



Pathogenic Microorganisms in University Offices- Detection and Designing a Sustainable Organic Treatment

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ABSTRACT: People in developed countries spend approximately 90% of their lives indoors, yet little is known about the source and diversity of microbes in built environments and pathogens are spreading everywhere especially in the offices. This research study aimed to identify the pathogenicity in Abu Dhabi University (ADU), Abu Dhabi campus, in addition to come up with an active organic treatment. The paper includes a review of some similar work done on the same issue, and it explains the methods of data and information collection. Sampling was conducted in ADU offices. Samples from keyboards, computer mouse, desks, and door handles were examined in order to identify the availability of pathogens. Based on the obtained results, a safe organic treatment was designed and tested as an alternative of the synthetic detergents used to clean offices. The proposed organic treatment had the capability to kill all pathogens in the tested samples including *Salmonella* and *Escherichia coli* (*E. coli*). The final proposed treatment is new, safe and 99.99% active.

Keywords: Microbes, Organic Treatment, *Salmonella*, *Escherichia coli*, Pathogens.

I. INTRODUCTION

Coping and treating pathogens has been a goal to improve the health of the population. Pathogens are spreading everywhere especially in the offices and as most people spend most of their time in the workplace, they face a big risk because of the spreading pathogens [2]. To illustrate specifically, “research by University of Arizona researchers also found that the average desktop has 400 times more bacteria than the average toilet seat” [14]. They are exposed to many pathogens than can cause serious problems. ADU’s offices were chosen as universities are the common destination of people who seek higher education, and they contain, or have access to, the cumulative knowledge of the human kind, which is the base for the evolution of civilization. They are also acknowledged as important centers for innovation and environmental education [15].

II. LITREATURE REVIEW

There are many efforts to identify pathogens and treat them in the workplace, starting with keyboard since workers spend most of their time working with bare hands; which make it easy for pathogens to spread around.

According to different studies in the workplace, pathogens are available in keyboards. To illustrate specifically, keyboards and mouse are working as a reservoir of pathogens. According to a study which was conducted in an intensive care unit, microbacterial analysis from samples in patients' rooms yielded 26 contaminated samples from keyboard and mouse (5.9%)”[7]. Moreover, keyboard and mouse play a role in increasing the risk of workers in the workplace as they work as a vehicle of pathogenic transmission. Chemicals are used to treat the pathogens and the residues could be found in food and the surrounded environment. An effective organic treatment could be used as a solution to sterilize the offices in an environmental friendly way [2].

Keyboards and Mice

It’s not only about the intensive care unit, as keyboards in universities can be contaminated as well especially in cafes. A study in Nigeria indicates that hygienic practices in the cyber café are far below expectations which could infer that users in these cyber café are almost ignorant or less informed of the risks involved in their usage of computers and that these surfaces could act as carriers or vehicles/sources of potential pathogens” [6]. Furthermore, the knowledge of public about the possibility of pathogens in keyboards and mouse is poor [9].

Moreover, another study in Center for Radiation Research showed that “the contamination rate of keyboards and mice was 99.9% and 100%, respectively” [5]. This is a high percentage of risk because it shows that all the keyboards and mice in this radiation center are contaminated which will affect the worker’s health as well. Another study in Pakistan to identify pathogens in keyboards showed that all the 300 tested samples were contaminated with pathogenic bacteria (*E.coli*, *Salmonella*, *Shigella*, and *Staphylococcus*). *E.coli* dominated the isolates. The second most common bacterial growth in all samples was Gram-positive *Staphylococcus* Potential pathogens isolated from all specimens were: *Staphylococcus aureus*, *Salmonella*, *Shigella* and *Pseudomonas spp* [13].

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Unfortunately, this might lead to many diseases as the *Shigella* bacteria is known to cause diarrhea. *Salmonella* bacteria affects the intestinal tract as they live in humans and animals intestines, *Pseudomonas* spp “can infect any part of the body including the liver, brain, bones, and sinuses” [4]. and staphylococcus “is the leading cause of skin and soft tissue infections such as abscesses (boils), furuncles, and cellulitis” [12].

The average number of microorganisms present on multiple-user computer keyboards was significantly greater than on single-user keyboards” (Anderson, 2009). The contamination percentage might be different from a study to study due to the surrounding conditions of the computer outputs.

Door Handles

Another important object that work as a vehicle of pathogenic transmission is door handles. Many people open and close the same door with bare hands, which supports the transition of pathogens. In addition, door handles are one of the most common touch surfaces which increases the chance of pathogens. According to Maurice McDonough, you can find *E.coli*, *Salmonella*, and staphylococcus bacteria [11]. All of them are dangerous as they are able to cause serious problems to human health. Another study has proven the bacterial contamination of door handles. For instance, “Frequency distribution of the isolates showed that *Staphylococcus aureus* were 44(38.3%), *Bacillus* species 26(22.6%), *Escherichia coli* 16(13.9%), *Micrococcus* spp 13(11.3%), *Salmonella* spp 10(8.7%) and *Klebsiella* spp 6(5.2%) [8]. According to [10], seven bacterial contaminants were isolated from samples taken from door

handles. These organisms include *Staphylococcus aureus*, *Klebsiella pneumonia*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Proteus species*, *Bacillus species*, and *Neisseria species*.

III. METHODOLOGY

Given the limited nature of this research and its topicality to Abu Dhabi’s ADU campus, the aim would be to examine the spreading pathogens in keyboards and computer mouse, desks, and door handles.

Sample Collection

Sampling was conducted in Abu Dhabi University campus. Ten offices were chosen in different colleges and samples swabbed approximately 13 cm² of the same five surface types: chairs, phones, computer mouse, computer keyboards, and desktops. Then samples were placed in 2 ml of Nutrient broth in a sterile test tube, and vortexed for one minute. Used nutrient agars, as it is a general-purpose medium supporting growth of a wide range of non-fastidious organisms. It typically contains (mass/volume): 0.5% Peptone - this provides organic nitrogen. 0.3% beef extract/yeast extract - the water-soluble content of these contribute vitamins, carbohydrates, nitrogen, and salts. After 18-24 hours of inoculation, the nutrient broth turbidity of medium was measured. This medium was then sub inoculated in different types of media for morphological identification of bacterial colonies (Fig1.1-1.6)

Methodology was repeated several times to ensure the effectiveness of the organic treatment.



(Test tubes Figure1.1)



(Plates Figure1.2)



(Nutrient Agar Figure1.3)



(Stirring rod Figure 1.4)



(Incubator Figure 1.5)



(Beaker Figure1.6)

Organic Treatment

Pathogens need to be treated in order to provide healthy-safe environment. Furthermore, treatment should be done in an effective way without any harmful chemicals. Organic treatments are possible and effective according to studies [2].After many trials and mixtures, the organic treatment

became active. For that, the final active organic treatment is consisted of (Figure 2):

- ❖ 60 ml propolis oil
- ❖ 30 ml grapefruit oil
- ❖ 5 ml lavender oil
- ❖ 5 ml organic apple vinegar
- ❖ 4.9 grams lemon salt



Figure 2. Ingredients used to prepare the final treatment

IV. RESULTS & DISCUSSION

All samples from 10 offices were contaminated (fig.3). This result agrees with previous studies[13]. In addition, different colonies identifies different kind of pathogens as previous studies concluded [11]. To illustrate specifically, printer room was highly contaminated. A lot of time spent to examine the samples with different treatments .After many trials, the active organic treatment constituents were: propolis oil, organic grapefruit oil, organic lavender oil, organic apple vinegar, and lemon salt.

These bacteria are the same as the bacteria they found in previous studies in keyboards and mice; which means we can get off of all these bacteria by using the same organic treatment of keyboard ([1]; [12]; [13])



(Figure 3. Sampling results before using the treatment)

According to previous studies, propolis oil has the capacity to kill pathogens except *E.coli* and *Salmonella*. For that, grapefruit oil was added as it can overcome both *Salmonella* and *E.coli*. In addition, lavender oil was added to add a good smell as its antibacterial and antifungal; lemon salt and vinegar work as natural preservations. The organic treatment was highly active which has the power the kill different kinds of pathogens including salmonella and *E.coli*. If Dettol kills 99% bacteria, this organic treatment killed 99.99% bacteria (fig. 4)



(Figure 4. Samples results after using the treatment)

V. CONCLUSIONS

This research proved the availability and growth of different microorganism in the samples collected from the office premises. The research concluded proposed eliminating the pathogens by using an organic treatment, which is not

available in the market yet. The proposed treatment is composed of propolis oil, grapefruit oil, lavender oil, lemon salt and vinegar. The organic treatment was highly active to eliminate different kinds of pathogens including salmonella and *E.coli*.

The proposed treatment could be used indoors and by any business owner as a safe, cheap and active treatment in the workplace. The active organic treatment benefits is it has high activity active while protects people health, have a healthier environment, achieves sustainability, reduces the risk of pathogens and saves money.

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AUTHORS PROFILE



Dr. Manar serves as Assistant Professor of Environmental Health and Safety at college of Health Sciences in Abu Dhabi University. Graduated from the University of Jordan, she received her PhD in Sustainability and Environmental Studies. Dr. Manar has teaching and leadership experiences as she worked in the field of environment and sustainability in both academic and industrial institutions. Dr. Manar worked in department of Applied Sciences and Mathematics, College of Arts and Sciences, Abu Dhabi University and in College of Sustainability Sciences and Humanities, Zayed University. She also worked in the fields of Environmental Control, Sustainable Practices, Quarantine System and Food Safety in Ministry of Agriculture, Jordan and as a Lecturer in the Faculty of Agriculture, University of Jordan. Dr. Manar's research interests include environmental sustainability, pesticide residues, pollution, food safety and environmental health and safety issues.



Shaima ALJunaid graduated from Abu Dhabi University, She received her Bachelor Degree in Environmental Health and Safety with 3.99 out of 4 CGPA. She is working as a management trainee in Burjeel Medical City and implementing national and international health and safety standards. Shaima has been chosen as one of the 20 pioneers in the UAE for Wiser program as Wiser aims to inspire women and girls to play an active role in addressing global sustainability challenges. Shaima has won the 2nd place in in region's largest science competition "Think Science" among 4000 participants in the category of Energy, Environment, and Applied Sciences. Shaima's research interests include environmental sustainability, impact management, occupational safety and health.



Dr. Asiya Nazir is an Instructor at department of Applied Sciences and Mathematics. She has a PhD in Life Sciences, a Master of Biotechnology and a Bachelor of Science. Her major area of research is on Industrial microbiology and fungal biotechnology. She is an author of book "Microbial Cellulases" and her research has been published in several reputed journals. Her research interests tend to be of multidisciplinary nature and have good experience in the molecular biology, microbiology, and cell biology and protein biochemistry techniques. She is equipped with the knowledge of applied sciences as well as research experience at the frontier of materials science