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MITIGATION OF ENVIRONMENTAL WASTE ACCUMULATION THROUGH THE EXPLORATION AND SCREENING OF AGRO-WASTE FOR INHERENT ANTIMICROBIAL PROPERTIES

S. BHUYAN[1], N. GOGOI*[2], R.C BORO[3] AND D. SAIKIA[4]

[1,2,4]Department of TAD, College of Community Science, AAU Jorhat 785 013, Assam, India
[3]Department of Biotechnology, College of Agriculture, AAU Jorhat 785 013, Assam, India

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ABSTRACT

The escalating accumulation of waste, particularly agro-waste, poses a substantial threat to the environment. In response to this critical issue, innovative approaches are essential to reduce waste heaps and their detrimental impacts. This study focuses on harnessing the potential of various agro-waste materials for the creation of multifunctional agents suitable for applications in the realms of food, textile, and industry. From an initial selection of six distinct agro-waste sources, three were identified for their promising antimicrobial properties. The study presents a comprehensive framework for repurposing agro-waste into value-added products with antimicrobial attributes. Overall, the findings of this research underscore the significance of transforming waste materials into valuable resources, emphasizing the importance of adopting eco-friendly practices to counteract environmental degradation.

KEY WORDS: Antimicrobial, Agro-waste, Environment, Biaoactive compound, Microbes

INTRODUCTION

In recent decades, the increasing concerns about environmental degradation and resource depletion have spurred researchers and industries to seek innovative and sustainable solutions to address these pressing issues. One such solution lies in the effective utilization of agricultural waste, commonly known as agro-waste, which is generated in substantial quantities worldwide. Agro-waste encompasses a wide array of organic residues and byproducts that are left over from agricultural and agro-industrial activities. These materials, if not managed properly, can contribute to environmental pollution, greenhouse gas emissions, and land degradation. However, when harnessed through appropriate techniques, agro-waste presents a promising avenue for mitigating environmental challenges while concurrently yielding valuable resources. The agriculture sector, being one of the fundamental pillars of human civilization, has exhibited immense growth to meet the global demand for food, fiber, and bio-energy. However, this growth has also brought forth a significant increase in the generation of agricultural residues such as crop stalks, husks, shells, and fruit peels. It includes crop residue, weeds, leaf litters, saw dust, vegetable matter, livestock waste, etc. (Sharma, 2019). Using waste materials for waste control, to get a cleaner environment, and economic benefits is crucial that decreases the price of disposing of environmental trash and the labour requirement (Koul *et al.,* 2021). This paper aims to explore the multifaceted advantages of agro-waste utilization with a specific focus on its positive impacts on the environment. The utilization of agro-waste not only offers potential economic benefits but also contributes significantly to mitigating climate change, conserving biodiversity, and protecting soil and water resources. The paper aimed at screening of agro-waste for biochemical analysis and also for antimicrobial efficiency for utilization in textile sectors.

([1]Assistant Professor, [2]Professor, [3]Assistant Professor, [4]Phd Scholar)

METHODOLOGY

Selection of Agro-waste having antimicrobial activity

For the preliminary study, 6 (Six) agro-waste were selected based on available literature having inherent antimicrobial properties and collected from Jorhat town, Assam. The plants selected were Mango leaves (*Mangifera indica*). Rice straw (*Oryza sativa*), Olive leaves (*Olea europaea)*, Onion peels (*Allium cepa)*, Garlic peels (*Allium sativum)*, Tea leaves (*Camellia sinensis).*

Selection of the microorganisms that affect the fabric

Microbes are incredibly powerful species belonging to the invisible kingdom that are linked with thousands of deadly diseases. The species required minimum substrate like water, carbon, nitrogen and inorganic salts for their growth and multiplication (Gupta and Bhowmik, 2007). For the study the microbes, i.e. *B.subtils* (Gram positive) and *E.coli*, (Gram Negative) were selected and taken from Department of Biotechnology, Assam Agricultural University, Jorhat.

Screening of plants for the experiment

Preparation of plant extracts

For screening of plant extracts for the experiments, the plant sources namely olive leaves, mature lemon leaves, onion peels, garlic peels, mango leaves, mature tea leaves were cleaned, shade dried and powdered. These were extracted separately as per the reviewed research works conducted by different scientists throughout the globe. The different methodologies adopted in the current study are stated below.

METHOD

Olive leaves

Olive leaves were collected, washed, shade dried and powdered. They were extracted for 24 hours using 80% methanol and 30% distil.water at 25% concentration per 100 ml of solution (Yanhong *et al.,* 2017)

Mature lemon leaves

Mature lemon leaves were washed, crushed, and extracted at 20 g/100 ml concentration using methanol as extraction medium for 24 hours (Naseer *et al.,* 2014).

Onion peels

Onion peels were collected from shops and were grinned in to powdered form using 10 g/100 ml for 24 hours. The extraction medium used for extraction was 100% methanol (Vasudeo, 2009).

Mango leaves

Mango leaves were collected, washed, shade dried and powdered. They were extracted for 24 hours using acetone 10 g per 100 ml of solution (Ogbonna *et al.,* 2022)

Mature Tea leaves

Mature Tea leaves were washed, crushed, and extracted @ 10 g/100ml using methanol as extraction medium for 24 hours (Shafei *et al.,* 2018)

Garlic peels

Garlic peels were collected from shops and were grinded in to powdered form using 10 g/100 ml for 24 hours. The extraction medium used for the extraction is 100% methanol (Vasudeo, 2009).

The suspensions were filtered through a muslin cloth and finally through a whatman filter paper (No. 41) to separate the plant extract supernatant.

Subculture of the test organisms

Microbial growth is indicating as a rise in population size or biomass. Sub-culturing was carried out to keep culture in its active state (extend life and/or enhance cell count) for a variety of purposes (Jain *et al.,* 2020). The test organisms were sub cultured as per the standard procedure to obtain the pure cultures. An appropriate quantity of nutrient agar (NA) was dissolved in distilled water separately and autoclaved at 120 °C for 15 minutes at a pressure of 15lb. Later the nutrient agar media was poured into the sterilized petri disk and allowed to solidify under aseptic conditions in a laminar airflow chamber. Bacterial suspension of the organism was prepared separately by adding 0.3-0.4 ml of nutrient broth in the lyophilized cultures. A loopful of microbial suspension was streaked on the solidified media in a zigzag fashion. The plates were incubated under aerobic conditions at 37 °C for 24 hours for bacteria.

Preparation of media

Nutrient Agar (PDA) medium is a commonly use general purpose media for a broad range of bacteria

(Uthayasooriyan *et al.,* 2016) prepared by suspending 28 g of nutrient agar power (Hi-Medium Laboratories Ltd.) in 1000 ml distilled water. Mild heating was done to dissolve the medium completely. Autoclave the dissolved solution (IK-104) at 121 °C (151b pressure per square inch) for 15 minutes.

Screening of plant extracts against microorganisms

The screening of antimicrobial activities of green extract for both gram positive and gram-negative bacteria was determined by using nutrient agar for agar well diffusing method (Ren *et al*., 2018). From the nutrient agar, 15 ml of melted solution were poured into the Petri plates. After medium were solidified, 250 µl of microbes' cultures aged 48-72 hours was added to the Petri disk and then spread by spreader evenly and dried. After that hole were made by using a 5mm cork borer. Each hole was filled with 150 µl of plant extract with the help of a micropipette. The samples were slowly impregnated dropwise on the hole. Packed the Petri plates with paraffin then, incubated at 37 °C for 1-2 days then observed the zone of inhibition around the wells. The zone of inhibition was recorded in millimetres.

RESULTS AND DISCUSSION

Screening of plant species against different microorganism

Six plants based agro-waste were selected based on the literature survey for the preliminary study. Screening of agro-waste for antimicrobial property against two pathogens namely *B. subtilis* (Gram negative) and *E. coli* (Gram positive) were carried out for six plant selected agro-waste. Based on the zone of inhibition the sources of agro-waste were selected for the study. The result of antimicrobial test of six agro-wastes was presented in Figure 1. It was cleared that the garlic peel and mature lemon leaves showed no zone after 24 hours inhibition against both the pathogens *B. subtilis* and *E. coli*. In olive leaves extract the zone of inhibition against *E. coli* showed 4mm but no zone was showed in *B. subtilis*. Among mango leaves, onion peel and mature tea leaves plant extracts, onion peel extract showed highest (17 mm) zone against *B. subtilis* and (5 mm) against *E. coli*, followed by mature tea leaves as (17mm) against *B. subtilis* and (12 mm) against *E.coil* and (1 mm) against *E. coil* was shown by mango leaves extract.

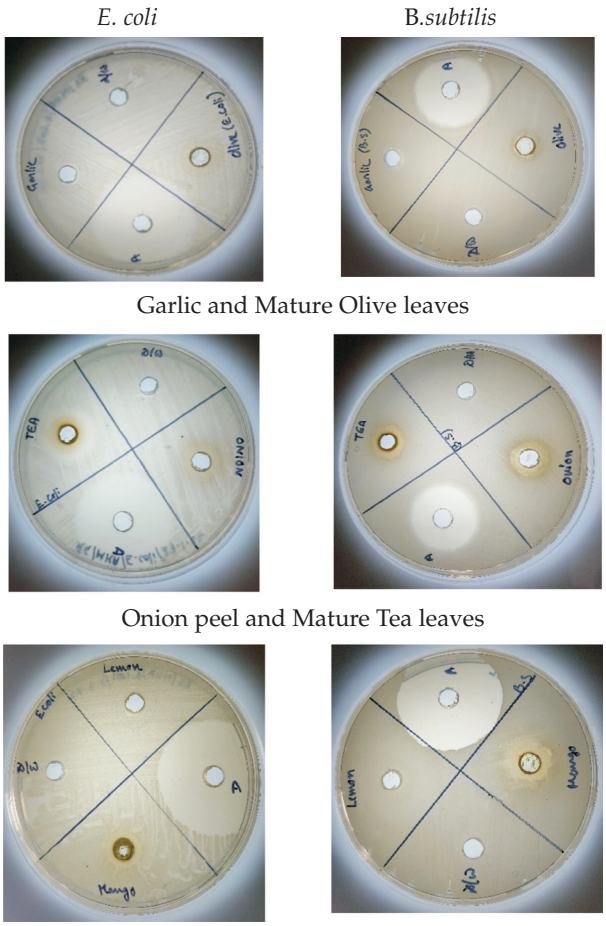

Fig. 1. Antimicrobial activity of different extractions against *E. coli* and *B. subtilis*

Based on the pre-antimicrobial analysis onion peel, mature tea leaves and mango leaves were selected for screening of phytochemical present based on the zone of inhibition among six agro-wastes for both the pathogens. Similar studies on antimicrobial effect of green extract showed the presence of antimicrobial property by tea leaves and onion peel against gram positive and gram negative bacteria (Kabrah, 2016; Vasudeo, 2009; Uniyal and Rahal, 2022).

CONCLUSION

The findings of this research shed light on the antimicrobial potential of various agro-wastes against two significant bacterial strains, namely *B.subtilis* and *E.coli.* Among the six agro-wastes studied, namely mango leaves, tea leaves, and onion peel demonstrated remarkable antimicrobial properties against both *B.subtilis* and *E.coli*. These

results underscore the viability of these agro-wastes as potential sources of natural antimicrobial agents. Further investigations into the specific compounds responsible for this antimicrobial activity, as well as their potential applications in food preservation or pharmaceutical formulations, hold promise for addressing the growing concerns surrounding bacterial infections and resistance. Nevertheless, further research is required to elucidate the mechanisms underlying the observed antimicrobial effects and to ensure the safety and efficacy of these agro-waste derived antimicrobial agents in practical applications.

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Conflict of interest

The author declared no conflict of interest for conducting the research work.

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