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Contents

ANTIOXIDANT ACTIVITY OF SUN-DRIED TROPICAL LEMON (Citrus limon) PEEL

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ABSTRACT

The peels of lemon (Citrus limon) are the major by-products obtained during the processing of lemon and are most of the time discarded as food waste. Lemon peels have been reported to possess many bioactive substances with beneficial properties. These properties may probably have potential applications for use in agriculture, industry, aquaculture, medicine and food processing. This research was conducted to determine the antioxidant activity of lemon peels. The free radical used was 2, 2-diphenyl-1-picrylhydrazyl (DPPH), while ascorbic acid was used as the standard antioxidant for the analysis. The DPPH free radical scavenging activity of the lemon peel extracts increased from 6.29 to 53.32% with a corresponding increase in the concentrations of the peel extract from 0.2 to 1.0 mg/ml. The lemon peel extracts, therefore, exhibited DPPH free radical scavenging activity in a dose-dependent manner. The inhibition of ascorbic acid at the concentration of 1mg/ml was 98.65% while for the lemon peel at the same concentration the inhibition obtained was 53.32%. Lemon peels which are considered a waste product have been shown to possess some level of antioxidant activity. The half-maximal inhibitory concentration (IC50) is the value of the test sample that can scavenge 50% of DPPH free radical. The IC50 value recorded for the lemon peel was 0.93mg/ml as
against the IC50 value of 0.41mg/ml of ascorbic acid. Lemon peels are by-products that may be used as a potential low-cost natural antioxidant source for human food and animal feed.

KEYWORDS: lemon peel; scavenging activity; antioxidant; free radical; sun-drying

INTRODUCTION

Lemon (*Citrus limon*) is a typical citrus fruit. The plant is a potent source of vitamin C. The peels of lemon (*Citrus limon*) are the main by-products obtained during the processing of lemon fruit and are most of the time discarded as food waste. Lemon peel forms around 40–50% of the total fruit mass which is mostly considered a waste (Singh *et al.*, 2020). The peel of a lemon is made up of two distinct layers, the outer layer is called the flavedo (epicarp) while the inner layer of the

peel (the white spongy part) is called the albedo (mesocarp). Nevertheless, lemon peels have been reported to demonstrate several bioactivities that are beneficial (Liu *et al.*, 2022). Lemon peels also contain pectin and fibre and can be useful as prebiotics (Jiang *et al.*, 2022).

Plants with free radical scavenging properties and antioxidant capacity are valuable for pharmaceutical, agricultural, and industrial applications and as food and feed additives. Research authors have employed many methods in processing lemon peel like; oven drying freeze drying, air drying/shade drying and microwave drying.

To the best of the authors' knowledge, literature is scarce on research work done on the antioxidant potential of sun-dried lemon peels. In the tropics, the sun-drying method may be advantageous, low-cost and a better option for processing lemon peels.

This research work aimed to evaluate the antioxidant activity of sun-dried lemon peels and to identify their potential for possible use as a food and feed additive.

MATERIALS AND METHODS

Processing of Test Sample

The lemon fruits were hand peeled and the peels were collected and cut into small pieces and sun-dried for 3 days. They were then grounded and packed in airtight polythene bags. The ground samples of the peels were taken for laboratory analysis for the determination of antioxidant activity.

Preparation of Sample Extract

The sample extract was prepared by weighing 1g of the dried sample into a conical flask. Then 100ml of ethanol was added to the weighed sample. The extraction of the sample was carried out by using a digital 4 holes water bath (Model: E-Track England) at 70 degrees for 40 minutes. This was then cooled at room temperature and transferred into a 100ml volumetric flask. Extracts were filtered using a Whatman filter paper (No. 1).

Free Radical Scavenging Assay

To determine the antioxidant activity of the extract, 2, 2-diphenyl-1-picrylhydrazyl (DPPH) was

used as a free radical according to the method outlined by Mukherjee *et al.* (2011) with minor modifications. The concentration of 100 μM of DPPH was dissolved in methanol to a final concentration of 0.03mM. Serial dilutions were made to check the IC50. In 96-well microplate total volume was 100 μl which was consisting of 90 μl of DPPH solution and 10 μl of the test solution. Different concentrations (0.2, 0.4, 0.6, 0.8 and 1.0 mg/ml) of the extracts and ascorbic acid (the standard antioxidant) were used. The contents were mixed and incubated for 30 minutes at 37°C. To determine the absorbance at 517 nm, an ultraviolet (UV) spectrophotometer was used. The decrease in absorbance indicated increased radical scavenging activity which was determined by the following formula for DPPH:

$$\text{DPPH Scavenging activity (\%)} = \frac{AC - AS}{AC} \times 100$$

AC= Absorbance of control

AS = Absorbance of sample

RESULT AND DISCUSSION

In this study, the DPPH free radical scavenging activity of the lemon peel extracts ranged from 6.29 to 53.32%. The antioxidant activity increased with the increasing concentrations of the peel extract from 0.2 to 1.0 mg/ml (Figure 1). The lemon peel extracts showed DPPH free radical scavenging activity in a dose-dependent manner.

The inhibition of ascorbic acid (the standard antioxidant used) at the concentration of 1mg/ml was 98.65% while for the lemon peel at the same concentration, the inhibition obtained was 53.32% (Figure 1). Abd El-ghfar *et al.* (2016) reported 52.64% free radical scavenging activity for dried lemon peel this value is close to the value obtained in this study.

In contrast to the value recorded in this study, Olyad *et al.* (2020) reported a much higher value of approximately 68% at the same concentration (1mg/ml). The differences in these results may be due to variations in cultivar, processing method and environmental factors. Other possible factors that may be responsible for variability in results generally are as follows; 1) different test models or assays used. 2) The composition of the lemon peel analysed, may be affected by the way the lemon is peeled, whether it was hand-peeled or knife peeled. This would affect the proportion of epicarp and mesocarp in the test sample. 3) Whether the lemon was ripe or not ripe before peeling.

4) The method of drying used. 5) The handling and storage conditions. 6) Growing conditions and soil fertility.

The IC50 which is the half-maximal inhibitory concentration that is the value of the test sample that can scavenge 50% of DPPH free radical. The value of IC50 is inversely proportional to the antioxidant activity of the sample that is, the lower the IC50 value the higher the scavenging activity.

The IC50 value recorded for the lemon peel was 0.93mg/ml against the IC50 value of 0.41mg/ml of ascorbic acid. These values are the concentration required to attain a 50% radical-scavenging effect.

According to Abd El-ghfar *et al.* (2016), the presence of natural flavonoids, phenolics, ascorbic acid and carotenoids is responsible for the antioxidant activity of lemon peels. As a result of the level of antioxidant activity exhibited by lemon peels, is it recommended for consideration as potential natural additives in food products and feeds to enhance the antioxidant activity and improve shelf-life.

Pieracci *et al.* (2022) in their experiment obtained 0.70mg/ml as the IC50 of lemon pulp waste while that of orange pulp waste was 0.81mg/ml. These values are lower than the values obtained for lemon peels in this study, probably because it was a pulp waste and not a peel waste, as there might be some difference in their composition although both are considered by-products of citrus fruits.

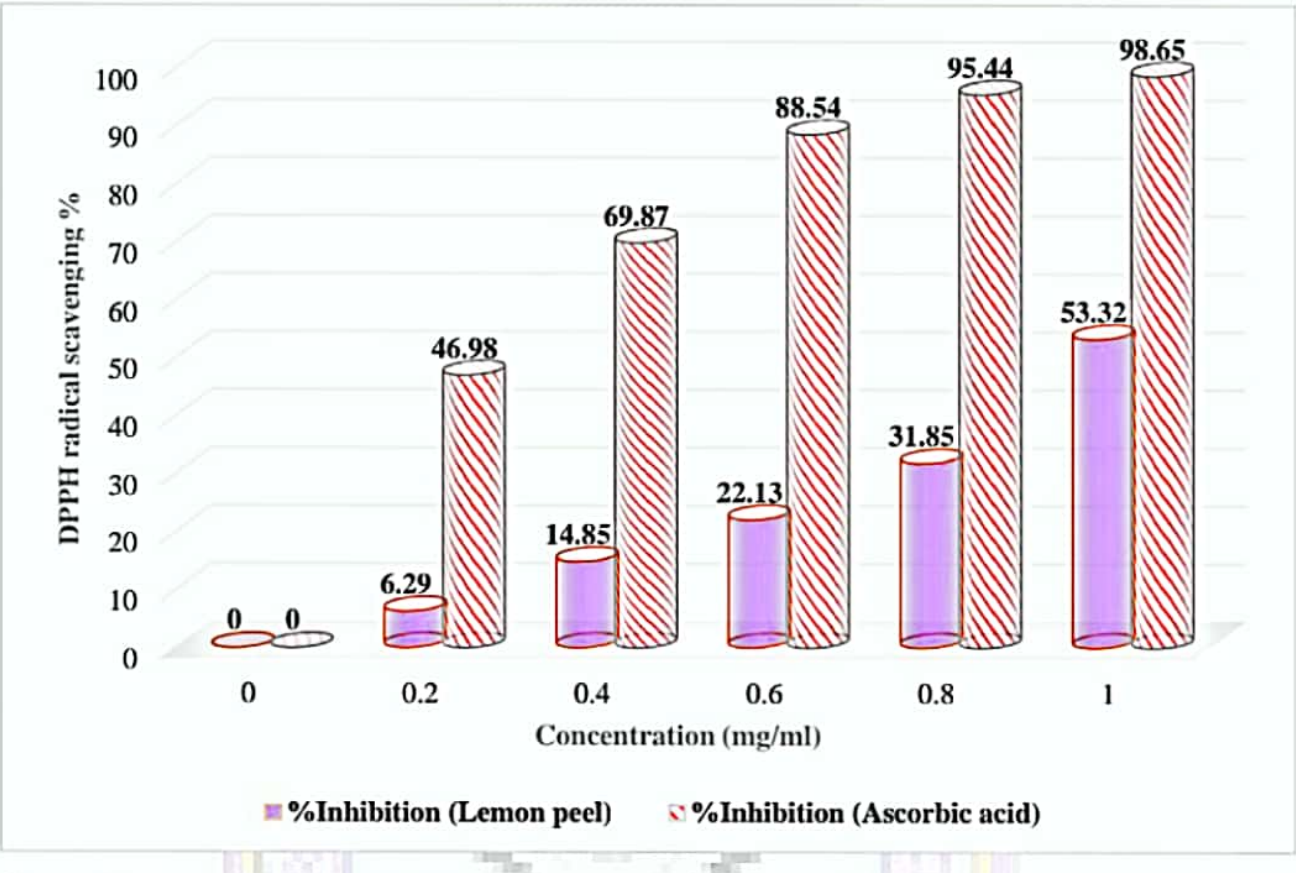

Figure 5: Free radical scavenging activity of sun-dried lemon peel

CONCLUSION

The sun-dried lemon peels used in this experiment are a cheap source of natural bioactive compounds with good antioxidant activities. This citrus by-product is not only cheap but considered safe and with health-promoting benefits, capable of protecting the cell against free radical damage. Also, the peels are natural by-products that can act as a good source of antioxidant for possible application in foods, drugs and feeds and may replace synthetic antioxidant derivatives.

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