Chemical composition and antioxidant activity of quince fruit pulp collected from different locations

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**ABSTRACT**

This study was carried out to examine the physicochemical and functional characteristics of quince fruit pulp. The matured quince fruits were collected from different locations of Poonch, AJ&K, Pakistan. Significant differences (P < 0.05) were found among fruits collected from these locations. The quince pulp has the following characteristics: pH (3.43), total soluble solids (14.22°Brix), acidity (1.25%), carbohydrate (13.38 g/100 g), reducing sugar (5.15 g/100 g), non-reducing sugar (4.61 g/100 g), moisture (84.27 g/100 g), ash (0.62 g/100 g), fat (0.24 g/100 g), protein (0.49 g/100 g), fiber (1.65 g/100 g), ascorbic acid (15.46 mg/100 g), and total phenolic (68.13 mg gallic acid equivalent/100 g) and antioxidant activity (50.05%). This exploration is the basic direction, which highlights the nutritional characteristics of quince fruit grown in AJ&K, Pakistan.

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**Introduction**

Quince (Cydonia oblonga) fruit is known with different names, Urdu name “Bahee Dana”, Farsi name “Beh”, Greek name “Strythion”, and Hindi name “Bihi”.¹ It has yellow golden color when matured, harder flesh along with more astringent taste, characteristic aroma, and plano-convex seeds set into two vertical rows.² There are more than 70 genotypes and particular varieties of quince fruit cultivated around the world.³ The most vital varieties are Portugal, Pineapple, Botermo, Spahan, Meeh, Ekmek, Morava, Smyrna, Champion, Van Deman, and Orage.⁴

The quince fruit has significant nutritional characteristics more than many fruits. It is rich in organic acids (citric acid, ascorbic acid, malic acid, aspartic acid, and glutamic acid), mineral elements (phosphorus, calcium, magnesium, iron, and potassium), carbohydrates, fiber, proteins, amino acids, vitamins, and tannins.⁵⁻⁷ It is an essential dietary source of health-promoting compounds (flavonoids and phenolic acids) which contribute antioxidant capacity, anti-ulcerative activities, anti-carcinogenic, anti-inflammatory, anti-allergic, and antimicrobial activities.⁸⁻¹³

The Holy Prophet (PBUH) said: “Eat quince, for it sweetens the heart. For Allah has sent no prophet as His messenger without feeding him on the quince of Paradise”. Hazrat Jabir bin Abdullah (R.A) narrated that Holy Prophet (PBUH) said: “Eat the Quince (Safarjal) because it cure the heart attack and relieves (removes) the burden of the chest”. Hazrat Talha bin Ubaid Ullah (R.A) recited that Holy Prophet (PBUH) said: “Quince makes the breath pleasant, heart strengthen, and relieves (removes) the burden of the chest”.¹⁴

Due to quince fruit astringency, stiffness, and acidity, it is not edible fresh; nevertheless,¹⁵ it is often used to prepare jam, wine, juice, and puree, for liqueur making, and for the extraction of

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aromatic compounds; carbonated syrups, drinks, caramels, and marmalades.\textsuperscript{[16]} Climatic factors mainly rainfall, temperature, light intensity, and relative humidity have great influence on the nutritional quality of fruits.\textsuperscript{[17]} The current study was designed to evaluate the physicochemical and functional characteristics of quince fruit pulp collected from different locations of Poonch district, Azad Kashmir, Pakistan.

**Materials and methods**

This investigation was carried out in the Laboratories of Food Science and Technology Department, Faculty of Agriculture, The University of Poonch Rawalakot, Azad Kashmir. Quince fruits were collected at ripening period from different localities of Poonch district, AJ&K, Pakistan, namely L\textsubscript{1} (Abbaspur), L\textsubscript{2} (Hajira), L\textsubscript{3} (Mandhole), L\textsubscript{4} (Rawalakot), and L\textsubscript{5} (Thorar). The localities were selected according to their geographical regions such as latitude, longitude, and environmental conditions.

| Localities     | Longitude                  | Latitude                  | Environmental conditions          |
|----------------|----------------------------|---------------------------|----------------------------------|
| Rawalakot (L\textsubscript{1}) | 73° 48’ to 73° 80’ E | 33° 51’ to 33° 85’ N | Cold winter, mild summer         |
| Hajira (L\textsubscript{2})   | 73° 53’ to 45.96’ E       | 33° 46’ to 18.12’ N      | Mild winter, hot summer          |
| Abbaspur (L\textsubscript{3}) | 73° 58’ to 38.89’ E       | 33° 48’ to 43.56’ N      | Mild winter, hot summer          |
| Mandhole (L\textsubscript{4}) | 73° 57’ to 36.87’ E       | 33° 40’ to 48.96’ N      | Mild winter, hot summer          |
| Thorar (L\textsubscript{5})   | 33.8474’ N                | 73.6398 E                | Cold winter, mild summer         |

**Pulp extraction**

The pulp of quince fruit was extracted from all collected samples. For the preparation of quince pulp, sound fruits were cautiously sorted and washed to eliminate dust, adhering dirt, and chemical residues and to decrease the bacterial load and then peeled. After the removal of seeds, quince fruits were cut into pieces and then dipped in 1% citric acid solution to avoid browning and grinded to get the pulp extract.

**Physicochemical and functional analysis of pulp**

Quince fruit weight and pulp weight were measured by a digital electronic balance. The pH, total soluble solids (TSS), total acidity, ascorbic acid, reducing sugar and non-reducing sugar, total moisture content, total ash content, fiber content, crude fat, and protein and total carbohydrate contents were measured by a method as reported by The Association of Official Analytical Chemists.\textsuperscript{[18]} Phenolic profile as milligram of gallic acid equivalent (GAE)/g extract was assessed by the method as reported by Singleton,\textsuperscript{[19]} and 2.5 ml of 10% Folin-Ciocalteau's reagent and 2 ml sodium carbonate (7.5%) were added in 0.5 ml of aqueous extract to quince fruit sample. Then, the mixture was incubated at 45°C for 40 min, and spectrophotometric absorbance was measured at 765nm. The antioxidant capacity of the quince sample was estimated spectrophotometrically by following the 2,2-Diphenyl-1-picrylhydrazyl (DPPH) method suggested by Williams.\textsuperscript{[20]} Sample extract of 0.5 ml was mixed with 1 ml DPPH solution and ethanol and kept in dark place for 30 min at room temperature. The absorbance was noted spectrophotometrically at 517 nm, and % antioxidant activity was measured by using the following formula:

\[
\text{DPPH Scavenging activity} \, (\%) = (A_o - A_s / A_o) \times 100
\]

where \(A_0\) is the absorbance of control and \(A_s\) is the absorbance of the sample. The data obtained were statistically analyzed by using two-factor factorial under complete randomized design, and least square design test was used at 5% level of significance.
Results and discussion

Quince is a most popular fruit due to its various nutritional properties ranging from medicinal to dietary utilization. In many technological processes, the physicochemical characteristics play a vital role in maintaining the behavior, nature, fruit quality, and their response to processing and handling of products. The quality of the end product also depends on physicochemical properties of the raw material. In the current exploration, the quince fruit and pulp were analyzed for different physicochemical characteristics such as fruit weight, pulp weight, pH, TSS, total acidity, reducing sugar, non-reducing sugar, fat, protein, ash, moisture, fiber, and carbohydrate content.

Fruit weight is very essential to determine the quality of fruits, its shape, and also its end product. Quality of fruit is recognized by its physical characteristics, such as fruit weight which corresponds to the external appearance and highlighting the size of fruit. [7] In the present study, quince fruit weight and pulp weight were found significant (P < 0.05) among different locations. The pulp weight is an important parameter to study as it greatly affects the yield and economics of end product. On the other hand, a chemical composition of fruit pulp depicts the nutritional, organoleptic, and quality attributes of the end product. [21]

Maximum mean value of fruit pulp was found in L$_5$ (370.0 g), while the minimum value of fruit pulp was found in L$_1$ (265.3 g) as shown in Table 1. The differences in fruit weight and pulp weight of quince may be due to the types of fruit cultivar and the effect of environmental conditions. [21]

pH plays an important role in determining the food properties related to processing, produce products, and well-defined characteristics. In this study, significant effect (P < 0.05) was observed on the pH of quince pulp extracted from fruit collected from different locations. The maximum value of pH was found in L$_2$ (3.44), while the minimum pH was 3.31 in L$_3$ (Table 2). The pH results found in this study are nearly similar to the finding reported by Ali [7] which ranges from 3.3 to 3.6. The highest acidity value was recorded in L$_5$-1.25%, while the minimum value was recorded in L$_3$-1.11% (Table 2). The values of recent investigation for acidity (%) are in accordance with the findings reported by Sharma and Ali [5,7] who stated that acidity% in quince fruit ranges from 1.05% to 1.31.0% and 1.2% to 2.0%.

Moisture content of fruits is very important for determining the keeping quality and freshness of any food products [22]. In the present experiment, maximum moisture content was documented in L$_3$-(84.27%) followed by L$_5$-(84.16%), while minimum moisture content was recorded in L$_4$-(84.04%) followed by L$_2$-(84.09%) (Table 2). The data obtained from the recent experiment are closely similar to the result reported by Sharma and Mir $^{[5,23]}$, who stated 83.91% to 84.29% moisture content in quince fruit. The excellence of many food products depends on the mineral concentration, so it is very essential to determine ash contents during storage because it may affect the nutritional characteristics of food. The statistical analysis showed a highly significant effect (P < 0.01) of locations on the ash% of quince pulp. In the present study, the maximum value of ash content was recorded in L$_5$-(0.62%) followed by L$_3$-(0.56%), while the minimum value of ash content was recorded in L$_1$-(0.42%) followed by L$_4$-(0.44%), respectively (Table 2). This result was similar to the findings reported by Hegedus and Mir$^{[6,23]}$ who stated 0.41% to 0.65% ash content. The variations in ash content might be due to fruit varieties and locations and also dissimilarities in plant genotype, soil, and environmental factor. [24]

The TSS is a major component in the definition of juiciness and harmony of flavors and often used to provide a technological characterization of fruits. [22] Nutritional composition of fruits, especially TSS,

| Treatments | Fruit weight (g) (mean± SE) | Pulp weight (g) (mean± SE) |
|------------|----------------------------|---------------------------|
| L$_1$      | 273.00 ± 8.19D             | 265.33 ± 10.02D           |
| L$_2$      | 290.67 ± 9.07C             | 284.00 ± 13.53C           |
| L$_3$      | 276.67 ± 7.64D             | 272.00 ± 11.14C           |
| L$_4$      | 344.00 ± 12.77B            | 335.00 ± 14.53B           |
| L$_5$      | 378.67 ± 6.51A             | 370.00 ± 10.54A           |

Results are expressed as mean ± SE of replications (n = 3). Means sharing similar letters are statistically nonsignificant (P > 0.05). L$_1$: Locality Abbaspur; L$_2$: Locality Hajira; L$_3$: Locality Mandhole; L$_4$: Locality Rawalakot; L$_5$: Locality Thorar.
Table 2. Chemical analysis of quince fruit pulp.

| Treatments (Locality) | pH (mean ± SE) | Acidity (%) (mean ± SE) | TSS (mean ± SE) | Moisture(%) (mean ± SE) | Ash (%) (mean ± SE) | Fat (%) (mean ± SE) | Fiber (%) (mean ± SE) | Protein (%) (mean ± SE) |
|-----------------------|----------------|-------------------------|----------------|-------------------------|---------------------|-------------------|----------------------|------------------------|
| L1 Abbaspur           | 3.36 ± 0.01B   | 1.13 ± 0.01D            | 13.94 ± 0.02C  | 83.94 ± 0.05C           | 0.42 ± 0.03C        | 0.21 ± 0.02AB     | 1.57 ± 0.03BC        | 0.44 ± 0.02BC          |
| L2 Hajira             | 3.44 ± 0.02A   | 1.21 ± 0.01B            | 14.08 ± 0.01B  | 84.09 ± 0.09ABC         | 0.52 ± 0.02B        | 0.24 ± 0.03A      | 1.65 ± 0.05A         | 0.40 ± 0.03C           |
| L3 Mandhole           | 3.31 ± 0.03C   | 1.11 ± 0.02D            | 14.17 ± 0.02AB | 84.16 ± 0.19AB          | 0.56 ± 0.058        | 0.17 ± 0.02BC     | 1.56 ± 0.01C         | 0.49 ± 0.03A           |
| L4 Rawalakot          | 3.36 ± 0.02B   | 1.17 ± 0.01C            | 14.16 ± 0.12AB | 84.04 ± 0.06BC          | 0.44 ± 0.02C        | 0.21 ± 0.02A      | 1.62 ± 0.02AB        | 0.43 ± 0.02BC          |
| L5 Thorar             | 3.43 ± 0.01A   | 1.25 ± 0.02A            | 14.22 ± 0.02A  | 84.27 ± 0.11A           | 0.62 ± 0.03A        | 0.15 ± 0.02C      | 1.56 ± 0.04C         | 0.46 ± 0.02AB          |

Results are expressed as mean ± SE of replications (n = 3). Means sharing similar letters are statistically nonsignificant (P > 0.05). L1: Locality Abbaspur; L2: Locality Hajira; L3: Locality Mandhole; L4: Locality Rawalakot; L5: Locality Thorar.
increases facts to consumers in terms of identifying more nutritive fruits. In the current study, the maximum value of TSS was recorded in L5-(14.22°Brix) followed by L3-(14.17°Brix) and L4-(14.16°Brix), while the minimum value was recorded in L1-(13.94°Brix) followed by L2-(14.08°Brix) (Table 2). These results are interrelated with the results of Mir,[23] who described 13.9°Brix to 14.26°Brix.

The maximum fat content recorded in quince pulp collected from L2 (0.24%), while the minimum value for L5 (0.15%) (Table 2). Similar results were stated by Forni and Sood.[25,26] Proteins are responsible for important nutritional and technological characteristics[21] of food. Protein content found in quince varied from 0.40% to 0.49%. The maximum value of protein content was recorded in L5-(0.49%), while the minimum value was recorded in L4-(0.40%) (Table 2). The findings are nearly similar to the findings reported by Sood.[26]

Fruits are good source of fiber, which promote digestive health, reduce the gastrointestinal disorders, cardiovascular disease, and cancers.[22] Differences were also observed among different treatments with regard to fiber content, with a variation from 1.56 to 1.65 g. The values found were nearly similar than those cited by Hegedus[6] and cited values of 1.9% of fiber and the value 1.6% reported by Sharma.[5] The variation in chemical composition of quince fruit pulp may be due to different cultivar and the effect of environmental conditions where these cultivars grown.[21]

Relatively higher carbohydrate contents were recorded in quince pulp from L1- (13.38%) and the minimum value in L5- 12.98% (Table 3). The results found in this research was well supported to the finding described by Mahammad.[27] The highest value of reducing sugars was recorded in L4-5.15%, while the minimum value in L1-4.92%. The results are similar to the previous study stated by Sharma and Dar.[25,28] A very small amount of non-reducing sugar was found in quince. The statistical analysis showed a highly significant effect ($P < 0.01$) of locations on the non-reducing sugar of quince pulp. The maximum value was observed in L4-4.61%, while the minimum in L5- 4.36%. The results of the recent experiment are closely related to those presented by Sharma and Mir.[5,23]

Functional components of quince fruit pulp

Quince fruit is rich in phenolic compounds and organic acids, which contribute health-promoting properties such as antioxidant, anti-inflammatory, anti-allergic, anti-bacterial, and anti-carcinogenic capacity. Vitamin C has antioxidant capacity and excellence mark for postharvest shelf life of fruits.[5] Statistical analysis showed a significant effect ($P < 0.05$) of locations on the ascorbic acid of quince pulp. The maximum value of ascorbic acid was recorded in L5-(15.46 mg/100 g) followed by L4-(15.37 mg/100 g), while the minimum value was recorded in L1-(15.14 mg/100 g) followed by L1-(15.23 mg/100 g), respectively (Fig. 1).

The results of the current research are related to the study of Mir.[23] Ascorbic acid concentration can be effected by countless factors such as climatic condition, variety, storage conditions, processing technologies, and harvest practices.[17] Therefore, variation among quince diversities used in this research for ascorbic acid may be influenced by the above factors. The phenolic components play defensive roles against heart diseases and also show the main role in the adulteration control of foods.[7] Total phenolic contents recorded in quince pulp were L1-(65.73 mg GAE/100 g), L2-(68.13

| Treatments | Carbohydrate (%) (mean ± SE) | Reducing sugar (%) (mean± SE) | Nonreducing sugar (%) (mean± SE) |
|------------|------------------------------|------------------------------|-------------------------------|
| L1         | 13.38 ± 0.11 A               | 4.92 ± 0.03 C                | 4.43 ± 0.05 CD                |
| L2         | 13.06 ± 0.10 BC              | 5.02 ± 0.12 BC               | 4.53 ± 0.04 AB                |
| L3         | 13.24 ± 0.16 AB              | 5.12 ± 0.02 AB               | 4.47 ± 0.04 BC                |
| L4         | 13.12 ± 0.11 BC              | 5.15 ± 0.05 A                | 4.61 ± 0.06 A                 |
| L5         | 12.98 ± 0.07 D               | 4.97 ± 0.03 C                | 4.36 ± 0.04 D                 |

Results are expressed as mean ± SE of replications ($n = 3$). Means sharing similar letters are statistically nonsignificant ($P > 0.05$). L1: Locality Abbaspur; L2: Locality Hajira; L3: Locality Mandhole; L4: Locality Rawalakot; L5: Locality Thorar.
mg GAE/100 g), L₃-(66.83 mg GAE/100 g), L₄-(67.33 mg GAE/100 g), and L₅-(68.04 mg GAE/100 g) (Fig. 2). The results of the phenolic contents of recent research are nearly similar to the findings reported by Fattouch. [9]

The highest antioxidant activity was recorded in L₂-(50.05%) and lowest activity was found in L₁-(46.04%) fruit pulp (Fig. 3). Results of the study are similar to the findings by Ali [7]. The substantial
differences in phenolic content and antioxidant activity among fruits from different locations may be due to the differences in plant genotype, orchid, soil conditions, and environmental aspects, as it was previously reported by Franck.[24]

**Conclusion**

The pulp of quince fruit collected from different localities of AJ&K has sufficient nutrients including phenolic compounds and ascorbic acid, which contribute to antioxidant activity although great variation in chemical composition was found among the fruits from different localities. These changes are attributed to the difference in soil and environmental conditions.

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