



Antibacterial and Antifungal Activities of Some Fruits Peel Extracts: The Best Possible Source of Low Cost Natural Antimicrobial Agents

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ABSTRACT

The huge amounts of wastes are produced in the form of liquid and solid during the industrial processing of fruits. It can lead to pollution, if not disposed off timely and properly. The fruits waste and peel is biodegradable with immense economic potential. The peels of fruits are considered as agro waste and thrown into environment for degradation, instead of using as antimicrobial and antioxidant agents. The present research focuses on the best possible application of muskmelon (*Cucumis melo* L.), mango (*Mangifera indica* L.), kinnow (*Citrus reticulata* Blanco) and lemon (*Citrus limon* L.) fruit peels as a source of low cost natural antimicrobial agents. The antimicrobial activities of peels extract of four selected fruits against a wide range of microorganisms were evaluated and substantiated using control positive antibiotics as well. In all the peels, the highest antibacterial activity was found in muskmelon against *Escherichia coli* followed by *Staphylococcus aureus*, *Proteus vulgaris* and *Lactobacillus*. However, the highest antifungal activity was reflected by the kinnow against *Saccharomyces cerevisiae*. The present study explores the possibility of utilizing these fruit peels to fight against multidrug resistant microorganisms. The findings revealed that the fruit peels are potential best possible economic source of natural antimicrobial agents.

Keywords: Fruit peel, Antimicrobial, Antibacterial, Antifungal, *Escherichia coli*, *Staphylococcus aureus*, *Proteus vulgaris*, *Lactobacillus*, *Saccharomyces cerevisiae*.

Received 23.09.2021

Revised 05.10.2021

Accepted 21.05.2022

INTRODUCTION

Fruits are the essential part of a healthy diet. These are good source of fibre, carbohydrates, vitamins, minerals and also reduce the risk of many diseases [1-4]. The fruit peels are considered as agro waste and hence thrown into environment instead of exploiting their potential benefits [5-7]. These peels are good source of antimicrobial, antioxidant, anti-inflammatory and antiproliferative agents [8-9]. Different parts of a plant are being exploited by the human beings since ages [10, 11]. They can be used for food, clothing, fuel, timber and phytomedicines [12, 13]. Extensive use of antibiotics in today's era has led to the emergence of multi drug resistant pathogens [14]. These strains have reduced susceptibility to antibiotics and can also cause some serious side effects [15]. It has been observed that fruit and vegetable wastes possess different enzyme activities and antimicrobial activities [16, 17]. Enzymes produced from such waste exhibited antimicrobial activity against Gram positive and Gram negative bacteria, so these enzymes can be used to inhibit/ kill microorganisms in house as well as laboratory [18]. Polyphenols play an important role in our everyday diet, as they are naturally present in fruits and vegetables [19]. These can interact with biological systems as free radical scavengers and play an important role in preventing neurodegenerative and cardiovascular disorders [7, 8, 20]. These polyphenols also exhibit antioxidant, antimicrobial effect [21-22]. Various studies suggested that the waste material produced from the processing of fruits and vegetables in industries, is a good source of polyphenols [23]. Present study investigates the antimicrobial activity of muskmelon (*Cucumis melo* L.), mango (*Mangifera indica* L.), kinnow (*Citrus reticulata* Blanco) and lemon (*Citrus limon* L.) peel extracts against selected microorganisms. Furthermore, this study also supposes to propose a best solution for the minimization of agro waste.

MATERIAL AND METHODS

Collection of fruits and peel: This study was carried out in the Department of Biotechnology, Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala (Haryana). The fruits (muskmelon, mango, kinnow and lemon) were taken as samples. Some samples were obtained from local market and some collected from home fruits as waste peel material.

Preparation of peel extract: The fruit samples were washed properly and peeled extraneous matter. The obtained peel materials were dried at room temperature in a shaded region for 7-10 days followed by grinding in mortar and pestle. The sterile distilled water was used as solvent for the extraction of collected peel materials. The 10 g of each powdered sample was extracted with 100 ml of solvent and incubated for 24 hrs in shaking incubator. The mixture was filtered using Whatman No.1 filter paper and the collected filtrate stored at 4°C for further use.

Antimicrobial activity assay: Antimicrobial activity was tested against different microbial pathogens viz. *Escherichia coli*, *Staphylococcus aureus*, *Proteus vulgaris*, *Lactobacillus* and *Saccharomyces cerevisiae*. The pure cultures of these were collected from the Microbiology Laboratory, Department of Biotechnology, Maharishi Markandeshwar (Deemed to be University). The minimum inhibitory concentration of crude plant extracts against pathogenic strains was determined by dilution method [24]. Nutrient agar and potato dextrose agar media were used for standardization of bacterial and fungal pathogens respectively [25]. The crude plant extract prepared were tested for the antimicrobial activity through well diffusion method [26]. In each well 100µl of crude peel extract was added. Streptomycin (1mg/ml) and fluconazole (1mg/ml) were used as positive control for bacterial and fungal test organisms respectively.

Measurement of zone of inhibition: The bacterial and fungal plates were incubated at 37°C and 30°C for 24 hrs and 48-72 hrs respectively. After incubation, microbial growth inhibition zones were measured [27]. The antimicrobial activity of each extract expressed in terms of diameter of zone of inhibition (mm) produced by respective extract.

RESULTS

The present study was done to evaluate the antimicrobial activity of different fruit peel extracts against broad spectrum of microbes including gram negative bacteria, gram positive bacteria and fungus. A comparative evaluation of antibacterial and antifungal activity of extracts of different fruit peels were carried out and showed good antimicrobial activity. The significant zone of inhibition in different peel extracts against the selected microbial communities was recorded (Table 1). The different resistance pattern observed in bacteria and fungi are likely to be related to differences in their cellular organizations, fungi and bacteria cell wall structure and way of protein synthesis. In present study, the highest antibacterial activity was observed with muskmelon peel extract among all tested extracts against *E. coli* followed by *S. aureus*, *P. vulgaris* and *Lactobacillus* (Fig. 1). However, peak antifungal activity was found with orange peel extract followed by mango, lemon and muskmelon against *Saccharomyces cerevisiae*. The different peels of fruit were subjected for antibacterial and antifungal activities and the result were investigated and illustrated (Fig. 1).

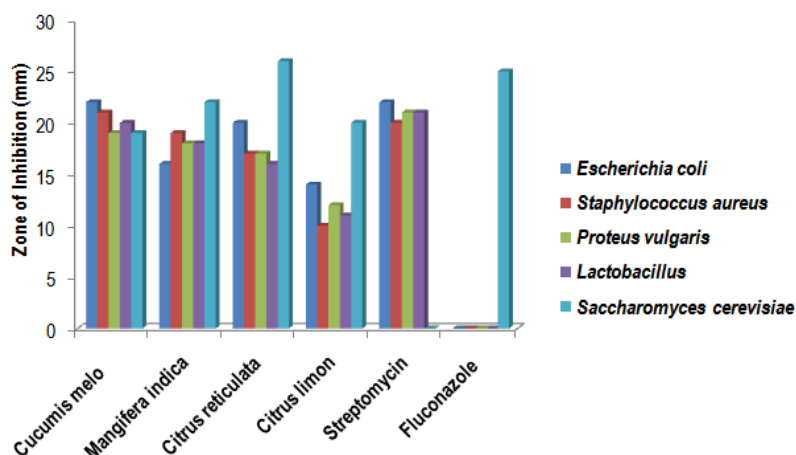


Fig. 1: The antibacterial and antifungal activities of different fruits peel extract and positive controls (Streptomycin and Fluconazole).

Table 1: Antibacterial and Antifungal activities of fruit peel and antimicrobial agents

Fruits peel extracts and Control positive antibiotics	Antimicrobial activities by zone of inhibition assay (mm)				
	Bacteria				Fungi
	<i>Escherichia coli</i>	<i>Staphylococcus aureus</i>	<i>Proteus vulgaris</i>	<i>Lactobacillus</i>	<i>Saccharomyces cerevisiae</i>
<i>Cucumis melo</i>	22	21	19	20	19
<i>Mangifera indica</i>	16	19	18	18	22
<i>Citrus reticulata</i>	20	17	17	16	26
<i>Citrus limon</i>	14	10	12	11	20
Streptomycin	22	20	21	21	-
Fluconazole	-	-	-	-	25

DISCUSSION

The findings of the present investigation corroborated to the previous reports of Negi and Jayaprakasha who found that acetonc and methanolic extracts from pomegranate peel showed antimicrobial activity against *Bacillus cereus*, *S. aureus*, *E. coli* and *Pseudomonas aeruginosa* [28]. It was suggested that a large quantity of tannins identified in pomegranate extracts were responsible for antimicrobial property [29]. Cowan also suggested that the antibacterial properties of these extracts could be related to tannins and inactivate microbial adhesions, enzymes, and cell envelope transport proteins, and responsible for morphological modifications as well [30]. The peel extracts of apple and pomace were active against the targeted microorganisms suggested that the peel extracts exhibited more antibacterial activity than pulp because of their biochemical properties [31]. The antibacterial activity of orange peel extract derived from *Citrus medica* L. and *Citrus aurantium* L. was evaluated and found effective against various bacterial strains like *E. coli* (MTCC No.118), *S. aureus* (MTCC No.1349) and *Pseudomonas flourences* (MTCC No.103) [32]. Researchers also reported that the antimicrobial properties of banana peel against *S. aureus*, *Bacillus subtilis*, *B. cereus*, *Salmonella enteritidis* and *E. coli* were found to be effective [32, 33]. Citrus fruits have a broad spectrum of biological activity, including antibacterial, antifungal, antidiabetic, anticancer and antiviral activities due to alkaloids [7, 8, 34-35]. It was found that the acetone extract of fruits peel used against *Enterococcus faecalis* and *B. subtilis* gave inhibition zone diameter of 23 and 20mm respectively [36]. Studies showed that different acids like citric, succinic, malic, acetic, and tartaric are commonly found in fruits which attack on structural components, metabolic enzymes, protein synthesis systems, and the genetic material of microorganisms [37]. The essential oils from citrus offer the potential for all natural antimicrobials for use in improving the safety of organic or all natural foods [38]. Subba *et al.* determined that orange and lemon oil had in vitro antibacterial effects on *Salmonella* and other food-borne microorganisms [39]. The results thus obtained in this study helped to explore the possibility of selected fruit peels as a source of antimicrobial agents in future.

CONCLUSION

Fruit peel is a common waste among household as well as industries. It can lead to the problem of pollution if not utilized or disposed-off properly. The antimicrobial activities of muskmelon, mango, kinnow and lemon fruit peel extracts were observed during the investigation and were found effective against *E. coli* followed by *S. aureus*, *P. vulgaris*, *Lactobacillus* and *S. cerevisiae*. The investigation has opened up the possibility to use these fruit peels in future drug development for the treatment of various pathogenic and resistant microbes. Thus these are best natural and economic sources of antimicrobial agents and can be used to cure various microbes borne diseases. Therefore, this study will definitely open up a scope for utilization of the fruit peels for antimicrobial treatment.

ACKNOWLEDGEMENT

Authors are sincerely grateful to the authorities of Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala (Haryana), India for invariable prop up during experimentation and assemblage of findings.

CONFLICT OF INTEREST

The authors claim no conflicts of interest because none financial support was received from any government, non-government agency or organization to conduct this research work.

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CITATION OF THIS ARTICLE

R Singh, S K Upadhyay, M Singh, M Gupta, P Singhal, S Goyal and P Sharma . Antibacterial and Antifungal Activities of Some Fruits Peel Extracts: The Best Possible Source of Low Cost Natural Antimicrobial Agents. Bull. Env. Pharmacol. Life Sci., Vol 11 [8] July 2022 : 43-47