



Morphological and Proximate Analysis of Orange (*Citrus scinesis*) Peel and Tomato (*Solanum lycopersicum*)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/EJNFS/2021/v13i530423

Editor(s):

(1) Dr. Rasha Mousa Ahmed Mousa, University of Jeddah, Saudi Arabia.

Reviewers:

(1) Okache, Thomas Akobi, Federal University Dutsin Ma, Nigeria.

(2) MosisaChewaka Aga, Ambo University, Ethiopia.

Complete Peer review History: <https://www.sdiarticle4.com/review-history/72818>

Original Research Article

Received 23 June 2021
Accepted 03 September 2021
Published 10 September 2021

ABSTRACT

The main objective of the study is to evaluate the nutritional composition of orange peel and tomato for the development of natural colour to increase the awareness about the use of natural food colour which reduces the risk assessment of artificial colour. Fruits are very important constituents of the diet and provide nutrients such as, vitamin, minerals, and fibre etc. Orange is one of the most popular fruits in the world. It is rich in nutrient like vitamin C, folic acid, carotenoids, flavonoids etc. These nutrients are very useful for boosting immunity. In this study we discuss about nutritional composition of orange peel and tomato. Proximate analysis of each sample was conducted to evaluate the moisture, fat, protein, ash etc. The morphological analysis of the samples was done by using scanning electron microscope which helps in identifying the different structural forms of the samples. Results of the study suggest that orange peel and tomato both have a good nutritional property. The fat, protein, ash and fibre content in orange peel was found to be 3.4, 4.8, 4.2 and 8.3 respectively while in tomato the values are 0.24, 2.26, 0.18 and 1.19 respectively. Orange peel removed the amount of cholesterol and fight against heart diseases in your body because orange peel contains pectin and natural fibre, it controls our blood pressure and helpful for weight loss. Tomato is an edible, red berry types of fruits. Tomatoes contribute to a

healthy well-balanced diet. Because they are rich in nutrients like minerals, vitamins (B and C), sugar and dietary fibre. Tomato is a good source of lycopene; it is a red colour pigment present in high amount (2573 µg) per 100 tomatoes is a very good sources of raw materials for fruits and vegetables industry

Keywords: Orange peel; tomato; proximate analysis; SEM; morphology.

1. INTRODUCTION

Citrus fruit is one of the most successful crops. Citrus has a dominant members include sweet orange (*Citrus scinensis*), tangerines/mandarin (*Citrus reticulata*), lime (several species) and grapefruits (*Citrus Paradis*). Citrus fruits are important for their pleasant fragrance, because of flavonoids and limonoids [1]. Citrus peel contains different molecules, used as a natural additive in food industry [2]. The total phenolic content of orange peel ranged from 1.13 to 7.30 g/100g db, orange peel contains natural products like sugar, flavonoids, carotenoids, folic acid, necessary vitamin C, pectin and essential oils which can be used for human health [3]. Fruit peels are used as a source of antimicrobial agents and typically contains some essential constituents, who can be employed for pharmacological and pharmaceutical purposes [4]. Citrus fruit peels are an integral part of a nutritious breakfast and consequently improve the beginning of a healthy every day [5]. Orange peel is recognized for different health benefits for human. The presence of different nutrient in orange peel has some positive impact on health immunity such as digestive system, nutrient act as anti-infection, anti-bacterial and anti-cancer. Citrus peel possesses immense economic and medicinal value because of their multiple uses, such as various types of food industry (dairy industry, bakery industry and beverage industry), cosmetics and pharmaceuticals industry. Several phytochemicals' compounds are also present in orange peel like limonoids, synephrine, polyphenols, pectin, flavonoid, and hesperidin.

Tomato (*Solanum lycopersicum*) is perishable fruit vegetable have a very short life, usually 2-3 weeks. It belongs to the family Solanaceae [6]. Tomato is a most common fruit crop consumed by people across the globe. It is mostly cultivated in tropical and sub-tropical climates; lycopene is a water insoluble pigment present in tomatoes [7]. Tomatoes are mostly consumed in both form either raw or processed, which provide a significant proportion of the antioxidants in the diet [8]. Tomatoes have a greater source of alpha-tocopherol and vitamin C. Tomato skin contains good number of amino acids and the

tomato seeds had contain higher amount of minerals such as (Fe, Mn, Zn and Cu). Tomato is the rich source of natural antioxidants. In tomatoes, lycopene is the carotenoid present in higher concentration and contains other carotenoids such as, phytoene, phytofluene, and the provitamin a carotenoid β-carotene. The flavanone and naringenin is present in very small amount in tomatoes [9]. Tomatoes are one of the major fruits providing an estimated 75% of daily intake of lycopene, and of folate, ascorbic acid, α-tocopherol and potassium. These nutrient and phytochemicals of tomatoes have antioxidant and phytochemicals properties may help to human health [10]. Tomatoes helps us fighting against many human diseases like different types of cancer and reduces the risk of hypertension and other cardiovascular diseases. The main objective of this research work and the aim of the current study to know the nutritional properties of orange peel and tomato and its health benefits for human health.

2. MATERIALS AND METHODS

2.1 Chemicals and Reagents

Sodium hydroxide (NaOH), Conc. Sulphuric acid (H₂SO₄), Acetone, Distilled water, Glutaraldehyde, Osmium tetroxide, anhydrous copper.

2.2 Raw Material Collection

The tomatoes for analysis were purchased from local market of Telibagh, Lucknow. And orange was obtained from the supermarket (Spencer's) of Lucknow. The raw material was purchased based on uniform maturity and weight and stored at a room temperature before analysis. Selection of raw materials such as orange and tomato was done at different quality parameters like colour, texture and tenderness etc.

2.3 Sample Preparation

2.3.1 Preparation of orange peel powder

Fresh orange washed with tap water to remove dirt particle and potential pathogenic micro-

organism after washing removed peels of orange with hand peeler [11]. Cut the peels into small and uniform pieces and oven dried at 50-60°C in hot air oven. Dried fruit peels were grinding through mixer grinder to make a fine powder and packed in airtight container [12].

2.3.2 Preparation of tomato powder

Tomato was washed with running or tap water to remove unwanted material, cut the tomato into (4- 5) cm in length. and oven dried at 60-70°C in hot air oven. Dried tomato was grinding through mixer grinder to make fine tomato powder [13]. Powder was packed in sealed Aluminum foil sachets and stored for further analysis.

2.4 Proximate Analysis of Sample

2.4.1 Determination of moisture content

Moisture content of both sample (orange peel and tomato) was determined by using hot air oven according to Rangana method [14]. 5g of sample was taken in clear and dried dish. The dish was placed in the hot air oven at 70-80°C for 2 hours then, the dish was placed to desiccator for allow to cool. The dish containing dried sample was weighed by using electronic weighing balance.

The loss of weight = $\frac{\text{Initial weight} - \text{Final weight}}{\text{weight of the sample}} \times 100$

2.4.2 Determination of fat

Fat content was determined by using Soxhlet Apparatus. Soxhlet method is a traditional method used for extracting lipids in different food [15]. 2 gm of sample was taken in thimble and placed in thimble holder; 250 ml of petroleum ether was added. After 4 hours extraction, the heater and water tap were turned off. The thimble was taken into an oven at 70°C for about 30 minutes, ether was drained out. The weight of the beaker and the fat it contains was weighed.

Fat (%) = $\frac{W1 - W2}{W} \times 100$

2.4.3 Determination of protein

Percentage of protein in sample was determined by the Kjeldhal method. (It does not directly measure the percentage of protein). The percentage of protein was calculated from the nitrogen content present in the sample [16].

2.4.4 Determination of Ash

Determination of Ash content was done by using Muffle Furnace. Oven dried crucible was taken then, taken 5g of sample into the crucible. The ignition is completed by keeping it in muffle furnace at 550°C until grey ash is formed. The dish is cooled in the desiccator and weighed. The ash content is estimated by using formula-

Ash (%) (dry basis) = $\frac{M2 - M}{M1 - M} \times 100$

2.4.5 Determination of crude fibre

Percentage of crude fibre was done by using S. Ranganna method [14]. 2 gm of fat free sample was taken in a thimble. Washing with distilled water was done from 10 min at 60°C in a hot plate. Treat with 1.25% dilute sulphuric acid on hot plate for 15 min, again wash with distilled water for 10 min, thereafter, treated with 1.25% sodium hydroxide for 10 min place the sample in muffle furnace at 550°C for 2 hours.

Crude fiber (%) = $w2 - w1 \times 100 \div w$

2.4.6 Determination of carbohydrates

Percentage of carbohydrates as a nitrogen free extract (NFE) was calculated by using formula-

NFE = $100 - (\% \text{protein} + \% \text{fat} + \% \text{fibre} + \% \text{ash} + \% \text{moisture})$

2.5 Scanning Electron Microscope

Scanning electron microscope (SEM) is a very useful instrument to visualize morphological structure of food. SEM has been very attractive for food scientists because it has both feature surface and internal [17]. The analysis of both sample (orange peel and tomato) was done by using high-resolution Scanning Electron Microscope (JSM 6490) Japan (JFC 1600, Auto fine coater [18]. First, prepared sample in form of dry powder after drying protect the sample from relative humidity [19]. And keep the sample Eppendorf micro centrifuge tubes. Then 2-4mm of frozen dried sample were taken and coated by using the sputter coater of JEOL, both samples were examined at 10 KV. Image were taken in representative parts of tested sample and observed at a high magnification [20].

2.6 Statistical Analysis

Statistical analysis was conducted in this study for the measurement of the data. The proximate analysis was done in triplicates and the data was expressed as mean \pm standards deviation.

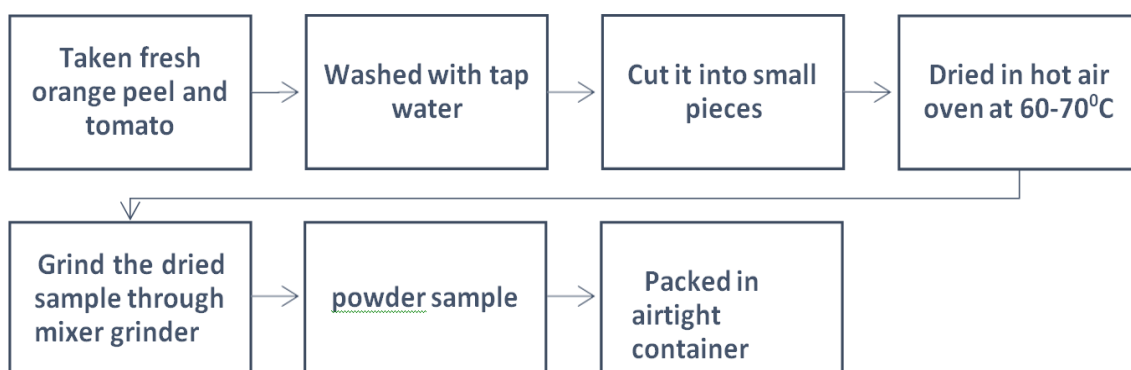


Fig. 1. Flow chart of powder formation of orange peel and tomato



Fig. 2. Food colour extracted from orange peel and tomato

3. RESULTS AND DISCUSSION

3.1 Proximate Analysis of Samples

Proximate composition is a most important factor for ensuring the quality of food and food products. The proximate composition of each sample was done by using different method of analysis. Fruits generally have high moisture content compared to other foods. In this study the percentage of moisture content obtained in orange peel (49.0 ± 0.47) and the percentage of tomato (90.75 ± 0.03), fat percentage of each sample was obtained (3.4 ± 0.14) and (0.24 ± 0.20) respectively both samples show the low percentage of fat. Percentage of protein of each sample was (4.8 ± 0.13) and (2.26 ± 0.05) respectively. Ash percentage of each sample was obtained (4.2 ± 0.17) and (0.18 ± 0.01). Fruits are very good sources of fibre in this analysis percentage of fibre of each sample was (8.3 ± 0.42) and (1.19 ± 0.04) respectively. The obtained result of both samples is also represented in below table.1. Adewale et al., also obtained similar results of proximate analysis of orange peel [21].

3.2 Scanning Electron Micrograph of Samples

SEM micrograph examination was done due to high resolution metallic coating which is used during the preparation of samples. The microstructure of orange peel has rigid, fibrous with sharp edges, represent the foreign particle which is apparently attached on the surface. The surface of orange peel become collapsed. While the microstructure of tomato become fibrous, dense and compact rough structure due to removal of water. According to Comfort Onyeche Ochida et al., SEM analysis of the cells of tomato have become fibrous, dense and rigid [17].

3.3 EDX characterization spectrum

3.3.1 Spectrum 1.

The below spectrum has several visible peaks. The visible peaks confirm the presence of Oxygen, Potassium, Calcium, and platinum in the tested sample (Orange peel).

3.3.2 Spectrum 2.

The below spectrum. The visible peaks confirm the presence of Carbon, Oxygen, Chlorine,

Potassium, and platinum in the tested sample (Tomato).

cell of food. Microstructure is important to understand the mechanism involved during drying of foods. The above micrograph of orange peel shows the surface change of orange peel it become rigid, fibrous with sharp edges, as well as the 2 micrograph shows the physical change in tomato. It became dense, rough with compact structure.

3.4 Scanning Electron Microscope

The above figure 1-2 shows the microstructure of orange peel and tomato various important physical and chemical characteristics of food, changes during drying due to removal of water from inner

Table 1. Proximate composition of orange peel and tomato

Sample	Moisture	Fat	Protein	Ash	Fibre	Carbohydrates
Orange peel	49.0±0.47	3.4±0.14	4.8±0.13	4.2±0.17	8.3±0.42	54.17±1.09
Tomato	90.75±0.03	0.24±0.20	2.26±0.05	0.18±0.01	1.19±0.04	2.26±1.17

Table 2.Elements present in Orange peel

Element	Weight%	Atomic%
O K	76.90	96.69
K K	1.50	0.77
Ca K	0.77	0.39
Pt M	20.83	2.15
Total	100.00	

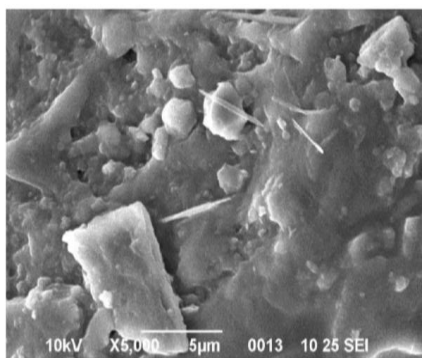


Fig. 3(a). High-resolution SEM image of orange peel

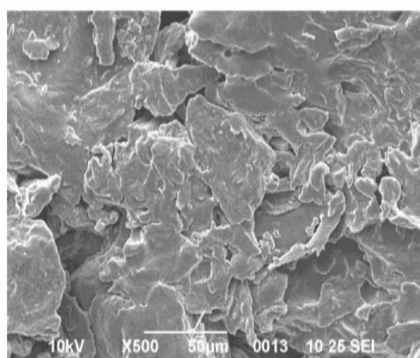


Fig.3 (b) High Resolution SEM image of tomato

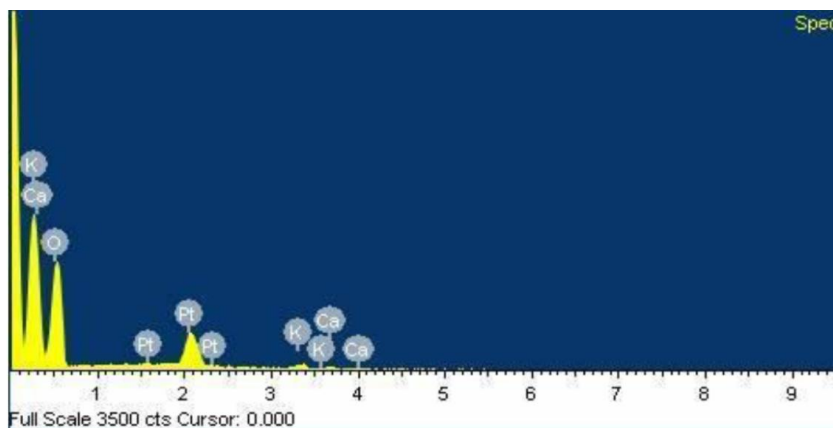


Fig. 4(a) Graphical Representation of Elements present in orange peel

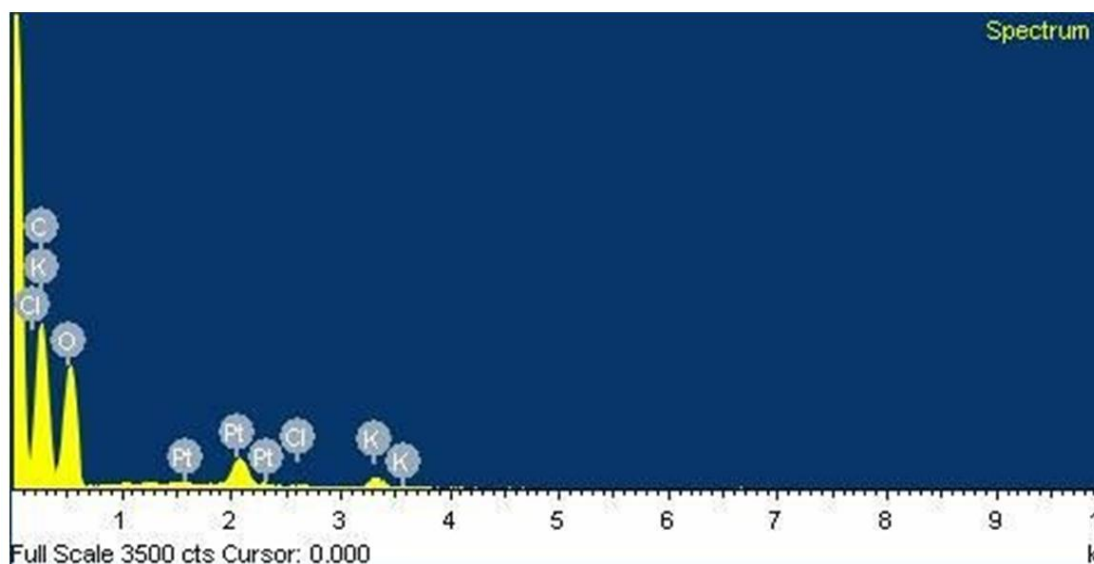


Fig. 4 (b) Graphical Representation of Elements present in Tomato
Table 3. Elements present in Tomato

Element	Weight%	Atomic%
C K	34.63	43.90
O K	57.81	55.02
Cl K	0.30	0.13
K K	1.21	0.47
Pt M	6.04	0.47
Totals	100.00	

EDX analysis was done, during the EDX measurement, after completing EDX analysis corresponding peaks shows in spectrum 1 and 2. In spectrum 1 the quantity of O, k, Ca, and Pt were (76, 1.50, 0.77 and 20.83%) respectively, while the spectrum 2 the quantity of C, O, cl, k, and Pt were (34.63, 57.81, 0.30, 1.21 and 6.04%) respectively. And these values are represented in above table.

4. CONCLUSION

In this study nutritional characteristics of orange peel and tomato were determined, it showed that orange peel and tomato have good source of nutrients and provide relevant information about its consumption pattern. It was concluded from this research that orange peel and tomato both are rich in vitamin C and dietary fibre. The SEM analysis of the samples determined the physical or morphological characteristics. The appearance of orange peel and tomato was changed after drying, and the EDX determination showed the presence of certain elements in tested sample. The use of orange peel powder in food products improved antioxidant capacity, although there

was a reduction in titratable acidity and anthocyanin content. Orange peel used as a by-product in food industry.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

ACKNOWLEDGMENT

The author acknowledges with gratitude the contribution of the faculty of the department of food and nutrition, Babasaheb Bhimrao Ambedkar University, Lucknow. A sincere thanks and a huge number of credits goes to Prof. Sunita Mishra (Dean & Head), School for Home Sciences, Babasaheb Bhimrao Ambedkar

University who aided and provided with all possible resource for completing this research work successfully, secondly, I would like to thank my friends who helped me a lot in finalizing this research work within the limited time frame.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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