



Mini Review Article

Curbing Chemical Chaos against COVID-19 by Simple Solitary Solution – A Mini Review on Bio-Enzymes

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Abstract

Environmental pollution is rising drastically due to the indiscriminate and intentional release of harmful chemicals into the atmosphere. Research has been concentrated on establishing novel, budget-friendly, eco-friendly solutions to minimize and eradicate pollution in the air, water, and soil due to chemicals. Bio Enzymes have a promising potential to efficiently detoxify and transform pollutants at a measurable pace and possibly curb the chemical chaos. This paper reviews the studies reported on the uses and properties of Bio Enzymes. It also highlights the bio innovative idea that came up during INDVSCOVID 19 virtual design thinking challenge.

Keywords: Bio Enzymes, Chemical pollution, Bio Fumigation.

Background

Although it is widely recognized that the quality of the air we breathe and the water we intake can affect our health, it is much more difficult to comprehend that our choices of cleaning and disinfecting products, and the chemicals that we spray or use to clean and disinfect, can compromise the climate and, as a result, our health (Velazquez et al.). In the past few decades, uses of the harmful chemical have increased drastically. Chemicals become the major ingredient of every manufactured product (Wolkoff et al.). A single product may be made from a handful to thousands of different chemicals,



depending on the size. Unfortunately, some of the chemicals like fluorinated compounds, BPAs, or phthalates, can leach from goods, and are usually found in the indoor air, water, food, house dust and most disturbingly in our bodies (Manisalidis et al.; Singh and Li). Today, for solving one issue of cleaning the environment, we have loaded the environment with synthetic chemicals. These chemicals are ruling our house (kitchen, wardrobes, laundry, bathroom, etc.), our workplace, our parks and surrounding. According to the Global Health Observatory in 2016, 13.7 million people died due to dwelling in an unhealthy environment (J Wolf). For the sake of cleaning the environment, we have made our environment full of chemicals, which have been associated with various diseases and disorders including cancer, cardiovascular, respiratory, and neurological diseases (Prüss-Ustün et al.; Piekarski, Diaz and McNerney; J Wolf).

Emerging Concern

In nature, there is a balance of pathogens and non-pathogens. For instance, the non-pathogenic bacteria like nitrogen-fixing microbes presenting the roots of the plant; lactobacilli in the milk helps in the conversion of milk to curd. There is an enormous number of good bacteria present in the human gut which helps in food digestion and absorption (Gensollen et al.; Meena; Butler et al.). Therefore, to sanitize our atmosphere with chemical cleaners, we are potentially destroying the non-pathogenic microbes too from the environment. Moreover, these chemical-based cleaners when sending out to our environment from houses as greywater, pollute the water bodies, air and also making the soil unfertile. For instance, the laundry detergents contain phosphate and non-biodegradable branch-chained alkyl sulphonates, which causes persistent foam. When this foam is flushed down in the drain, responsible for frothing in the water bodies like lakes, ponds, rivers, etc.(Ho et al.; Ramachandra et al.). Other chemicals like bleach are highly corrosive and can impact the human body. Bleach also emits harmful gases such as ammonia and chlorine when combined with other cleaning agents (Hoque et al.; Zainy). In the current scenario of the Covid-19 pandemic, advisory to prevent the spread of the virus further escalates the use of cleaning and disinfecting agents (Cirrincione et al.; Gharpure et al.; Khan and Yadav; Wang et al.).

Potential Solution

To deal with the world's most pressing challenge which is caused by chemicals, we need a simple, smart, and sustainable solution. With that thought, the search begins and we came across the Bio Enzymes, which is an eco-friendly, chemical-free, non-toxic solution fermented from fruits, vegetables, flowers, and leaves waste in the presence of jaggery and water (VAMA and CHEREKAR). This review article emphasizes the research and significant work done on Bio Enzymes to date. It also highlights the winning bio innovative idea that comes up during INDVSCOVID 19 virtual design thinking challenge to develop strategies and solutions for current challenges. The winning idea consists of: "The use of natural,



eco-friendly Bio Enzymes to fumigate hospitals and its arena to make them infection-free".

Methods

A systematic search of the literature was conducted in PubMed, Google Scholar, Science Direct and Scopus. Open access publications, websites and books have also been checked for more information. To find the relevant articles, Boolean operators “OR” and “AND” were used. MeSH subheadings were used and keywords were relevant for given databases. The search terms included were “Bio Enzyme”, Eco Enzyme”, “Fruit Enzyme”, Garbage Enzyme”, “Kitchen Waste”, and “organic waste”, combined with benefits and usages.

Literature Review

The literature review has been done to examine the research studies conducted on usages and properties of Bio Enzymes by various researchers. Over the past few decades, most research in bio enzymes has emphasized the role of bio enzymes in treating the water bodies and wastewater, soil stabilization, waste management, pest control, and as an antimicrobial agent.

Bio enzyme is a solution produced by fermentation of fresh kitchen waste (fruit and vegetable peels or dregs), leaves and flowers, sugar (brown sugar, jaggery, or molasses sugar) and water. Bio Enzymes is a complex organic substance of protein chain, mineral salts, and juvenile hormones. They have an amazing property to breakdown, change, create and catalyze functions that make it a natural cleaning aid. These cleaners utilize bacteria to digest waste and bacteria do this by producing enzymes(Hasanah). Bio Enzyme is also known as an eco-enzyme (natural and eco-friendly), garbage enzyme, kitchen enzyme, or fruit enzyme (as it is composed of fruit/vegetable kitchen waste). It is dark brown and has a strong sweet-sour fermented scent. It is a multipurpose solution, and its applications cover household, agriculture, animal husbandry and many more(VAMA and CHEREKAR; Hasanah). It was first developed by Dr. Rosukon from Thailand. Dr. Rosukon has been actively involved in enzyme research for more than 30 years and she encourages people to make bio enzymes at home to ease global warming and protect the planet from chemical pollution. She said that next time before throwing fruits and vegetable waste, think that you can turn it into a multipurpose enzyme solution.

The procedure of making simple smart and sustainable solutions super easy. Just take an air-tight plastic container. Dilute one ratio of sugar, followed by three ratios of kitchen fruits and vegetable waste into 10 ratios of water in the container. Close the container tightly and place it in a cool dry well-ventilated area for at least 3 months. Make sure some space is left in the container for the fermentation process. Once in a while stir and push the floating garbage downwards. After three months the container



is full of non-pathogenic, useful bacteria. Now the solution is ready to filter and use. The sediment can be used as a fertilizer.

How to Make **GARBAGE ENZYME**

Materials and ingredients:



Formula:
A ratio of 1:3:10 for sugar: vegetables/fruits waste: water respectively is needed to produce garbage enzyme.

Method:



Use an air-tight plastic container. Dilute 1 ratio of brown sugar, followed by 3 ratio of fruit and vegetable waste into 10 ratio of water.

Make sure some space is left in the container for the fermentation process. Close the container tightly. Within the first month of the fermentation process allow some gas to be released to avoid pressure build up in the container. Once in a while stir and push the floating garbage downwards.

Figure 1



The above-mentioned characteristics of a simple solution sound too good to be true. Although, it is considered as a miraculous solution and needs an hour to control the air pollution, water pollution, deforestation, ozone layer depletion, and waste management (Galintin, Rasit and Hamzah; Hasanah). According to users of bio enzymes, this solution is cost-effective. It can be used to clean anything from hair wash to car wash. This can be used as a natural insect and pest repellent, especially for mosquitoes. Various studies have assessed the Enzymes anti-bacterial and anti-viral properties of the bio enzymes (Hasanah; Mavani et al.; Lim et al.; Saramanda and Kaparapu; Rahman et al.; Neupane and Khadka).

Uses of Bio Enzyme

In agriculture and soil stabilization:

Numerous studies have attempted to explain the application of bio enzymes in the field of agriculture and soil stabilization (Gao and Liu; Mekonnen et al.; Tong and Liu). Researchers attempted to analyze the properties of the enzyme in the conversion of ammonia to nitrate, a natural and useful hormone and nutrient for plants (Tong and Liu; Bharathiraja et al.; Ravindran et al.). It also helps in transforming carbon dioxide into carbonate ions, which have the potency to nourish plants, fish, and other living creatures in the ocean (Yoong).

In treating the water bodies:

“Treatment of synthetic Greywater using 5% and 10% garbage enzyme solution” study presents that ammonia, nitrogen and phosphates could be eliminated by using bio enzyme solution (Nazim and Meera). The study done by (Sambaraju and Lakshmi) shows the efficiency of Bio Enzymes in treating dairy wastewater. Another study “Effect of Bio-Enzyme in the treatment of Fresh Water Bodies” proves the efficacy of Bio-Enzymes in treating pond water. The result shows that ponds were cleaner and BOD, COD reached permissible levels (Penmatsa et al.). (Galintin, Rasit and Hamzah) reported the removal of phosphorus and ammonia from aquaculture sludge done by biocatalytic reaction and carbon present in the bio-enzymes. These studies provide important insights to indicate the role of bio enzymes in treating wastewater and water bodies.

To purify the air:

During the fermentation process going on, it emits ozone (O₃) which has the potential to separate the carbon dioxide and other heavy metals from the air which ultimately helps to reduce the heat trapped in the atmosphere (Yoong).

Managing waste:

The chief ingredient for making bio enzymes is fruit and vegetable waste. Therefore, by making the bio



enzyme we effectively cut down the cost of waste disposal. This solution also helps to reduce the number of landfills (Yoong; Neupane and Khadka).

Eco-living:

Bio enzymes are a natural and safe replacement for all the harsh and harmful chemicals that are normally used in house cleaning, personal hygiene, washing fruits and vegetables to remove pesticides and many more (Yoong; Janarthanan, Mani and Raja).

Virtual Design Thinking Challenge

#IMPACTWEEKINDIA is a 60 hours-Virtual Design Thinking Challenge organized by the Impact Week. It was a unique opportunity for bright minds to discuss and engage current and urgent challenges such as unemployment, supply chain disruption, education imparting, healthcare system, et al. Using Design Thinking and user-centric design toolkits, solutions and strategies are developed in teams. In that challenge my research team working on the healthcare system.

The Challenge and its relevance: India, one of the most densely populated countries with a population of 1.36 billion. However, there is relatively high pressure on health facilities, with doctor: patient ratio as high as 1:1445. This already abundant pressure has mounted heavily during these times of the current pandemic of COVID-19. One of the many challenges that these frontline health workers are saddled with is the inadequacy of Personal Protective Equipment (PPE) to protect themselves during treatment and saving lives. With statistics showing that 1 million PPE kits are used every day in India, our team's assumption was based on this, until our 9 interviews with users proved that the pain area was centered on infection control in hospitals due to the inappropriate disposal of PPEs. For the doctors, the risk their patients face mattered first before theirs.

The doctors we interviewed all confirmed that there have been so many cases where healthy patients get to their homes after visiting hospitals only to find out that they got infected by the coronavirus or experienced other side effects like respiratory and skin infections, allergies due to the chemical fumigation (which takes hours and results in longer waiting hours between treatments). Does the real challenge now lie in how to prevent the spread of this infection in hospitals and their surrounding areas? Can fumigation be done using low cost, eco-friendly disinfecting products? How can fumigation be done faster without longer waiting hours? How do we ensure that the hospital remains to be a place where one visits to get treatment and not infections?



Our Solution and its value: Our solution was to develop an eco-friendly disinfecting fumigation product (BIO-ENZYME) at hospitals to ensure proper disinfecting of PPEs as well as to rid the environment from nosocomial infections. The doctors tested the prototype of the solution and confirmed their satisfaction. They are being freed from longer waiting time to enable them to save more lives. Moreover, developing this product creates an income-generating opportunity for the local farmers and juice makers that we will be working with. This is a critical value considering the millions of job losses due to the pandemic. Averagely, 1000L of fumigation is used in hospitals across India. Chemical Fumigation products stand at Rs400 which means Rs400,000 a day and Rs12,000,000 in a month. Bio-enzyme is expected to be priced at Rs300 which translates into Rs3,000,000monthly cost savings.

Conclusion

Based upon the above review, results can be concluded that Bio Enzymes have the potential to efficiently detoxify and transform pollutants and possibly curb the chemical chaos. Despite these promising benefits of bio enzymes, further research is required to bring this innovative idea into reality. Laboratory testing to investigate the antimicrobial and antiviral properties of the solution, to check the efficacy, potency, shelf-life of the solution and enzyme profiling needs to be done before launching the solution into the market.



Figure 2

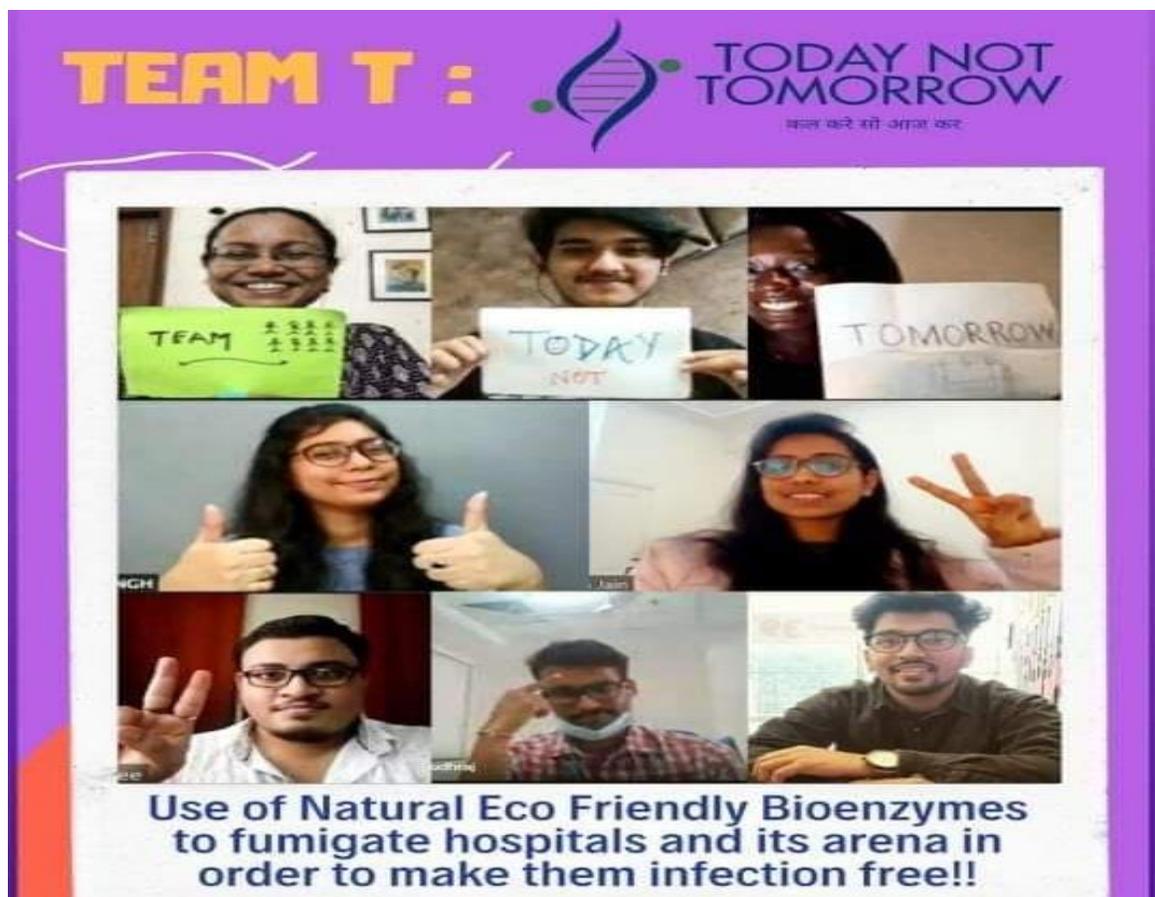


Figure 3

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