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Nutritional Evaluation and Antioxidant Activity of Zest obtained from Orange (*Citrus sinensis*) Peels

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ABSTRACT: Oranges (*Citrus sinensis*) are very important in fruits and contain very important nutritional components which have medicinal importance as well. The zest of orange peel was obtained by scraping out outer most colored covering of orange peel. The aim of this study was to evaluate the nutritional significance and antioxidant activity of zest obtained from orange peel. Data revealed that orange outer most covering (zest) had higher amount of fiber 5.01%. The total moisture content (4.716%) and total ash content (0.0338%) were calculated in dried sample of orange peel zest. Protein, Fat and carbohydrate contents were 3.00, 1.65 and 10.70 % respectively. Antioxidant activity demonstrates the different inhibition percentage at different concentration. Antioxidants keep the DNA of healthy cells from mutating into cancerous cell, so antioxidants are the first line of defense for cancer and other serious disease. Heavy metals Cd, Pb, Ni, Co, As, Cr were not detected in zest of orange peel.

Keywords: Antioxidants, Orange peel, Zest, Nutritional analysis, DPPH analysis

I. INTRODUCTION

Orange is the most widely grown and commercialized citrus specie. It belongs to the family Rutaceae and its different parts possess various medicinal properties additional nutritive value. Orange is composed by an external layer (peel) formed by flavedo (epicarp or exocarp) and albedo (mesocarp), and an inner material called endocarp that contains vesicles with juice. Juice, flavedo and albedo account for about 50, 10 and 25% (w/w) respectively of the whole fruit. Fruit peel, or fruit skin is outer most covering or skin or the fruit. Peels of citrus fruits comprises of two layers, red outer layer as flavedo and inner white layer as albedo (Nagi *et al.*, 1977).

Zest can be prepared by scraping or cutting the outer most colorful skin of orange, it can be used as fresh, dried, candied or pickled in salts. Peel is a rich source of rough dietary fibers, also known as NSP (non-soluble polysaccharides), such as hemi-cellulose, pectin, tannins, and gums etc. Peel is low in calories, sugar, and fats and free from cholesterol. It adds bulk to the food and helps cut down overall calories intake. The citrus peel and seeds are very rich in phenolic compounds, such as phenolic acids and flavonoids. The peels are rich in flavonoids than seeds (Yusof *et al*., 1990). In Asia, the use of orange zest, lemon zest and dried orange peel in cooking proved to be a curable substance for digestive disorders. A little citrus peel in your diet can go a long way (Srividhya *et al*., 2013). The antioxidant properties of plant extracts have been due to their polyphenol content (Benavente-garicia *et al*., 1997). So, plants containing high level of polyphenol have a great importance as natural antioxidants. The determination of metal traces is very important because they are involved in biological cycles and indicate high toxicity. The levels of heavy metals and mineral ions were measured in medicinally important plant species, *Citrus sinensis* and *Psidium guajava.* Dried powdered samples of the plants were digested using wet digestion method and elemental determination was done by atomic absorption spectrophotometer. The content of Hg, As and Se in *C. sinensis* fruit peel and *P. guajava* leaves was not detectable and met the appropriate safety standards (Dhiman *et al*., 2011). The aim of present study was to conduct proximate and heavy metal analyses along with antioxidant activity of zest obtained from orange peels.

II. MATERIALS AND METHODS

A. Sample preparation

Ripened and fresh oranges were collected from local market of Lahore on 10th of January 2015. Dozens of oranges were washed with distilled water. The upper most colored covering was removed with the help of sharp knife by wearing gloves. The zest (the upper most colored covering of orange peel) is spread in the tray and is kept in the oven for 24 hours at 100°C. Then after 24 hours the zest is grinded into fine powder with the help of grinder and sieved. As a result of this process sample is obtained in powdered form and is kept in zipper bag.

B. Product characterization

Experiments were performed on the sample (zest) to find out its nutritional value and its antioxidant activity. Standard deviation of all experiments (ash, moisture, protein, fiber) were taken and showed as ±STDEV. Different experiments were performed and precise measures were taken. Standard methods of the AOAC, 1984 were used to determine the moisture content, crude protein, crude fat, total ash and crude fiber content.

pH of zest is measured by the pH meter. There are many methods for determination of moisture content. Vacuum oven was used for the determination of moisture content, in which sample was placed for several days on slow heating. Ash content of sample was calculated by complete cheering of sample, and then placing it in muffle furnace until carbon free ash was obtained.

Kjeldhal method was used for the determination of protein in sample. The percentage of protein ranges from 1%-3%. Placed sample in Kjeldhal's flask with catalyst and concentration H_2SO_4. After specific time cools the flask and prepared solution ok 100ml of NaOH that rinse with distilled water. Boric acid and methyl red was taken as indicator. The content heated by passing steam through apparatus. The colored solution of boric acid then changes, then titrate solution against saturated HCl. First the percentage of nitrogen was calculated, and then by the value of nitrogen we calculated the value of protein content in our sample. For the fiber content, the sample was defatted. In digestion flask asbestos, conc. H_2SO_4 added, was attached to condenser for 30 min. washing of residue was done; once again the process was repeated. Cheering of residue was performed, three readings were taken. Heavy metals were determined by Atomic Absorption Spectrophotometer and inductively coupled plasma.

For the determination of the antioxidant capacity of the zest obtained, the DPPH method was used, it is quick and easy method. It is based on discoloration reaction between nitrogen electron and hydrogen atom of hydroxyl group. Experiment is performed on different concentration; % inhibition of DPPH increases as the concentration increases, value of blank was 0.747 at 517λ.

III. RESULTS AND DISCUSSION

In the present study, the nutritive value was analyzed in fruit peel of *Citrus sinensis* (orange) collected from Lahore (local market). The zest obtained from the outermost colored covering in oranges, was rich in nutritional value. The results of proximate analysis of zest sample are given in Table 1.

Table 1: Proximate analysis of Zest obtained from orange peels.

Characteristics	Readings in Triplicate			Average/ ±STDEV
	1	2	3	
pH	6.0	5.9	5.9	5.9±0.05
Moisture (%)	4.717	4.716	4.717	4.716 ±0.005
Ash (%)	0.0339	0.0338	0.0337	0.0338 ± 0.04
Protein (%)	3.0	3.0	3.1	3.00 ±0.05
Crude Fiber (%)	5.02	5.02	5.01	5.01 ±0.005
Fat (%)	1.64	1.65	1.65	1.65 ±0.005
Carbohydrate (%)	10.7	10.8	10.5	10.7±0.15

pH is the hydrogen ion concentration. Precise measures were taken while taking each reading, pH meter was dipped in distilled water, and wash thoroughly after one reading. The pH has bitter oil, plant fiber and very small amount of acid so; the pH of zest is slightly acidic.

The moisture content of orange peel was calculated, three different readings were taken which showed the moisture content upto 4.716 %. The moisture content of fruits ranges between 0.5- 95%. Aina *et al*. (2012) found moisture content of pectin that was 95.25%.

The total ash content was also determined in sample (zest) and result was 0.0338%. Nassar *et al*. (2008) demonstrated the ash content ranges from 0.5-4.7%. Rivas *et al*. (2008) also calculated the value of ash that was 3.50%. Protein was calculated and the sample contains 3.0% protein. Abd El-aaland and Halaweish (2008) calculated the protein content that is 1%. Rivas *et al*. (2008) also calculated the value of protein in orange peel that was 6.50%.

Orange peel is rich in fiber content. In obtained Zest 5.01% fiber content was found. Snart *et al*. (2006) calculated the fiber content as 14% (3.4 g). Total carbohydrate contents were obtained by difference. Crude fat was determined by using soxhlet apparatus. Five grams of the sample was extracted using petroleum ether (boiling point range 40-600 °C) as the extractant. Each analysis was carried out in triplicate and Anova statistical method was used for the statistical analysis (Adewole *et al*., 2014).

Peels represent between 50-65% of total weight of the fruits and remains as the primary by-product. If not processed further, it becomes west produce odor, soil pollution, harborage for insects and can give rise to serious environmental pollution, therefore: by keeping this in view, heavy metal analysis was done and no heavy metals were detected. Results was that Pb, Cd, Ni, Co, Ar, Cr, were not detected. Dhiman *et al*. (2011) measured the level of heavy metals in citrus species which showed that the content of Hg, As and Se in *Citrus sinensis* were not detected. Similarly, prepared sample of zest is safe and heavy metals were absent (Table 2).

Hegazy and Ibrahium (2012) revealed that all extracts of the orange peel exhibited variable antioxidant activity. Karsheva *et al*. (2013) conducted research and found that orange peel was rich of polyphenols and exhibited high antioxidant activity. The obtained Zest show antioxidant activity and also it was found that by increasing concentration, % inhibition was also increased (Fig. 1). The graph was plotted between concentration and % inhibition which shows that concentration is directly proportional to % inhibition.

Table 2: Determination of heavy metals in sample (zest).

Heavy metals	Results
Pb (Lead)	Not detected
Cd (Cadmium)	Not detected
Ni (Nickel)	Not detected
Co (Cobalt)	Not detected
As (Arsenic)	Not detected
Cr (Chromium)	Not detected

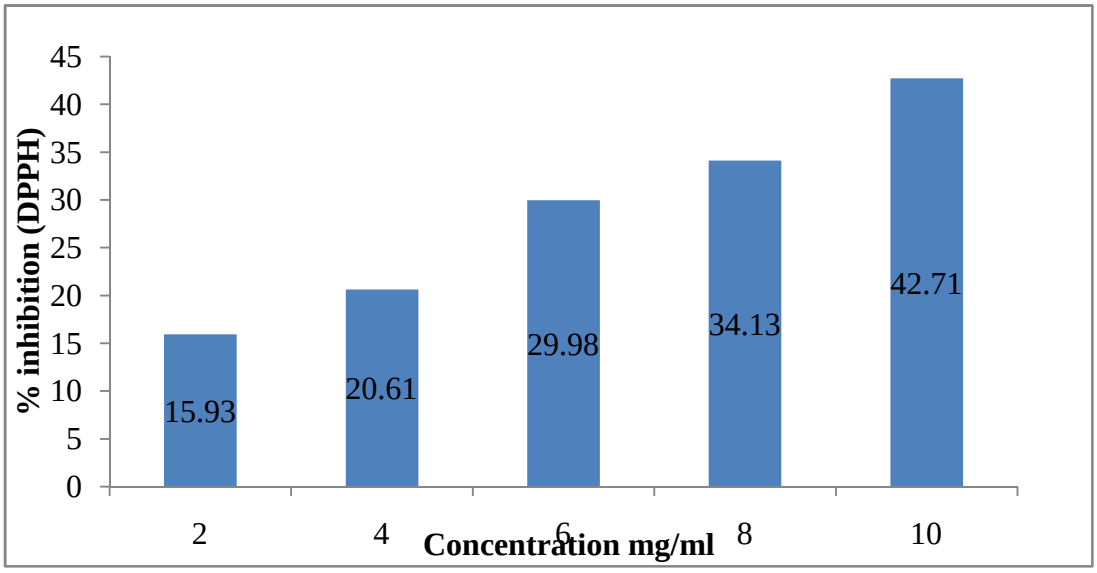

Fig. 1. Percentage Inhibition (DPPH) of Zest.

The antioxidant activity of the extracts of orange zest revealed that the radical scavenging activity is strappingly linked with the presence of flavonoids, phenolic acids, and their derivatives, so sustaining the significance of orange zest as an important dietetic source of antioxidant compounds (Olufunmilayo *et al*., 2015). Orange zest may be considered as natural antioxidant in food application as well as for health supplements or functional foods, to improve oxidative stress.

IV. CONCLUSION

Orange peel is treated as waste material which may create environmental problems for local communities since presence of biomaterials in orange peel. Effective solid waste management is one of the most essential elements for industries to achieve a sustainable development. Zest is nutritive and cheap product. This study may thus lead to the formulation of an antimicrobial drug and can be used as a potent natural antioxidant additive or food products and as a dietary supplement. Zest can be used instead of orange pulp as a flavoring agent.

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