Spotlight: Microbes in the Media (Hero or Villain?)

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Personal Motivation

As a Final Year Project student, I have only ever been examining bacteria through scientifically informed lens. Yes, I do experiment on them – but that interaction stops the moment I step out of the laboratory. These are merely tiny microorganisms after all: I observe bacteria on streak plates, validate results from assays… the list goes on. These interactions lead me to objective, unbiased perspectives regarding bacteria. How can something so small possibly be interpreted subjectively and draw strong emotions from people? *Or so I thought*. Microbes can indeed cause an uproar and many waves of (unpleasant) emotions – think about the flock of controversies surrounding COVID-19 on social media – people believing in the 'lab leak theory' or vaccine spooks that perpetuate vaccine hesitation and worse, rejection. It then dawned on me that our relationship with microbes is not that simple. We have not only been co-evolving alongside each other in a biological context but also in terms of our (one-way) perception of micro-organisms. Therefore, with this renewed motivation to explore how humans feel about microbes (specifically bacteria due to my vested interest), I embarked on this mini project to study the different portrayals of bacteria in the media and how consumption of said media can shape our very personal feelings towards these minute players in a global stage.

Microbial Threat Fearmongering: How Popular Culture (Mostly) Villainizes Bacteria

Through time, the media often paints an undesirable picture around microbes, characterising them as dirty and illness-inducing. This is observed almost everywhere, with some notable examples including cleaning product advertisements and their repeated promises to *kill* 99.99% of bacteria to Contagion's bacteria-studded billboard which aimed to evoke *fear* in movie-

watchers. These all point us, the common man, to one thing: Bacteria are dangerous, and we should rightfully fear them. This implicit association gradually takes shape when people are repeatedly exposed to strong, emotionally driven messages and portrayals which subsequently influences our attitudes and behaviors towards these microscopic organisms.

The most indicative evidence of our distaste for bacteria is in our almost fanatic-like impulses to purchase cleaning products during times of disease outbreaks (Koksoy Vayisoglu & Oncu, 2021), albeit the abundance of research proving that excessive antibacterial product usage ironically increases the likelihood of developing multiple allergies (Hong et al., 2014). Or look at our antibiotic over-usage as a population, which stems from the uncertainty and dread of something serious and far more sinister than we can comprehend during times of sickness (think: death). This fear of the unknown prompts incessant requests for antibiotics which doctors readily prescribed in the common 'demonize-and-destroy' approach. Mircobephobia, yes, that is a legitimate term! – shows mass media production, whether it is for educational awareness or capitalistic ventures (Stark, 2010), have hurt our perception of microbes terribly. In suggesting a dystopian-like ending full of human suffering, bacteria became the scapegoat and carries the burden of humans' apprehension of the unfathomable. It is, after all, easier to pin the blame on something when things go wrong.

As such, this phenomenon is also predominantly reflected in our popular culture. Entertainment outlets leverage on sensationalisability of bacteria to hit the frontlines, generate hype and buzz around their new releases. Terms like 'superbugs' and 'bacteria' have become a hot, search engine keywords for many highly raved entertainment and leisure sources, ranging from books like Superbugs by Matt McCarthy to televisionised movie screenings like Bacterium (2006) and Dr Ehrlich's Magic Bullet (1940). Rationally, this makes sense for media sources to hinge on since anything that spurs emotional reactions from the consumers directly translates to capital. Notice the rising trend of how dystopian-like societies and dooms-day scenarios

oftentimes takes place in the backdrop of a looming, malicious and frightening threat by pathogens such as bacteria itself? This, again, drives at a recurring theme: Depicting bacteria as the 'bad guy' works most of the time in garnering attention from the masses, and unpleasant feelings driven by the possibility of major catastrophes caused by bacteria (which most of us do not understand much about admittedly) sells out fast. The perpetual cycle encourages mass media to continue generating such sensational entertainment pieces and feed into our ever-growing perception that all bacteria harm us and should be destroyed at all costs.

Bacteria, Friend or Foe?

"Bacteria, art thou a villain?" With most of our interactions stemming from all sorts of negative portrayals, it is compelling to believe all things bacteria-related are horrible. But this sweeping statement is distasteful as well – after all, if they were no good for us, why do they exist? In overwhelmingly large numbers for good measure too, in fact, 5 million trillion trillion (Rappuoli et al., 2023) of them co-exists with us.

It would not be a stretch to consider bacteria can be beneficial too. Think about your favorite foods. Chances are they might include popular items like cheese, kimchi, kombucha or beer. Surprise, surprise, these foods are fermented (Leeuwendaal et al., 2022) with bacteria which subsequently enhances their umami flavors and preserves them well for our next food-binging round. Food scientists are constantly on the quest to develop better-tasting, higher quality foods from bacteria (Barrangou & Hill, 2021). This, as I quote from the Asian Scientist, proves to us that 'the future is (indeed) fermentation'. Similarly, bacteria are not just found in food, they are found *in us* too! Do not panic just yet, most bacteria found on or inside us are typically harmless, beneficial even. On our skin, commensal bacteria such as *Staphylococcus epidermidis* colonizes every surface possible, almost like an invisible protective coat. This protects our body from those (actually harmful) bacteria which then do not stand a chance to land on our skin for

subsequent invasions, effectively preventing the development of illnesses. These bacteria are like mini-warriors who diligently secrete natural antimicrobials to fend off intruders (Severn & Horswill, 2023). Another bacteria, the *Micrococcus* species is our skin's natural sunscreen; They are relatively resistant to ultraviolet (UV) radiation, making them effective protectors against UV-induced skin damages (Verma et al., 2024) which can lead to skin cancer. These reports highlighting the benefits of bacteria in mainstream media is far and between, unfortunately. Perhaps this has got to do with the attenuated virality that this information can achieve with the public, thereby communicating such information is a less intuitive approach when the spotlight is turned to bacteria during mass media production.

On the other hand, we do see more news reports and focus on the negatives brought about by bacteria, primarily overt focus has been placed on bacterial infections. This is critical from a public health angle, of course. Take for example *Staphylococcus aureus*, a well-known opportunistic pathogen which can quickly enter through cuts in the skin and lead to infections like skin and soft tissue infections and even pneumonia (De la Calle et al., 2016) in those with a weakened immune system. Perhaps something closer to our gut might show the complicated relationship between us and bacteria. Let's move to the intestines: *Clostridium difficile*, usually a harmless gut flora, can suddenly grow in numbers exponentially. When this happens, disaster is brewing, literally. *C. difficile* infections causes individuals to develop severe diarrhea (Poutanen & Simor, 2004) which can be life-threatening. Words signifying danger, speed, threat and uncertainty is typically used whenever bacteria are mentioned on mainstream media such as 'rare, serious', 'issues warning', 'battles' – see: The numerous articles publicizing the 'flesh-eating' bacteria outbreak in Japan, Tokyo just recently.

Rethinking the Bacterial Branding Buzz

It is interesting, however, to consider how we are so quick and accustomed to draw negative associations to bacteria. I am sure the immediate thought whenever we think of bacteria has to do with diseases. Research has shown that emotionally-charged words are processed faster (Pauligk et al., 2019), affecting our semantic networks strongly, that is, the usual, negative key terms that downplay the role of bacteria influences our cognitive thinking. Our brain naturally organizes schemas for faster interpretation of information. Sad to say, but this means bacteria would often be parked in the 'bad guy, disease-causing villain' schema. Therefore, there is a need for all of us, especially popular culture and mass media to rethink how our relationship with bacteria has soured along the way. There must be a way to rectify this situation, we can start off with rewiring our neurons to begin associating bacteria with more positives instead. The narrative should change, just like how the approach that The Guardian has taken – bacteria can be 'useful' and 'help change the world' through its ability to eat plastic waste and clean oil spills. This can help halt the 'demonize-and-destroy' storyline we are *oh* so used to and instead, prompt us to develop a more nuanced understanding and mutualistic relationship with bacteria.

The Finale – We Should Still be *Somewhat* Scared of Bacteria

This is not to say that we should be ignorant of bacteria's flipside. Pathogenic bacteria species which threaten our health and lives do exist. However, the strongest evidence of how our single-minded, negative perspective of bacteria has backfired on us is the rise in global prevalence of antimicrobial resistance. This trend rose precisely because of our mistaken perspectives of bacteria – the incessant and instinctive thought to kill and kill bacteria has turned on us this time. This abuse of antimicrobials led to decreased effectiveness in clinical treatment regimens and the emergence of fitter, more resistant bacteria strains. Considering this, I urge everyone to practice critical considerations and thinking when we think of bacteria. Yes, we should

eliminate those pathogenic strains, but we should not forget to practice mindfulness in our approach: Many bacteria can help us tremendously too. Should we engage them in the right manner, they can act as our co-actors on the global stage to pull off a magnificent performance (good health shall prevail!). Nonetheless, should we be willfully ignorant and folly around, they might just destroy the stage instead.

Reflections

It was insightful to explore how our relationship with bacteria has developed over the years due to scientific advancements (such as the increase in knowledge when it comes to characterizing different species) but also been hampered by the rise of popular culture and excessive use of sensationalized, exaggerated imagery and terms, which results in majority of the population believing that all bacteria are bad. This has given rise to abuse of antibiotics and antimicrobial agents to ease people's unease of co-existing with bacteria, which as we now know, can be a double-edged sword. As such, I now realize the importance of interdisciplinary communication – between Science and Media. Although they seem like disparate fields, one is not more important than the other, instead, it would be better to say that both works in tandem for the better of society. Therefore, it is extremely important for both disciplines to interact more closely, work together to paint a holistic picture (without any knowledge and communication gaps) so that the public has a better grasp of bacteria to maximize the benefits they can offer whilst protecting themselves from opportunistic pathogens.

References

Barrangou, R., & Hill, C. (2021). Todd R. Klaenhammer, an inspirational food microbiologist who leaves a lasting legacy. *Proc Natl Acad Sci U S A*, *118*(22). https://doi.org/10.1073/pnas.2107754118

De la Calle, C., Morata, L., Cobos-Trigueros, N., Martinez, J. A., Cardozo, C., Mensa, J., & Soriano, A. (2016). Staphylococcus aureus bacteremic pneumonia. *Eur J Clin Microbiol Infect Dis*, *35*(3), 497-502. https://doi.org/10.1007/s10096-015-2566-8

Hong, S., Kwon, H. J., Choi, W. J., Lim, W. R., Kim, J., & Kim, K. (2014). Association between exposure to antimicrobial household products and allergic symptoms. *Environ Health Toxicol*, *29*, e2014017. https://doi.org/10.5620/eht.e2014017

Koksoy Vayisoglu, S., & Oncu, E. (2021). The use of cleaning products and its relationship with the increasing health risks during the COVID-19 pandemic. *Int J Clin Pract*, *75*(10), e14534. https://doi.org/10.1111/ijcp.14534

Leeuwendaal, N. K., Stanton, C., O'Toole, P. W., & Beresford, T. P. (2022). Fermented Foods, Health and the Gut Microbiome. *Nutrients*, *14*(7). https://doi.org/10.3390/nu14071527

Pauligk, S., Kotz, S. A., & Kanske, P. (2019). Differential Impact of Emotion on Semantic Processing of Abstract and Concrete Words: ERP and fMRI Evidence. *Scientific Reports*, *9*(1), 14439. https://doi.org/10.1038/s41598-019-50755-3

Poutanen, S. M., & Simor, A. E. (2004). Clostridium difficile-associated diarrhea in adults. *Cmaj*, *171*(1), 51-58. https://doi.org/10.1503/cmaj.1031189

Rappuoli, R., Young, P., Ron, E., Pecetta, S., & Pizza, M. (2023). Save the microbes to save the planet. A call to action of the International Union of the Microbiological Societies (IUMS). *One Health Outlook*, *5*(1), 5. https://doi.org/10.1186/s42522-023-00077-2

Severn, M. M., & Horswill, A. R. (2023). Staphylococcus epidermidis and its dual lifestyle in skin health and infection. *Nat Rev Microbiol*, *21*(2), 97-111. https://doi.org/10.1038/s41579-022-00780-3

Stark, L. A. (2010). Beneficial microorganisms: countering microbephobia. *CBE Life Sci Educ*, *9*(4), 387-389. https://doi.org/10.1187/cbe.10-09-0119

Verma, A., Zanoletti, A., Kareem, K. Y., Adelodun, B., Kumar, P., Ajibade, F. O., Silva, L. F. O., Phillips, A. J., Kartheeswaran, T., Bontempi, E., & Dwivedi, A. (2024). Skin protection from solar ultraviolet radiation using natural compounds: a review. *Environmental Chemistry Letters*, *22*(1), 273-295. https://doi.org/10.1007/s10311-023-01649-4