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PHYTOCHEMICAL ANALYSIS AND AASSESSMENT OF BIOACTIVITY OF CITRUS FRUITS LEMON

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ABSTRACT

Plants have in them certain particular chemicals, called phytochemicals, which may not have nutritional property. They are being absorbed by the human body, and they can mitigate the free radical damage incurred to the cells. Many antioxidant compounds can be found in fruits and vegetables including phenolics, carotenoids, anthocyanins, and copherols. Fruits and vegetables are eaten and are considered to be among the most important sources of phytochemicals for human diet. Phytochemicals has many health effects as antioxidants against many diseases or antibacterial, antifungal, antiviral, cholesterol lowering, antithrombotic, or anti-inflammatory effects. Lemon is very rich in important natural compounds, including citric acid, ascorbic acid, minerals, flavonoids, and essential oils. Citrus fruits juice, has many Bioactive Ingredients like natural antioxidants, phenolic acids, and flavonoids. Peels of citrus fruits are studied widely as it contributes half of the mass of the fruits. Phytochemicals are some of the most important natural preservation structures to reduce and inhibit pathogenic microorganism growth and preserve the overall quality of food products. Citrus plants synthesize and accumulate in their cells a great

variety of phytochemicals including low molecular phenolic. Citrus (lemon) is one of the most commercial fruit crops grown all over the world. The citrus peels are rich in nutrients and contain many phytochemicals, they can be efficiently used as drugs or as food supplements too. The fruit juices contain Vitamin C. Citrus (lemon) peel can be tested for antibacterial properties and can be utilised in various food industries which generates large peel wastes as food preservatives.

Key words: *Phytochemicals, food preservatives, drugs or food supplements, Citrus food*

INTRODUCTION

Plants have in them certain particular chemicals, called phytochemicals, which may not have nutritional property as such, but can function towards disease deterrence. As they're being absorbed by the human body, as a result of oxidative stress, they can mitigate the free radical damage incurred to the cells. An estimated 100 million tonnes of citrus fruits are produced

Each year, making the citrus family the major contributor to the fruit production in the world [1, 3]. Food and fruits are known to contain antioxidants that are linked to in vivo protection from oxidative stress [2, 3]. Many antioxidant compounds can be found in fruits and vegetables including phenolics, carotenoids, anthocyanins, and tocopherols [4, 6]. Approximately 20% of known plants have been used in pharmaceutical studies, impacting the healthcare system in positive ways such as treating cancer and harmful diseases [5, 6]. Plants are able to produce a large number of diverse bioactive compounds.

High concentrations of phytochemicals, which may protect against free radical damage, accumulate in fruits and vegetables [7, 6]. However, Plants face a variety of problems including controlling their own pollination and seed dispersal, local variations in the availability of the basic nutrients they need to synthesise their food, and the coexistence of biotic-stress. Thus, plants have established secondary biochemical pathways that enable them to synthesise a certain chemicals, frequently in response to particular environmental stimuli i.e. biotic and abiotic stress [8, 10].

Fruits and vegetables are eaten and are considered to be among the most important sources of phytochemicals for human diet. About 200,000 phytochemicals are known so far and 20,000 of them have been identified as originating from fruits, vegetables and grains [14]. Phytochemicals has many health effects as antioxidants against many diseases or antibacterial, antifungal, antiviral, cholesterol

lowering, antithrombotic, or anti-inflammatory effects [9].

Lemon is very rich in important natural compounds, including citric acid, ascorbic acid, minerals, flavonoids, and essential oils. Therefore, although the new Citrus cultivars have been mainly developed for fresh consumption, the particular characteristics such as their phenolic compound and in particular the flavonoids contents have led to their use in new fields such as pharmacology and food technology [16].

For the production of fruit juice, Citrus fruits are the main ingredient. It has many Bioactive Ingredients like natural antioxidants, phenolic acids, and flavonoids. Peels, of citrus fruits are studied widely as it contributes half of the mass of the fruits.

In addition, phytochemicals are some of the most important natural preservation structures to reduce and inhibit pathogenic microorganism growth and preserve the overall quality of food products [11]. These antimicrobials can protect food products, extending the shelf life naturally [11].

Citrus fruits belonging to the rutaceae family are among the major fruit tree crops grown worldwide. Although sweet orange (*Citrus sinensis*) is the major fruit in this group accounting for about 70% of citrus output. The group also encompasses small citrus

fruits such as tangerine tree (*Citrus reticulata*), grapefruit tree (*Citrus vitis*), lime tree (*Citrus aurantifolia*) and lemon tree (*Citrus limonum*) [12]. These plant secondary metabolites include several classes such as terpenoids, flavonoids and phenolics compounds having diverse chemical structures and biological activities and exist widely in citrus fruits [13].

Citrus plants synthesize and accumulate in their cells a great variety of phytochemicals including low molecular phenolic (hydroxy benzoic and hydroxycinnamic acids, acetophenones, terpenoids, flavonoids, stilbenes and condensed tannins [12, 15, 16, 17]. There are about 40 limonoids in citrus with limonin and nomilin being the principal ones [18]. These compounds, which occur in high concentration in grapefruit (*C. vitis*) and orange juice (*C. Sinensis*) partly provide the bitter taste in citrus.

Citrus (lemon) is one of the most commercial fruit crops grown all over the world. It is one of the largest plant species and is further consisting of 40 species which are found around the world [22, 15]. The citrus peels are rich in nutrients and contain many phytochemicals, they can be efficiently used as drugs or as food supplements too.

The fruit juices contain Vitamin C (ascorbic acid) [19, 20]. These fruits contain phenolics,

flavonoids, vitamins, and essential oils which are responsible for protection against various diseases which are related to antioxidative, antitumor and antimicrobial activities [21]. Peel waste are highly perishable and seasonal. There is always an increased attention in bringing useful products from waste materials and citrus wastes are no exceptions [22, 23]. The citrus peels are rich in nutrients and contain many phytochemicals, they can be efficiently used as drugs or as food supplements too. Researchers focus on natural components as of the increasing antibiotic resistance pathogens. Citrus (lemon) peel can be tested for antibacterial properties and can be utilised in various food industries which generates large peel wastes as food preservatives [22].

Therefore, it is of great interest to screen Lemon in order to validate their use in food and medicine and to reveal the active ingredient by characterizing their constituents.

REVIEW OF LITERATURE

- i. Makni *et al*, 2018 done quantitative and qualitative characterization of the Zest (ZL) and the Flesh (FL) of lemon (*Citrus limon*), to valorize the pharmacological uses of lemon, by evaluating *in vitro* activities (DPPH, free radical scavenging and reducing power). They have found that the ZL

contains high amounts of phenolics responsible for the important antioxidant properties of the extract, however, the FL is richer in flavonoids than the ZL. Analysis by LC/MS-MS identified 6 compounds (Caffeoyl N-Tryptophan, Hydroxycinnamoyl-Oglucoside acid, Vicenin 2, Eriocitrin, Kaempferol-3-O-rutinoside, and Quercetin-3-rutinoside) [Makni *et al*, 2018]. These preliminary results showed that *Citrus Limon* has antibacterial and antioxidant activity *in vitro* [Makni *et al*, 2018].

- ii. Roghini and Vijayalakshmi, 2018 evaluated the phytochemicals of *Citrus paradisi* by using quantitative and qualitative analysis of ethyl acetate, ethanol, and *n*-hexane and aqueous extracts with the help of standard techniques. The findings from quantification and phytochemical screening showed the presence of alkaloids, flavonoids, reducing sugars, Phenols, proteins, amino acids, saponins, tannins, terpenoids, and glycosides. Further, the study findings revealed that ethanolic extract of fruit extract was found to have more constituents when compared with other extracts by quantitative method.

Elemental analysis showed the presence of selenium (1.56 mg); manganese (4.95 mg); iron (5.12 mg); magnesium (34.5 mg) and zinc (9.85 mg). Chromatogram of flavonoid standards such as rutin, quercetin, gallic acid, hesperidin and ethanolic extract of *Citrus paradise* showed the high amount of naringin (Roghini and Vijayalakshmi, 2018).

iii. For several years scientists are trying to find out the effect of different solvents on the phytochemical present in plants, such as methanol, hexane, and ethyl alcohol, for the purpose of antioxidant extraction from various plants parts, such as leaves and seeds. These species have been largely studied through several phytochemical and pharmacological investigations reported in literature, where most of them have focused on polar compounds from leaf extracts. The range of therapeutic properties attributed to these plants has been correlated to their content of phenolic acids, flavonoids and triterpenoids. Chlorogenic acid and flavone C-glycosides (such as orientin, isoorientin, vitexin, isovitexin) have been consistently reported as the main

compounds in *C. obtusifolia*, *C. peltata*, *C. glaziovii*, *C. pachystachya* and *C. Hololeuca* [Andrade-Cetto *et al* 2007, Andrade-Cetto *et al* 2008, Lacaille-Dubois *et al* 2001, Müller *et al* 2016, Andrade-Cetto *et al* 2001, Andrade-Cetto *et al* 2016, Maquiaveli *et al* 2014, Gazal *et al* 2014, Ortmann *et al* 2016]. In order to extract different phenolic compounds from plants with a high degree of accuracy, various solvents of differing polarities must be used [Wong and Kitts 2006]. Moreover, scientists have discovered that highly polar solvents, such as methanol, have a high effectiveness as antioxidants.

iv. Anokwuru *et al* 2011, reported that acetone and N, N-dimethylformamide (DMF) are highly effective at extracting antioxidants, while Koffi *et al* 2010. Found that methanol was more effective in at a large amount of phenolic contents from walnut fruits when compared to ethanol [Ruan *et al* 2008, Koffi *et al* 2010, Anokwuru *et al* 2011; Altemimi *et al* 2017].

v. It has been reported by Koffi *et al* and Altemimi *et al* that ethanolic extracts of Ivorian plants extracted higher concentrations/amount of phenolics

compared to acetone, water, and methanol [Koffi *et al* 2010; Altemimi *et al* 2017]. Multiple solvents have been commonly used to extract phytochemicals, and scientists usually employed a dried powder of plants to extract bioactive compounds and eliminate the interference of water at the same time [Koffi *et al* 2010, Altemimi *et al* 2017].

- vi. Li *et al.* reported that conventional methods using various solvents presented less antioxidant activity and phenolic content than MAE [Li *et al* 2012]. Recently, Christophoridou *et al.* used a new microwave-assisted extraction (MAE) process, which converts energy to heat, thereby cooperating with solvents in order to extract a specific compound [Christophoridou *et al* 2005]. Williams *et al.* showed many advantages of MAE, including lower solvent consumption, shorter extraction times, and higher sensitivity towards target molecules [Williams *et al*, 2004].
- vii. The use of natural ingredients in herbal medicines is considered safer than the use of modern chemical drugs, because the side effects of

herbal medicines are relatively small if used appropriately [Berti, P.L. 2015, Sari, and M.A.N. 2013]. One of the herbal plants often used as medicine is the lemon fruit. Lemon fruit is an herbal plant that has the main content of alkaloid compounds which have the function as anticancer, antibacterial, antifungal, antiviral and antidiabetic. Alkaloid compounds that responsible for antibacterial is saponin [Henderson, *et al*]. Lemon (*Citrus limon*) juice contains many bioactive compounds such as flavonoids, carotenoids, limonoid, tannin, and terpenoids. The bioactive compounds contained in lemon (*Citrus limon*) each have an antibacterial [Russo *et al* 2014]. Lemon (*Citrus aurantifolia*) juice besides being used as an antibacterial, it is also useful as an antioxidant. The main content of lemon (*Citrus limon*) juice is vitamin C and citric acid. The content of vitamin C and citric acid makes the degree of acidity (pH) the lemon (*Citrus limon*) juice become acidic [Berti, P.L. 2015, Gonzales-Molina *et al* 2014]., Ekawati and Darmanto *et al*, 2019 studied to screen the acetone and ethanol extracts of *C. Limon* for its

antioxidant potential and antimicrobial efficacy agents against a panel of microbes implicated in skin diseases. As per Ekawati and Darmanto *et al* 2019, the highest antibacterial activity was obtained with the acetone extract of C. Limon against *Enterococcus faecalis* and *Bacillus subtilis*, and the most susceptible bacteria based on the overall mean inhibition diameters were the gram-negative *Salmonella typhimurium*, *Shigella sonnei* and the gram-positive *E. Faecalis* and *B. subtilis*. Both extracts were active against *Candida glabrata*.

CONCLUSION

As for Conclusion, citrus plants synthesize and accumulate in their cells, a great variety of phytochemicals including low molecular phenolic. Citrus (lemon) is one of the world's most commercially produced fruits crops. The citrus peels are rich in nutrients and contain many phytochemicals, they can be efficiently used as drug or as food supplements. Citrus peel can be tested for antibacterial properties and can be utilised in various food industries which generates large peel waste as food preservative.

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