Varietal Effects on Physiochemical Properties and Polyphenols Distributions in Pomegranate Fruits

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ABSTRACT

Pomegranate production has grown drastically in the past decade with soaring consumer demands for the "superfruit" in California. The *Wonderful* variety constitutes 90% of the commercially available pomegranates. Monoculture poses great risks since crops with similar genotype are highly susceptible to a single disease. The research objective was to study fruit physiochemical properties of five different pomegranate cultivars: *Molla Nepes* , *Parfianka*, *Purple Heart, Vkusnyi*, and *Wonderful*. Fruit parts, lipids, and antioxidant contents were analyzed. Average fruit weights were 259-493g with seed oil contents ranged from 15.23-21.32%. The *Wonderful* possessed the highest antioxidant activities, followed by *Purple Heart*, *Vkusnyi*, *Molla Nepes*, and *Parfianka* cultivars. The results showed that *Purple Heart* had positive attributes similar to *Wonderful* and could potentially be cultivated to diversify the pomegranate market.

INTRODUCTION

Pomegranate (*Punica granatum*) is one of the oldest plants domesticated by human. A myriad of health benefits are associated with pomegranate fruit and juice consumptions. Byproducts from pomegranate juice processing are also excellent sources of bioactive antioxidant and lipid compounds.

California is the largest pomegranate grower in the United States. The industry generates around $117 million annually. More than 90% of the commercial orchards grow the *Wonderful* variety which is the standard cultivar. Monoculture poses a great risk due to the susceptibility of crops with similar genotype succumbing to a single disease and pest. Thus, there is a need to explore other cultivars. Cultivating diverse pomegranate varieties can also attract new consumers for market expansion.

OBJECTIVE

The research objective is to investigate physiochemical characteristics of fruits from four novel pomegranate cultivars (*Molla Nepes, Parfianka, Purple Heart, and Vkusnyi)* that thrive in California soil and to compare them with the standard *Wonderful* variety.

MATERIALS

Pomegranate fruits of five selected cultivars were harvested in early November of 2014 from the United States Department of Agriculture National Clonal Germplasm Repository (Davis, CA).

METHODS

Weigh and separate 7-8 fruits into peel, seed, and juice parts

Dried seed

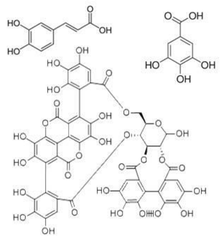
Seed oil extraction and analysis

- Extract oil with hexane
- Analyze fatty acid compositions with GC/MS
- Evaluate oil qualities based on the AOCS Official methods

Dried peel, seed

Phenolic compounds extraction and analysis

- Extract methanol-soluble and bound-insoluble polyphenols
- Estimate total phenolic contents with Folin-Ciocalteau reagents
- Measure DPPH• scavenging activities and Trolox equivalent antioxidant capacity (TEAC)



RESULTS & DISCUSSIONS

Components of pomegranate fruits

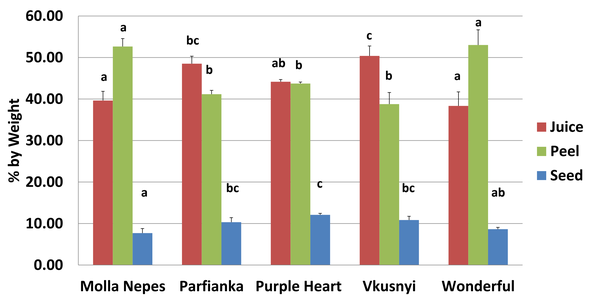


Figure 1. Fruit part distribution

Vkusnyi had the smallest fruits, weighing 259.47±22.50 g on average. *Molla Nepes* and *Wonderful* were nearly twice as heavy as *Vkusnyi* with recorded weights of 493.42±9.22 and 450.38±41.08 g, respectively. *Parfianka* and *Purple Heart* fruits were medium in size, and their average weights were 305.73±39.94 and 367.53±9.35 g. The fruits consisted of 38-50% juice, 39-53% peel, and 8-12% seed (Fig. 1).

Table 1. Proximate compositions of seed and peel

Pomegranate Components	Carbohydrate (% d.b.)	Protein (% d.b.)	Fat (% d.b.)	Ash (% d.b.)
Peel	90.8-91.9	3.1-3.9	1.3-2.3	3.3-4.3
Seed	60.5-71.8	11.4-16.8	15.2-20.6	1.6-2.5

RESULTS AND DISCUSSIONS

Seed oil analysis

Table 2. Chemical characteristics of pomegranate seed oil

Pomegranate Varieties	Oil Content (g/100g dry seed)	Acid Value (mg KOH/g oil)	Peroxide Value (meq. O2/kg oil)
Molla Nepes	21.32±1.86^{a}	5.31±2.67	3.58±0.70
Parfianka	15.23±3.76^{b}	3.55±0.34	3.17±0.39
Purple Heart	17.80±0.58^{ab}	3.58±2.00	3.03±1.14
Vkusnyi	18.97±0.89^{ab}	5.18±2.19	3.83±1.48
Wonderful	17.84±1.02^{ab}	3.66±2.21	2.25±0.06

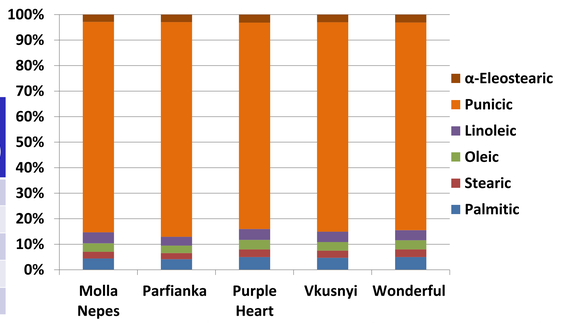


Figure 2. Fatty acid compositions of pomegranate oil

Total fat contents in pomegranate seeds ranged from 15 to 21% (d.b.) (Table 2). Significant variations were only observed between *Molla Nepes* and *Parfianka*. Pomegranate seed oil consisted of 81-84% punicic acid, 4-5% palmitic acid, 3-4% linoleic acid, 3-4% oleic acid, 3% α-eleostearic acid, and 2-3% stearic acid (Fig. 2). No significant differences in fatty acids compositions were detected among the five pomegranate cultivars. Acid and peroxide values were close to or below the standards for unrefined oil .

Phenolic compounds analysis

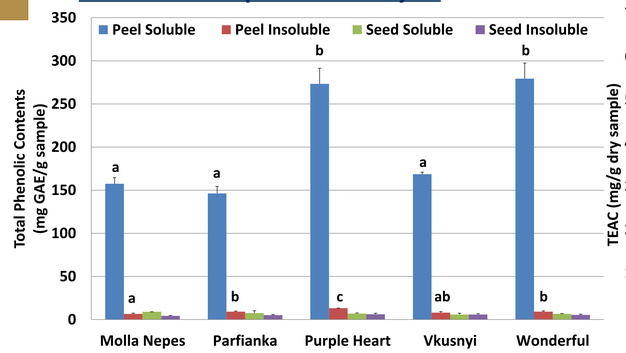


Figure 3 . Distributions of phenolic compounds in pomegranate peel and seed tissues

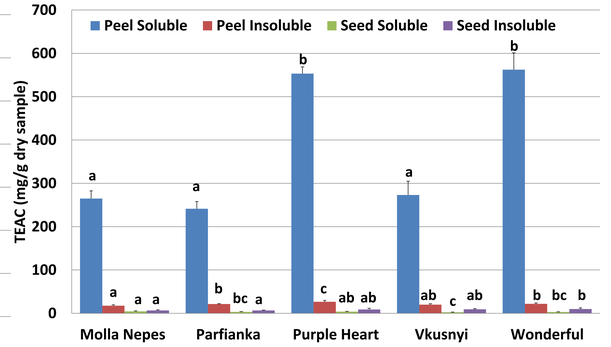


Figure 4. Trolox equivalent antioxidant capability of peel and seed extracts

Polyphenols in pomegranate can exist either as free phenolic acids or as esterified compounds bound to lipid or carbohydrate moieties. Total phenolic contents for peel soluble, peel insoluble, seed soluble, and seed insoluble extracts ranged from 146.29-279.32, 6.61-13.20, 5.86-9.04, and 4.28-6.19 mg GAE/g sample, respectively (Fig. 3). 87-93% of total polyphenols were distributed in the peel soluble fractions. Thus, pomegranate peel was the best raw material for phenolic recovery. Trolox equivalent antioxidant capability assesses antioxidant activity in plant extracts. Peel soluble extracts demonstrated the greatest antioxidant activity, followed by peel insoluble, seed insoluble, and seed soluble extracts (Fig. 4). The *Wonderful* and *Purple Heart* cultivars possessed the highest antioxidant activities. The differences were statistically significant, indicating that these two varieties were superior antioxidant sources compared to *Vkusnyi*, *Parfianka,* and *Molla Nepes*.

In conclusion, valuable lipids and antioxidants could be recaptured from the inedible parts of pomegranate fruits. Oil and phenolic contents were highly dependent on cultivars. While *Wonderful* contained the highest phenolic contents and antioxidant activities, the amount of polyphenols in *Purple Heart* was comparable to the standard variety. *Purple Heart* could be commercially cultivated as an alternative to *Wonderful*.

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