

Variation in Physico-chemical Characteristics of Different Walnut Cultivars Grown in Himachal Pradesh (India)

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Abstract

Walnuts (*Juglans regia* L.) are nutritionally rich finest nut crop of temperate regions having beneficial effect on the human health. Five different walnut cultivars grown in the temperate region of Himachal Pradesh namely; Kotkhai Selection, Govind, Lara, Partap and Maylannise were selected and evaluated for their physical characteristics, nutritional properties and biochemical composition. Among the fruit physical characteristics, the nut length was found in the range of 29.59 – 38.74 mm, nut diameter (26.72 mm-32.82 mm), nut thickness (28.81mm-34.70 mm), nut weight (7.07 g-12.98 g), kernel weight (3.04g-6.70g), kernel ratio (43.26%-51.62%) and shell weight (4.03-6.84 mm). Amongst the nutritional properties and biochemical composition of walnut cultivars, high protein content were observed in Kotkhai Selection (20%), followed by Partap (19%) cultivar. The fat content was found to range between 32.25-56.40%, total carbohydrates 8.09-14.0%, moisture content 2.71- 3.01%, Totalphenol content ranged 32.61-80.00mg/g and Scavenging Antioxidant activity varied between 40-85%. On the basis of aforesaid characteristics, Kotkhai Selection and Partap suitable for cultivation was found to be a superior walnut cultivars in temperate region of Himachal Pradesh, India.

Keywords: *Juglans regia* L., fruit characteristics, biochemical composition, Totalphenol , Antioxidant activity Himachal Pradesh

Walnut (*Juglans regia* L) is an important nut crop and has been regarded as high value and low volume fruit crop. With the increasing problems in apple production resulting due to change in climate scenario, the future success in hill horticulture will lie on the diversification and integration of orchard management techniques. It can be profitably grown in apple growing areas between 1200 to 2150 m amsl with chilling of 700-1500 hrs. Walnut species are important source of nuts

with high nutritional value and high-quality wood (timber) in the temperate zones across the world (Zhang *et al.*, 2009). The edible nuts are enriched with unsaturated fatty acids such as linoleic acid, oleic acid and thus, are of high economic interest to the food industry (Martinez *et al.*, 2008). In addition, walnuts have significant economical value and medicinal importance for human health because of unique sensory characteristics (Lopez *et al.*, 1995), hypocholesterolemic

effects (Savage, 2005; Dogan and Akgulb, 2005; Pereira et al., 2008) and antihypertensive effect (Arranz et al., 2008). Walnut also contains other beneficial components like protein, carbohydrates, vitamins, pectic substances, minerals (Mg, K, P, Cu & Fe), sterols and phytochemicals (Prasad, 2003; Colaric et al., 2006; Ozcan, 2009).

In Himachal Pradesh, there are different walnut cultivars are grow in different districts namely like Shimla, Kinnaur, Kullu, Lahaul and spiti region. There is scanty documented information on the physico chemical characteristics specially antioxidant activity of these cultivars. The present study was therefor conducted to evaluate the fruit characteristics, nutritional properties and biochemical composition of five different walnut cultivars which are widely grown in temperate region of Himachal Pradesh.

Materials and Methods

Walnut fruit sample from five different walnut cultivars namely; Kotkhai Selection, Govind, Lara, Partap and Maylannise were collected from Shimla district of Himachal Pradesh. The storage condition and time until analysis were similar for all the cultivars. There were at least three replication for fruit biochemical analysis and ten repetitions for physical analysis.

Physical analysis

Physical analysis include nut fruit properties viz; nut diameter, nut length, nut thickness, nut shape, nut size, nut weight, shell thickness and kernel properties methods, kernel weight and Kernel ratio which were determined according to the Turkish Standard Institute (TSI, 1990 and 1991). The shape of the nut was determined by the following formula:

$$\text{Nut index} = \frac{\text{Nut Length (mm)}}{(\text{Nut diameter} + \text{Nut thickness}) / 2}$$

Nut index < 1.25 were taken as sphere shape.

Nut index > 1.25 indicate the oval shape of the nuts

- Kernal ratio was determined by the formula:

$$\text{Kernal ratio} = \frac{\text{Kernal Wt. (g)}}{\text{Nut Wt. (g)}} \times 100$$

- Size "extra" for the nuts if,
Nut diameter > 27 mm for sphere
Nut diameter > 26 mm for oval

All these analyses were performed at least for 10 samples from each cultivar.

Biochemical analysis

The fat, protei, per cent moisture, total phenolics contents were determined by the standard AOAC methods (AOAC, 1990). Per cent carbohydrates were determined by difference. Measurement of Radical-scavenging Ability was done according to the method of Yamaguchi et al., (1998). An aliquot of different walnut cultivar extracts (50 mg/mL), α -tocopherol (vitamin E, Sigma, 50 mg/mL), or butylated hydroxytoluene (BHT, Sigma, 50 mg/mL) was mixed with the 100 mM Tris-HCl buffer (400 μ L, pH 7.4) and then added to 500 μ L of 250 mM DPPH in ethanol. The mixture was shaken vigorously and left to stand for 20 minutes at room temperature of $25^{\circ} \pm 2^{\circ}$ C in the dark. The absorbance of the resulting solution was measured at 517nm in a spectrophotometer. The scavenging ability was calculated as follows:

$$\text{Scavenging ability (\%)} = \frac{[(A_{517} \text{ of control} - A_{517} \text{ of sample}) / A_{517} \text{ of control}] \times 100}{}$$

All the parameters were determined at least in triplicate and the results are presented in mean \pm Standard Deviation (SD).

Results and Discussion

The physical properties of selected five different walnut cultivars namely Kotkhai Selection, Govind, Lara, Partap and Maylannise of Himachal Pradesh are presented in Table 1. A perusal of data on the fruit dimension and shape of five walnut cultivars revealed that, maximum nut length (38.74 ± 1.87 mm) was recorded in Partap cultivar while, the minimum (29.59 ± 0.71 mm) in Lara cultivar. The maximum nut diameter of (32.82 ± 1.55 mm) was noticed in Kotkhai Selection while, minimum (26.72 ± 0.92) was found in Maylannise. The nut thickness ranged from 28.81 ± 1.77 mm in Govind to 34.70 ± 1.71 mm in Kotkhai Selection. Nut shape was determined to be spherical for Kotkhai Selection, Lara, Partap and Maylannise while oval for Govind cultivar. On the basis of physical standards laid out by Turkish Standard Institute, the nut size was found to be in the extra category in all the cultivars under study.

The data presented in (Table 1) on the nut characteristics of different walnut cultivars showed that nut weights were in the ranged of 7.07 ± 0.25 g (Maylannise) to 12.98 ± 0.35 (Kotkhai Selection). Kernel weight ranged from 3.04 ± 0.28 g (Maylannise) to 6.70 ± 0.46 g (Kotkhai Selection). Kernel ratio (%) was in the range of 43.26 ± 3.87 % (Maylannise) to 51.62 ± 3.51 % (Kotkhai Selection). Kernel ratios were <50% for Kotkhai Selection, while the rest of the cultivars were >50%. Akca

and Sen (1995) have reported nut length as 39.97 mm, nut diameter as 33.59 mm and nut thickness as 34.75 of the promising walnut genotype. This notion is in agreement with our results. Khattak *et al.* (2000) determined the nut weight (12.30-1.90 g), kernel weight (5.43-8.94 g) and kernel ratio (43-47%) for the four walnut cultivars (Kurrum-1, Kurrum-2, Kurrum-3 and Kurrum-4) grown in Kurrum agency, Pakistan. Ozkan and Koyuncu (2005) have also found variations in different walnut cultivars grown in Turkey. These variations may be attributed to the differences in the ecological and genetic properties of walnut cultivars growing worldwide. The results of the present study indicated that fruits of Kotkhai Selection cultivars exhibited superior physical properties.

Various chemical characteristics of the selected five walnut cultivars are presented in Table 2. Moisture content was found to be in the range of 2.71±0.93% (Kotkhai Selection) to 3.01±0.85% (Lara). Fat content (%) was determined to be in the range of 32.25±0.21% (Maylannise) to 56.4±0.19% (Kotkhai Selection-1). Protein content was in the range of 15.00±0.32% (Maylannise) to 20.00±0.11% (Kotkhai Selection-1). Carbohydrate content was found in the range of 8.09±0.79% (Maylannise) to 14.00±0.61% (Partap). Pereira *et al.* (2008) determined fats (68.83-72.14%), proteins (14.38%-18.03%), carbohydrates (3.75%-7.16) and moisture (3.85-4.50) for the six walnut cultivars

grown in Purtagal. Al-Bachir, (2004) have also reported variation with the moisture content (3.48%), proteins (22.85%), fats (67.35%) and ash (1.26%). The results of the moisture and, fats content are promising with the results of this study but there is variation in term of protein content. These variations can be attributed to the environmental conditions, horticultural practices and genetic characteristics which influence the chemical composition of walnut fruits. The high level of antioxidants in this nut is reported several workers (Arranz *et al.*, 2007; Nwaoguikpe *et al.*, 2012).

Many researchers have reported variable levels of polyphenolic compounds such as Ellagic and Gallic acids; Apart from these, other phenolic acids have been found in walnuts such as phenylacetic acid, a strong antisickling agent such as protocatechoic acid, syringic, vanillic acid and caffeic acid. (Nwaoguikpe *et al.*, 1993). These phenolic acids found in foods have been associated with astringency; discoloration and inhibition of some enzymatic activity. At the same time, They are also known to provide the human body with extra line of defense against bacterial and viral attacks, thereby, boosting the immune system. In the present study phenol content (mg/g) was in the range of 32.61±1.21 (Maylannise) to 80.00±0.91 (Kotkhai Selection). Scavenging Antioxidant activity (%) was found in the range of 40.00±0.97% (Maylannise) to 85.00± 1.25% (Kotkhai Selection). The results of the

Table 1: Fruit physical properties of walnut cultivars

	Kotkhai Sel	Govind	Lara	Partap	Maylannise	Mean ± SD
Nut wt.(g)	12.98±0.35	8.22±1.2	8.51±1.89	12.43±1.23	7.07±0.25	9.84±0.984
Kernal wt. (g)	6.70±0.46	3.82±0.85	4.23±1.57	5.47±1.00	3.04±0.28	4.65±0.832
Shell wt. (g)	6.28±0.51	4.4±0.63	4.28±0.91	6.84±1.00	4.03±0.34	5.17±0.678
Kernal ratio (%)	51.62±3.51	46.27±5.15	48.88±9.21	44.26±8.55	43.26±3.87	46.85±6.05
Nut length	36.07±2.1	36.65±2.04	29.59±0.71	38.74±1.87	29.93±0.91	34.2±4.17
Nut thickness mm	34.70±1.71	28.81±1.77	29.67±0.9	33.04±1.86	29.5±0.92	31.15±2.58
Nut diameter mm	32.82±1.55	28.35±1.61	29.5±1.67	30.97±1.27	26.72±0.92	29.67±2.35
Nut index (Shape)	Spherical	Oval	Spherical	Spherical	Spherical	Spherical
Size	Extra	Extra	Extra	Extra	Extra	Extra

Table 2: Fruit biochemical properties of walnut cultivars

	Kotkhai Sel	Govind	Lara	Partap	Maylannise	Mean ± SD
Fat %	56.4± 0.19	35.70±0.4	34.95±0.37	45.90±0.45	32.25±0.21	41.04±10.03
Crude protein%	20.00±0.11	18.00±0.15	17.00±0.21	19.00±0.14	15.00±0.32	17.80±1.92
Carbohydrates%	8.39±0.34	12.59±0.47	11.59±0.87	14.00±0.61	8.09±0.79	10.93±2.60
Phenol (mg/g)	80.00±0.91	45.16±0.85	40.16±1.30	78.08±1.20	32.61±1.21	55.20±22.23
Scavenging Antioxidant activity%	85.00±1.25	70.00±1.31	75.00±1.08	80.00±1.22	40.00±0.97	70.00±17.68
Moisture	2.71±0.93	2.88±0.81	3.01±0.85	2.76±0.67	2.83±0.62	2.84±0.12

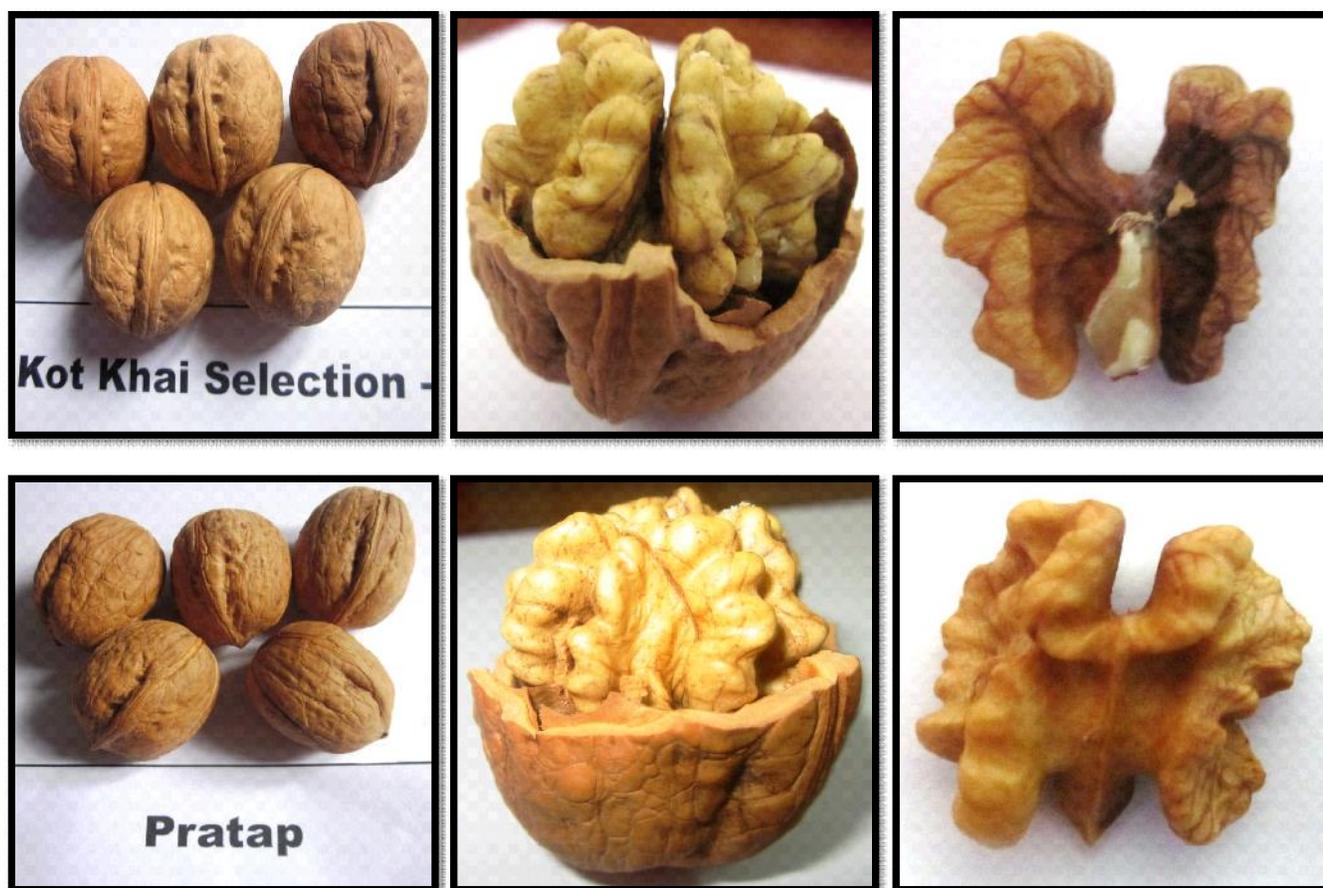


Fig. 1: Nut and kernel characteristics of promising walnut cultivars viz; Kot Khai Selection and Pratap

present study showed that Kotkhai Selection and Partap have exhibited superior biochemical properties than the rest of the cultivars. The physical appearance of nut and kennels of different cultivars is shown in (Figure 1.)

Conclusion

The data indicated that fruits of these cultivars vary greatly in terms of nut weight, kernel weight, kernel ratio, moisture content, protein content, carbohydrates content, energy contents, phenolic content and antioxidant activity. The variability observed in these parameters is due to both genetic and environmental factors which may influence the individual parameter, describing fruit properties, mineral composition and nutritional parameters. further, the kernels of Kotkhai Selection and Partap cultivars were determined to contained high protein content (>18% protein) while Govind and Partap contain high carbohydrates content of >10%. These results will be useful to know about reflect the nutritional properties of the local walnut cultivars that may guide in designing strategies to maximize the utility of walnut germplasm.

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