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Investigation of Chemical and Physical Analysis of Sweet Pomegranate Peels: A Scientific Analysis (*Punica granatum* L.)

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Abstract

The pomegranate, a highly valued fruit, has valuable components not only in its juicy, crimson arils but also in its often-discarded skin. This seemingly inconspicuous outer layer has a distinctive array of physical and chemical characteristics that elevate it from being considered mere trash. In this study, samples of sweet pomegranate peels (*Punica granatum* L.) with peels, specifically the Wardey (Egyptian Pomegranate), were collected from markets in Duhok, Kurdistan, Iraq. The analyses revealed that the chemical properties of the sweet pomegranate peels included a pH of 4.76, calcium, potassium, sodium, phosphorus content of 335- 145.21-63.12-117 mg/100g, and protein content of 3.14 g/100g. In addition, the analysis showed that the ash content was 3.32%, fat content was 1.68%, fiber content was 10.39%, and carbohydrate content was 69.12%. The physical properties of the samples indicated that the color was pink to light pink, thickness ranged from 2.16 to 3.02 mm, and the odor was reminiscent of tannic acid. The calorie content was recorded as 304.16 kcal/100g, and the moisture content was 12.35%. Furthermore the study's results showed that extracting total polyphenols, flavonoids, and antioxidants using methanol solvent yielded higher contents compared to ethanol solvent. As some of the components exceeded the limits of relevant standards, it is suggested that production techniques for pomegranate molasses should be improved and optimized to maximize their potential benefits.

Keywords; Pomegranate, Fruit peels, Poly phenols, Flavonoid and Antioxidants.

Introduction

The plant grows naturally into tiny trees or deciduous shrubs, producing up to 24 kg of fresh fruit per tree by the time it reaches maturity (5 years old) **(Meletis *et al.,* 2027).** The rind and albedo (peels) typically make up 30–40% of the fruit's fresh weight, with some variation among the over 500 cultivated varieties. The remaining edible portion, which makes up, on average, roughly 52% of the fruit's weight, is made up of 78% juice and 22% kernels (**Sreekumar *et al.,* 2014)**. The key elements influencing customer choice include the color of the rind and aril, juice sweetness, acidity, and astringency, as well as kernel hardness (**Pande, & Akoh, 2016)**.

Pomegranate fruits essential component found in their skins, seeds, arils, and blossoms has been shown to have positive health benefits. Pomegranate peels are unsuitable for human consumption and are extracted during the making of pomegranate juice. The peel of pomegranates is a rich source of flavonoids, tannins, and other phenolic compounds **(Jaiswal *et al.,* 2010 & Mehder., 2012)** . Studies have shown that the peel of pomegranates contains more physiologically active ingredients than the other edible parts of the fruit (**Diamanti *et al.,* 2017 & Sabraoui., 2020)**.

Since ancient times, people have used the pomegranate that thrives in tropical and subtropical climates, as a crop. Malum granatum, which translates as "granular apple" in Latin, is where its name originates **(El Barnossi *et al.,* 2021).** The tree has an extended, smooth-surfaced, green trunk that is twisted and thorny, as well as orange or crimson-colored leaves and flowers. It is very climate-adaptable, with globose fruit that ranges in diameter from 6 to 12 cm. Pomegranate peels range in color from yellow to green to pink, and they may even develop a deep crimson or dark purple **(Holland & Bar-Ya'akov, 2018)**.

The presence of bioactive substances known as "tannins" is what causes these biological actions. Tannins are substances that are found naturally in the kingdom of plants. Because of their astringent properties and capability to form compounds with proteins and polysaccharides, tannins serve primarily as a plant's defense against microbes and animal assaults **(Aguilera *et al.,* 2008)**. Tannins include a vast class of phytochemicals that range in molecular weight from 500 to 3000 Da **(Govea-Salas. 2016).** Complex tannins, condensed tannins, gallotannins, and ellagitannins are the four classes into which they are divided **(Fischer & Kammerer, 2011)**.

The apparent ability of pomegranate peel to heal wounds **(Chidambara Murthy., 2004)**, as well as its immunological modulatory, antibacterial, antiatherosclerotic, and antioxidative qualities **(Tzulker *et al.,* 2007)**, have drawn attention to it. Numerous studies have linked antioxidant activity to a lower risk of developing several illnesses **(Whitley *et al.,* 2003)**. Many plant components are utilized to cure a variety of human illnesses in traditional medicine **(Ibrahium., 2010).** Pomegranates are indigenous to the Mediterranean area, and they are widely utilized in many other nations', including the Indian subcontinent's, traditional medicine. The Latin terms "ponus" and "granatus" are the source of the name "pomegranate." There are around 1,500,000 tons of pomegranates produced worldwide **(Li *et al.,* 2006)**. Pomegranate is one of the most intriguing, colorful, and significant medicinal plants among other plant sources; its fruit, in particular, has several therapeutic applications (**Prakash & Prakash, 2011)**.

This phrase clarifies biological material as trash that can be properly processed and transformed into derivatives that are more valued by the market **(Barreira *et al.,* 2019).** "Food waste" is defined as "food fractions and inedible parts of food" that have been taken out of the logistics of food procurement **(Esparza *et al.,* 2019).** The fruit and vegetable business makes definitions more difficult. Unpalatable vegetable portions that are thrown away throughout the receiving, handling, shipping, and various processing steps are referred to as fruit and vegetable waste **(Fernandes *et al.,* 2019)**. Due to changes in dietary preferences and the expanding population, there has been a substantial growth in the production of fruits and vegetables in recent years, with more individuals choosing vegetarian diets **(Sagar *et al.,* 2018).** However, it is believed that up to 60% of the world's horticultural produce which includes fruits, vegetables, and root crop is squandered **(Swaminathan., 2015).** Roughly 25–30% of waste from fruit and vegetable peels, seeds, and inedible components is attributed to consumption and processing (**Vilariño *et al.,* 2017)**. The objective of study was to determine the physical and chemical properties of peels pomegranates extract and to determine the total phenolic, flavonoid content, and antioxidant activity.

Materials and Methods

Preparation of peels pomegranates extract

Pomegranate (*Punica granatum* L.) fruit samples with peels, specifically the Wardey (egyption Pomegranate), were gathered from markets in Duhok, Kurdistan, Iraq. They were then cleaned with distilled water, dried in an oven (OUMAI) at 50 °C for 48 hours, and stored at -30 °C until needed. Using a grinder, the dry samples were ground into a fine powder. Twenty grams of pomegranate peel powder were soaked in 100 milliliters of solvent (95% ethanol and 75% methanol). The samples were filtered through Whatman No. 1 r filter paper, and the filtrate was stored for later research in a refrigerator at 4 °C. the analysis, using three replicates, of phenolics, antioxidants in extract. Agricultural Engineering Sciences College, Duhok University, provided all analytical reagent-grade reagents, solvents, and standards.

Polyphenols

After making a few minor adjustments, we calculated the total phenolic content according to **(Zardo *et al.,* 2015)**, using the Folin-Ciocalteu reagent and gallic acid (as standard). To determine the total flavonoid concentration, we dissolved each unique extract in one milligram (in duplicate) in five milliliters of distilled water, then separated 0.5 milliliters (also in triplicate) in new tubes. Next, we combined 3.5 ml of extract, 1 ml of Folin-Ciocalteu reagent, and 1 ml of sodium carbonate (20% w/v) in a tube. The mixture should then be carefully mixed and allowed to sit in a water bath at 40 °C for thirty minutes. We measured the absorbance of the generated purple-bluish color at 765 nm using an extract-free control and a UV-Vis spectrophotometer (UV-1800 spectrophotometer, TOMOS).

Flavonoids

Significantly modified the method in **(Meda *et al.,* 2005)**, to determine the total flavonoid concentration of each extract. Five milliliters of distilled water were mixed with one milligram of each extract. Then, 0.5 milliliters of the solution were put into three separate tubes and mixed with 0.5 milliliters of 80% V/V methanol, 50 µl of 1 M potassium acetate, and 1.4 milliliters of water. We then let the tubes stand at room temperature for thirty minutes. We measured the absorbance of the reaction mixture at 415 nm using the quercetin standard curve, enabling us to determine the total flavonoid content.

Phenolic Acids

The concentration of phenolic compounds in extracts was measured in the study by dissolving the extracts in 7:3 ethanol and water or 5:5 methanol and water. Each sample, weighing 0.5 ml, was combined with 2.5 ml of 7.5% sodium carbonate solution and 0.5 ml of ten-fold diluted Folin-Ciocalteu reagents. Using a spectrophotometer, we measured their absorbance at 765 nm after allowing them to stand at room temperature for 30 minutes (**Elfalleh *et al.*, 2001)**.

Antioxidant

To test the antioxidant power, we used the method described in reference **(Choi *et al.*, 2002)** to see how well 2,2-diphenylpicrylhydrazyl (DPPH) could get rid of free radicals. with little alterations. We have created a fresh stock solution of substrate-methanol (0.004% w/v) for every sample, control, and standard curve. We dissolved each sample, including negative controls, in 100 microliters of methanol solution. We then diluted each sample with 3.9 milliliters of methanol stock solution (0.004% w/v). We exerted a strong and energetic effort. We agitated all samples for a duration of 15 minutes at ambient temperature to facilitate the process of color development, and then left them undisturbed in a lightless environment for a period of 30 minutes. Using a UV-Vis spectrophotometer, we quantified the absorbance of each individual sample (including samples, blank, controls, and standard) at a wavelength of 517 nm. We created the reference curve by blotting varying amounts of ascorbic acid. The formula for calculating the proportion of DPPH is given by [100 × (A1–A2)/A2]. A2 represents the absorbance of pomegranate peel extracts, while A1 represents the absorbance of the control.

Results and Discussion

The data in **(Table 1)** shows that the chemical properties value included pH with 4.76 and the type BP 3001/Trans pH meter was used to measure it. This number indicates how acidic the sweet pomegranate solution were contained the minerals such as phosphorous 117% , which Jenway UV-visible spectroscopy determined, calcium (335%), potassium 145.21%, and sodium63.12%, which the flame photometer assessed. The minerals that were discovered to be the most prevalent in them.

In general, it can be said that pomegranate fruit peel powder is rich in the healthiest minerals and is regarded as a healthy source of both macro and micro components. They ought to be used in food fortification as a result. The oven OUMAI used to measure the chemical properties that are the protein at 3.14 % using the Kjeldahl technique, ash at 3.32 % using the Mufel method, fat content at 1.68 % using the Soxhlet method, fiber at 10.39 %, and carbohydrates at 69.12 % using the Jenway UV-visible spectroscopy.

Table 1: Chemical properties of sweet pomegranate (*Punica granatum* L.) peels.

Chemical properties	Amount
PH	4.76
Calcium	335 mg/100g
potassium	145.21 mg/100g
Sodium	63.12 mg/100 g
phosphorous	117 mg/100 g
Protein	3.14 g/100 g
Ash	3.32 %
Fat	1.68 %
Fiber	10.39 %
carbohydrates	69.12 %

The data in **(Table 2)** indicated that the physical properties of sweet pomegranate peels are characterized by a distinct color, ranging from pink to light pink. The thickness of the peels is relatively uniform, measuring between 2.16-3.02 mm. Upon closer inspection, the peels emit a near-tannic acid smell, which is likely due to the presence of flavonoids and other compounds. In terms of nutritional value, sweet pomegranate peels have relatively high calorie content, with 304.16 kcal/100g. Additionally, the peels contain a moderate amount of moisture, accounting for approximately 12.35% of their total composition. which is consistent with our findings **(Padmaja& Prasad, 2011& Elfalleh *et al.*, 2012)**. We extracted the antioxidant phenolic using the following solvents, in order of efficiency: methanol and ethanol. The polarity of solvents may influence the solubility of phenolic and flavonoid chemicals, leading to this arrangement.

Table 2: Physical properties of sweet pomegranate (*Punica granatum* L.) peels.

Physical properties	Amount
Color	Pink to light pink
Thickness	2.16-3.02 mm
Oder (smell)	Near to tannic acid
Calories value	304.16 kcal/100 g
Moisture	12.35 %

The results in **(Table 3)** illustrated that the results of analyzing the total flavonoid, phenolic content, and antioxidant activity of different pomegranate peel extracts using two different solvents: ethanol and methanol. The results show that the methanol solvent extract had significantly higher levels of total phenols 18.03 mg GAE/kg and flavonoids 13.79 mg GAE/kg compared to the ethanol solvent extract 8.87 mg GAE/kg and 3.52 mg GAE/kg, respectively. Additionally, the methanol solvent extract exhibited a higher antioxidant activity of 93.32%, compared to the ethanol solvent extract which had an antioxidant activity of 73.40%. This suggests that the methanol solvent is a more effective extraction method for obtaining bioactive compounds from pomegranate peel, particularly flavonoids and phenolic acids, which are known for their antioxidant properties.

Table 3: Total flavonoid, phenolic content, and antioxidant activity of different pomegranate (*Punica granatum* L.) peel extracts.

Compounds	Ethanol solvent	Methanol solvent
Total poly phenols	8.87 mg GAE/kg	18.03 mg GAE/kg
Flavonoids	3.52 mg GAE/kg	13.79 mg GAE/kg
Antioxidant	73.40 %	93.32 %

Pomegranate peels are a useful addition to meat recipes since they are an excellent source of crude fibers. Studies have shown their ability to decrease blood levels of low-density lipoprotein (LDL) cholesterol, enhance insulin sensitivity and glucose tolerance, lessen hyperlipidemia and hypertension, enhance gastrointestinal well-being, and fend off specific malignancies, including colon cancer **(Lansky & Newman, 2007).**, In addition, they have been used as a stabilizing agent, a volume enhancer, a bulking agent, a lowering agent for fat absorption during frying, and a fat replacement. The powdered pomegranate peel has shown potent antioxidant action when dissolved in water. Pomegranate peels strong antioxidant qualities are a result of its high phenol concentration. Crude extracts and refined fractions of pomegranate peels have potential uses in the food preservation and pharmaceutical sectors, in addition to their possible health benefits.

Conclusions

In conclusion, the study reveals that the peels of sweet pomegranate (*Punica granatum* L.) Wardey (Egyptian Pomegranate) variety exhibit a rich chemical composition, with significant amounts of calcium, potassium, sodium, and protein, as well as a high content of total polyphenols, flavonoids, and antioxidants. The physical properties of the peels, including their pink to light pink color, moderate thickness, and tannic acid odor, also suggest their potential use in various applications. Moreover, the comparison of methanol and ethanol solvents for extracting these compounds shows that methanol is a more effective solvent for extracting these bioactive compounds. Therefore, it is recommended that production techniques for pomegranate molasses be optimized to maximize the utilization of these valuable components, particularly the peels nutrients and bioactive compounds.

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