
Ecology (fish conservation)	To count and measure the size of fish (Round Hickorynut; *Obovaria subrotunda*) glochidia	Shepard *et al.* 2021
Ecology (invertebrate)	To rear an invasive insect (fall armyworm; *Spodoptera frugiperda*) that impacts corn in China, to appreciate its life history	Huang *et al.* 2021
Ecology (plant)	To assess the germination of seeds of perennial grasses (*Festuca valesiaca*, *Poa densa*, *Stipa zalesskii*) that had been exposed to mountain fires, and thus smoke and heat	Zaki *et al.* 2021
Ecology (vertebrate)	To appreciate the impact of passage through the digestive tract of a marsupial (*Dromiciops gliroides*) in a temperate forest on seed germination ability of seeds from consumed fruits	Vazquez *et al.* 2022
Engineering	To serve as a chemical reactor to appreciate the fractal growth of copper	Wang *et al.* 2021*

Entomology	To assess the survival of susceptible and *kdr*-resistant strains of malaria mosquito (*Anopheles gambiae*) larvae in an insecticide-free environment	Medjigbodo *et al.* 2021*
Environment (pollution)	To microscopically examine microplastics isolated from salt marsh sediments	Lloret *et al.* 2021*
Evolution (fly sexual selection)	To rear fruit fly (*Drosophila melanogaster*) eggs.	Hotzy *et al.* 2022
Materials science (microbiology)	For culture of alkali-resistant bacterium (*Bacillus subtilis* M9) to assess its ability to precipitate calcium carbonate in the repair of a fiber matrix	Feng *et al.* 2021*
Materials science (nanotechnology)	Use as a platform for the creation of copper nanowires to develop cotton-based wearable heat fabrics	Guo *et al.* 2021*
Materials science (nanomedicine)	Use as a base to coat the nanopatterned surface of polycaprolactone with gelatin to create fortified biomedical patches	Kim *et al.* 2021*
Microbiology (antimicrobial)	Assays to assess the effectiveness of 19 essential oils on the growth and sensitivity of 10 microbes	Abers *et al.* 2021*
Microbiology (bacteria)	To assess surface motility as a precursor for software designed to measure spread	Casado-García *et al.* 2021
Microbiology (fungi)	To assess the characteristics of nono- and cocultures of *Monascus* spp. and *Aspergillus niger*, which are used to brew rice wine and cereal vinegar	Yuan and Chen 2021*
Microbiology (viruses)	To assess the efficiency of collection of respiratory viruses (influenza A virus, human metapneumovirus, parainfluenza virus type 3, and respiratory syncytial virus) on a cascade impactor with solid or semi-solid media	Kutter *et al.* 2021*
Neurobiology	To culture mouse embryonic stem cells and P19 embryonal carcinoma cells for the assay of mesoderm-specific transcript in in primary hippocampal or cortical neurons	Prasad *et al.* 2021

Tabela 1 cd.

Broad field of research (sub-field)	Brief description of application of Petri dishes	Reference*
Oncology	To culture human malignant melanoma cells (A375) for the live-dead assay	Tang *et al.* 2021*
Parasitology (veterinary)	To count the number of fluke (*Fasciola hepatica*) eggs in livestock (sheep and cattle) feces	Reigate *et al.* 2021
Plant science (ecology)	To assess the growth of hyphae of homo- and dikaryotic strains of an arbuscular mycorrhizal fungus (*Rhizophagus irregularis*) in root organ cultures of three plant hosts	Serghi *et al.* 2021
Plant science (phytopathology)	Use in pathogenicity assays to test the antifungal activity of bioactive compounds from an antagonistic rhizobacterium (*Bacillus vietnamensis*), isolated from ginger (*Zingiber officinale*) rhizosphere against the agent of Pythium rot (*Pythium myriotylum*)	Jimtha John *et al.* 2021*
Plant science (reproduction)	Study of life history and sex-specific characteristics of a moss, of *Weissia jamaicensis*	Santos *et al.* 2022
Plant science (thermotropism)	To establish a thermogradient for the assessment of thermotropism of maize (*Zea mays*) roots	van Zanten *et al.* 2021
Plant science (tissue culture)	To immobilize, culture and proliferate seedling-derived protoplasts of *Arabidopsis thaliana*	Jeong *et al.* 2021
Postharvest (seed germination)	To assess germination capacity of rice (*Oryza sativa*) grains that had been stored for variable periods of time	Shu *et al.* 2021
Reproductive biology	To examine testicular tissues or spermatozoa to determine sperm count in azoospermia	Amer *et al.* 2022
Soil science	To probe reflectance spectra from the surface of soil samples	Alomar *et al.* 2022
Stem cells (synthetic meat)	To culture skeletal muscle tissue on a hydrogel, or to induce muscle cells from embryonic or muscle stem cells, to generate *in vitro*-cultured meat	Singh *et al.* 2022*

Toxicology (food)	To assess the ability of lactic acid bacteria to detoxify aflatoxins (AFB_1, AFB_2) derived from *Aspergillus flavus*	Ibitoye *et al.* 2021
Toxicology (herbicide)	To assess the toxicity of a chloroacetanilide herbicide (alachlor) on earthworm (*Eisenia fetida*)	Gangadhar *et al.* 2021*
Toxicology (nanoscience)	To assess the toxicological response of fruit fly (*Drosophila melanogaster*) eggs to cadmium oxide nanoparticles	El Kholy *et al.* 2021*
Toxicology (pesticide)	To assess the toxicity of a systemic pesticide (fluralaner) on three insect pests (*Henosepilachna vigintioctopunctata*, *Megalurothrips usitatus*, *Phyllotreta striolata*)	Liu *et al.* 2021

* Indicates papers in which Petri dish was used erroneously as petri dish, in the paper (any location), any number of times; even if both correct (Petri dish) and incorrect (petri dish) uses appear in the same paper, an asterisk is indicated.

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