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Full Length Research Paper

Nutritional and physicochemical studies on fruit pulp, seed and shell of indigenous *Prunus persica*

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In this study, we are reporting for the first time a comparative study of the physicochemical and nutritional values and mineral contents of pulp, seed and shell of the local cultivar of *Prunus persica*, called Chinensis. The percentage of moisture in pulp (87.6) was much higher than that of seed (7.0) and shell (15.0). Seed had highest percentages of ash (3.36), fat (37.7), crude protein (2.7) and carbohydrates (47.4) while for pulp were 0.5, 0.2, 0.6, 9.2 and shell were 0.2, 0.086, 0.078, and 10.5 respectively. The percentage of fiber content was highest in the shell (74.2) which was 2.0 in the pulp and 1.9 in the seed. The pulp, seed and shell all contained higher quantity of potassium than sodium and other estimated minerals. They contained 35, 50 and 30 mg/100 g of potassium respectively while they had almost same amount of sodium (15 to 16 mg/100 g). The seed has highest quantity of zinc (4.3 mg/100 g) while copper was highest in shell (1.0 mg/100 g). The pulp and seed contained almost equal quantity of iron (1.3 mg/100 g) which was much higher than that in the shell (0.04 mg/100 g). The composition of fatty acids in the seed oil was determined by Gas-Liquid Chromatography and palmitic, oleic, linoleic and linolenic acids were found as major components. The seed oil of Chinensis was also compared with that of another indigenous variety, Red Indian, in the acid, iodine, saponification, and ester values, nonsaponifiable matter, free fatty acids, specific gravity, density, refractive index and triglycerides.

Key words: *Prunus persica*, nutritional, physicochemical, mineral studies.

INTRODUCTION

Fruits are an important part of human diet. It has been widely reported that diets rich in fruit and vegetables reduce the risk of chronic disease such as cancer and cardiovascular disease (Arts and Hollman, 2005; Mink et al., 2007). *Prunus persica* L. Batsch, commonly called peach, is a common fruit, and belongs to the family Rosaceae (subfamily Prunoideae). Peach which is known for its nutritional values and therapeutic properties has more than 2,000 varieties found in various parts of the world, which are characterized by their chemical composition that depends on climatic conditions (Chenchenko, 1968).

It is a small deciduous tree 6 to 10 ft tall, with a spreading canopy and is cultivated in plains and hills (Kirtikar and Basu, 1984; Nasir and Ali, 1972). The fruit has yellow or whitish flesh, which is very delicate and easily bruised in some cultivars, but is fairly firm in some commercial varieties. The fruit has a single large seed which is red-brown having oval shape (Huxley, 1992; Babu, 2004; Allardice, 1993). In Pakistan, peach is mainly cultivated in Peshawar, Swat Valley, Kohistan, Kalat and Quetta and occupies the area of 4543 ha with the production of 48284 tonnes (Anonymous, 2101). Although, many studies have been conducted on chemical and therapeutic aspects of peaches (Gilani et al., 2000; Moriguchi et al., 1990), very limited data is available about the local cultivars of Pakistan. The purpose of the present work was to analyze the physic-chemical and nutritional parameters and mineral elements contents of the pulp, seed and shell of the local cultivar of *P. persica,* called Chinensis. The seed oil of Chinensis cultivar of peach was also compared with that of another indigenous variety called red Indian in a number of parameters such as acid, iodine, saponification, ester, and INS (from iodine and saponification) values, nonsaponifiable matter, free fatty acids, specific gravity, density, refractive index and triglycerides.

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Table 1. Analysis of oils from Chinensis and Red Indian varieties of Peach.

Physicochemical values	Chinensis	Red Indian
Acid value	0.560	0.839
Iodine value	99.883	90.260
Saponification value	189.268	208.198
Non saponifiable matter	0.1823	0.2454
Free fatty acid	1.301	1.375
Specific gravity	0.9075	0.9073
Density	0.8698	0.8696
Refractive index	1.4623	1.4621
Ester value	188.708	207.359
INS value	89.385	117.938
Triglycerides	99.704	99.597

EXPERIMENTAL

Peach samples

The peaches Chinensis and Red Indian, cultivated in Swat valley, were purchased from the local market of Lahore in June 2008, and were identified by the taxonomists of Government College University, Lahore, Pakistan.

Instruments and chemicals

Physiochemical assays were carried out using standard methods. The refractive index of oils of two varieties of peach was determined by using Abbe's refractometer 3T. The fatty acids in the oils of the samples were identified using Schimadzu GC 14-A Gas-Liquid Chromatograph. For element determination, Varian Model AA240 Atomic Absorption Spectrometer was used. All the chemicals used were of analytical grade.

Moisture content

The moisture content in the pulp, seed and shell of Chinensis peach was determined by using AOAC (2002) method. The samples of the pulp, seed and shell of the peach were heated in an oven at 100°C for 6 h, and the percentage of moisture was calculated on the basis of the loss of the mass as a result of heating (Table 2).

Ash content

The ash content was of the pulp, seed and shell of Chinensis peach was determined by using AOAC (2002) method. 2 to 3 g of oven dried samples were burnt in a muffle furnace at 550°C temperature for 10 to 12 h until white ash was obtained, which was used to calculate the percentage of ash (Table 2).

Determination of fiber content

Finely ground and dried samples (1 g) of the pulp, seed and shell were put in three different flasks. To each flask 50 ml of 1.25% sulfuric acid was added, and the mixture was refluxed for half an hour. Then, the extract was filtered and the residue, after washing with 200 to 300 ml hot water, was put in 50 ml of 1.25% sodium hydroxide solution and refluxed for half an hour. The content was filtered and washed with 200 to 300 ml hot water. The residue was dried in an oven and burnt to ash in a furnace. The ash was weighed, and the percentage of fiber content was determined for each sample (Table 2).

Crude protein content

The crude protein was determined by Kjeldahl method. The samples of pulp, seed and shell of Chinensis peach were ground into fine powder and de-moisturized in an oven. Defatted samples (0.25 to 0.50 g) were taken for protein determination, and placed in a long neck flask containing 20 ml of concentrated sulfuric acid and 2 g of catalyst consisting of potassium sulfate, copper sulfate and selenium dioxide (9: 1: 0.02). Then samples were digested at high temperature, until transparent solution was obtained. After digestion the flasks were cooled and distilled water was added to make the volume up to 100 ml. Then 10 ml of this solution was added to the Kjeldahl flask, along with 20 ml of NaOH solution. Distillation flask containing $KMnO_4$ was heated and the librated nitrogen in the form of ammonia was absorbed in the receiving end in 10 ml of boric acid that contained methyl red as an indicator. Then, the boric acid solution was titrated against a base and the percentage of protein was accordingly calculated (Table 2).

Determination of fat content

The fat/oil was extracted by using Soxhlet apparatus. The finely ground samples of the pulp, seed and shell were heated in an oven at 100°C for 4 to 5 h in order to remove moisture. Then 2 to 3 g of each was packed in a pre-weighed, oven-dried thimble. The thimbles were stapled and placed in a Soxhlet apparatus, and extracted with n-hexane. After 12 to 14 h, thimbles were removed and allowed to dry in air, and then in oven. The pins of thimble were removed before weighing. The percentage of the fat was determined on the basis of the loss of weight of the samples (Table 2).

ANALYSIS OF THE OILS OF CHINENSIS AND RED INDIAN PEACHES

The fat content obtained from the seeds of the two varieties of peach, Chinensis and Red Indian, were subjected to various analyses. The details are given below:

Table 2. Nutritional parameters in pulp, seed and shell of Chinensis Peach (%).

Parameter	Pulp	Seed	Shell
Moisture	87.647	6.968	14.979
Ash	0.506	3.361	0.245
Fat	0.232	37.693	0.086
Fiber	1.994	1.856	74.155
Crude protein	0.602	2.677	0.078
Carbohydrates	9.228	47.445	10.457

Acid value: Acid value is the mass of potassium hydroxide in milligrams which is required to neutralize 1 g of oil. It is a measure of the amount of carboxylic acids in the oil. The oil sample (5 g) was neutralized with 100 ml ethanol, and was titrated with KOH using phenolphthalein as an indicator. The acid value was calculated using the standard procedure (Table 1).

Iodine value: Iodine value of an oil is the amount of iodine in grams which is consumed by 100 g of the given oil. It is a measure of the degree of unsaturation of fatty acids in the oil. The oil sample (0.25 g) was taken in iodine flask, to which 15 ml of carbon tetrachloride and 25 ml of Wij's solution were added. After keeping the solution in dark for one hour, 15 ml of 10% KOH, and 100 ml distilled water was added.

The liberated iodine was titrated against 0.1 N $Na_2S_2O_3$ solution, using freshly prepared starch solution as an indicator. The titration was continued till the disappearance of blue colour. Similar process was carried out for the blank.

The Iodine value was calculated using the standard procedure (Table 1).

Free fatty acid: To 2 g of oil, 25 ml neutral ethanol was added and the resulting solution was titrated against KOH using phenolphthalein as an indicator, and the value of free fatty acid was calculated (Table 1).

Saponification value: Saponification value of an oil represents the number of milligrams of potassium hydroxide or sodium hydroxide required to hydrolyze 1 g of the oil and is a measure of the average molecular mass of fatty acids found in the given oil. The oil (3 g) was mixed with 25 ml of 0.5 N KOH in a flask. Equal volume of solution was added into another flask for blank titration. Both the flasks were refluxed for two hours, allowed to cool to room temperature, and titrated against HCl solution using phenolphthalein as indicator. The saponification value was calculated and reported in Table 1.

Nonsaponifiable matter: The oil (4 g) was mixed with 50 ml of 0.5N alcoholic KOH solution in a round bottom flask and refluxed for 2 h on water bath with frequent shaking.

Then after adding 30 ml distilled water, the mixture was transferred to a separating funnel. The nonsaponifiable matter was extracted with diethyl ether and washed first with alkali solution, then with water.

The ether was distilled of on water-bath, the residue was weighed and the percentage of nonsaponifiable matter calculated (Table1).

Saponifiable matter: Both free fatty acids and triglycerides are present in saponifiable matter. The percentage of free fatty acids was determined using acid and saponification values:

% of free fatty acids = (Acid value × 100) / saponification value

The percentage of triglycerides is determined by abstracting the percentage of free fatty acids from 100. Similarly, the percentage of the saponifiable matter was calculated using the formula (Table 1):

% of saponifiable matter = (Acid value + triglyceride value) × 100

Ester value: The ester value was calculated by abstracting acid value from saponification value. It gave the percentage of triglycerides as a saponifiable matter (Table 1).

INS value: INS stands for iodine and *s*aponification, and INS value is the difference of saponification value and iodine value of an oil. It thus, relates to the molecular size of the oil and its degree of unsaturation. The INS values of the oils from the varieties of peach are given in Table 1.

Fatty acids: Palmitic acid, oleic acid, linoleic acid and linolinic acid were identified in both samples of peach oil.

Determination of minerals

For the determination of minerals, the samples of pulp, seed and shell of Chinensis peach were demoisturised in an oven at 102°C. Then the samples were burnt to ash in Muffle furnace at 550°C. The ash obtained was weighed and 5 ml of concentrated nitric acid was added. After boiling the sample for 10 to 15 min, the solution was filtered and the filtrate was diluted up to 100 ml with distilled water. In this way the stock solution was prepared. The minerals in the stock solution were determined by Atomic Absorption Spectrometry with the standard methods. The results are given Table 3.

RESULTS AND DISCUSSION

In the present investigation, the fruit pulp, seed and shell of a well known indigenous variety of peach, namely, Chinensis were subjected to various physicochemical and nutritional assays. These include moisture, ash, fat, fiber, protein and carbohydrate contents. The mineral content (sodium, potassium, zinc, copper and iron) was also determined.

The oils from the seeds of Chinensis and Red Indian varieties were extracted and their physiochemical characteristics were determined. These include acid, iodine, saponification, ester and INS values, free fatty acids, triglycerides, and nonsaponifiable matter, and physical properties such as specific gravity, density and refractive index. The results obtained are shown in Tables 1, 2 and 3.

Table 3. Mineral elements in pulp, seed and shell of Chinensis Peach (mg/100 g).

Minerals	Pulp	Seed	Shell
Sodium	16	16	15
Potassium	35	50	30
Zinc	0.69	4.3	1.3
Copper	0.12	0.06	0.99
Iron	1.35	1.30	0.04

Moisture content

It is obvious from the results that peach pulp, quite understandably, had more moisture (87%) than shell (15%), and seed (7%). The moisture content matches very well with the corresponding assay of a peach sample by Zhong et al. (2004). On the other hand, Loew (1948) reported 9.5% moisture content in a dried peach pits, while its kernel contained 7.6% moisture. Salem et al. (1974) reported the moisture content 3.1% in the seed of their peach sample. Thus, it may be inferred that different peach samples may have different moisture levels depending upon the nature of the variety and the prevailing climatic conditions.

Amount of ash

The amount of ash in seeds (3.361%) was higher than that of the pulp (0.506%) and shell (0.245%). It may be noted that amount of the ash content in pulp is almost double of that in the shell. Wahhab and Khan (1956) carried out analysis of ash of “Desi” and 6-A varieties of peaches and reported their mineral contents. The studies suggest that peach seeds contain higher content of minerals than pulp.

Fiber content

The fiber content of peach pulp, seed and shell were determined to be 2.0, 1.86 and 74.2% in respective parts. The overall peach dietary concentration is excellent and according to Grigelmo et al. (1999) is a valuable ingredient for food industry. Peach dietary fiber has high water holding capacity.

Protein content

The crude protein content of peach pulp, seeds and shell was determined by Kjeldahl method. The amount of protein was negligible in shells (0.08%); the amount in pulp was 0.6% which matches quite well with the pulp of Chinensis peach Moreover, the protein content of seed of peach reported by Alper (1918), and Salem et al. (1974) are quite close to the protein content in the present determination. The difference in the protein content varied from variety to variety, and could also be attributed to climatic conditions prevalent in different environments.

Carbohydrate content

Carbohydrate content of peach pulp, seeds and shells were analyzed. Peach seeds have highest amount of carbohydrates. The amount of carbohydrate in seeds was 47.45% in pulp 9.23% and in shells 10.46%. Saleem et al. (1974) reported total carbohydrate content in peach that was 15.59%. Bregadze et al. (1962) reported that carbohydrate contents in apricot and peach were almost same; they were 9.11 and 9.69% respectively. The carbohydrate of peach contains glucose, sucrose and fructose that are important energy sources.

Fat content

The fat (oil) content of peach varied in shell (0.09%), pulp (0.23%) and seed (37.7%). Obviously peach seed is a better source of oil. Several workers have also reported oil contents in different peach samples which showed variations (43.8, 42.3 and 45.5%) (Bush and Cogan, 1947; Loew, 1948; Alpers, 1918)

Mineral content

Peach pulp, seeds and shells of Chinensis peach were subjected to mineral analysis by atomic absorption spectroscopy; the results are presented Table 3. It was observed that potassium and sodium were in higher amounts, while iron, zinc and copper were in small quantities. It has been observed that in most of peach varieties sodium is absent but in peach Chinensis its amount was considerable that was 16 mg/100 g in pulp and seed, while shells contained 15 mg/100 g of sodium.

Analysis of oils of Chinensis and Red Indian peaches

The oils from the seeds of Chinensis and Red Indian

peaches were compared in various analytical parameters. The acid value of oil of Red Indian (0.839) was higher than Chinensis (0.560). Bush and Cogan (1947) reported the acid value 0.67%, which is comparable to our values. However, Gupta et al. (1968) reported the acid value as 4.46% which is very high. The acid value, thus, varies from variety to variety, and may also depend on environmental factors.

The iodine value of oils of Chinensis (99.883) was higher than the other variety Red Indian (90.260). These are comparable with the values reported for other varieties (Gupta et al., 1968; Loew, 1948; Bush and Cogan, 1947; Violante, 1965). The small variation in reported iodine values may be attributed to the nature of the variety and environmental conditions of the different region.

The saponification value of oils for the variety Chinensis was 189.268 and for Red Indian 208.198. While Chinensis has value comparable to those reported by Gupta et al. (1968), Loew (1948), and Bush and Cogan (1947), but Red Indian has higher value. The percentage of nonsaponifiable matter for Chinensis was 0.1823 and for Red Indian 0.2454. The percentage of free fatty acid was 1.301 for Chinensis and 1.375 for Red Indian variety.

The percentage of triglyceride was 99.704 for Chinensis and 99.597 for Red Indian. The ester value of Red Indian was higher (207.359) than that of Chinensis (188.708). Red Indian variety has INS value 117.938, which is lower than that of Chinensis variety (188.708).

The composition of fatty acids in the oils was determined by Gas-Liquid Chromatography. The major fatty acids were palmitic acid, oleic acid, linoleic acid and linolenic acid. Gupta et al. (1968) got the same fatty acids along with myristic, stearic and arachidic acids. Thus peaches have both saturated and unsaturated fatty acids.

The specific gravity of the oil of Chinensis (0.9075) was slightly higher than that of the other variety (0.9073). It was measured at 32°C. Gupta et al. (1968) reported specific gravity 0.9024 at 30°C, which is close to our values. The densities of oil of Chinensis and Red Indian were 0.8698 and 0.8696 respectively, which are lower than the values reported for other varieties (Loew, 1948; Bush and Cogan, 1947). Refractive index of the oil of Chinensis (1.4623) was slightly higher than that for Red Indian (1.4621) at 32°C, which are close to the reported values.

Conclusion

Analyses showed that Peach fruit has good nutritional values. Peach pulp had more moisture than shell and seed. The amount of ash in seeds was higher than that of the pulp and shell. The fiber content of peach shell was considerably high. The amount of protein was negligible. Peach seeds have high amount of carbohydrates and fat content. Potassium was in higher amount, while iron, zinc and copper were in small quantities. The amount of sodium was relatively high. The oil from the seeds of Red Indian has higher acid, and saponification values than that of Chinensis. Red Indian also has higher amounts of nonsaponifiable matter, glycerides and free fatty acids. On the other hand, Chinensis has higher iodine value.

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