Plant Archives Vol. 24, No. 2, 2024 pp. 2636-2640 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org

DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2024.v24.no.2.376

PHYTOCHEMICAL CONSTITUENTS OF FIG (*FICUS CARICA* L.) CULTIVARS AFGHAN, DEANNA AND BROWN TURKEY

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(Date of Receiving-16-04-2024; Date of acceptance-03-07-2024)

ABSTRACT

The present study was conducted on the phytochemical properties in Fig cultivars *viz*., Afghan, Deanna and Brown Turkey. The highest fruit weight (49.97 g) was recorded in the fig cv. Brown Turkey followed by Deanna (43.53 g). Total soluble solids were higher in Brown Turkey (18.2°Brix). The total phenols were found to be higher in Brown Turkey (172 mg GAE/100 g) followed by Afghan (130.75 mg GAE/100 g). The highest total flavonoids (16.25 mg/100 g) were recorded in Brown Turkey. Afghan recorded high total tannins (6.55 mg CE/g). The highest antioxidant inhibition of 50.36% was recorded in Afghan as compared to Brown Turkey (20.43%). The total anthocyanin content was high in Brown Turkey (5.29 mg C3G/100 g). The experimental results showed that Brown Turkey fig recorded with higher values for phenols, flavonoids, anthocyanins and antioxidants compared to Afghan and Deanna.

Key words : Fig, Phytochemicals, Antioxidants, Flavonoids, Tannins, Anthocyanins.

Introduction

Fig is botanically called as *Ficus carica* L. It belongs to the mulberry family, Moraceae. It originated in the Middle East and western Asia. It is one of the earliest fruit crops domesticated by mankind. In India, fig is cultivated in 5,600 hectares with a production of 13,802 thousand tonnes and productivity of 12.32 tonnes per hectare. It is commercially cultivated in Maharashtra, Gujarat, Uttar Pradesh, Karnataka and Tamil Nadu. Botanically, the fig fruit is called syconium. The edible fig species contains latex in parenchyma cells (Lazreg-Aref *et al*., 2012). The fruits are highly valued for their nutraceutical properties and health benefits. Fruits have laxative and antioxidant properties. They also aid in maintaining the body's acid-alkaline balance. A hundred gram of fresh fruits contain 20 g of carbohydrates, 1.02 g of protein, 1.86 mg of vitamin C, 2.10 g of fibre, 104.2 mg of calcium, 0.725 mg of iron (Vora *et al*., 2017). Besides these minerals, figs are also rich source of sugars predominantly fructose and glucose (Caliskan and Polat, 2011; Genna *et al*., 2008). The fresh fig fruits contain 18.25-23.4 per cent TSS and 0.14-0.29 per cent of acidity (Simsek, 2009).

Polyphenols contribute taste, colour and nutritional quality of fig fruits. Rutin is a major phenolic compound present in fig fruits (Veberic *et al*., 2008). Polyphenols and anthocyanins are associated with antioxidant activities (Ishige *et al*., 2001) which have antihyperglycemic, hepatoprotective and antispasmodic activities. Fig antioxidants boost plasma antioxidant capacity and protect plasma lipoproteins from oxidation. Phenolic compounds, flavonoids, ascorbic acid, lignin, xanthones and stilbenes are associated with the prevention of chronic diseases in humans (Hemmami *et al*., 2023). Phytochemicals control immunological and inflammatory responses, decrease the growth of cancer cells and prevent lipid oxidation. The research results on the comparative analysis of phytochemicals present in fig cultivars are meagre. Hence, the present study was conducted to estimate the phytochemical constituents such as total phenols, total flavonoids, tannins, total anthocyanins, antioxidant inhibition, acidity, carotenoids and ascorbic acid in fig cultivars namely, Afghan, Deanna and Brown Turkey.

Materials and Methods

Fig fruits

The study was conducted at Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu from 2021 to 2023. The fig cultivars *viz*., Afghan, Deanna and Brown Turkey harvested from Fruit block of Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. The fruits were harvested at their fully mature stage. The analysis of phytochemical constituents was carried out as per the standard procedures.

Titratable acidity

The titratable acidity was determined by the volumetric method. 5 ml of filtered sample extract was mixed with a drop of phenolphthalein indicator and titrated against 0.1 N NaOH solution till the appearance of pink colour. The titratable acidity of the fruit was expressed in per cent.

$$\text{Titratable acidity (\%)} = \frac{\text{Titrate value} \times \text{Equivalent weight of acid value (citric acid)} \times \text{Volume made upto} \times 100}{\text{Weight of sample} \times \text{Aliquot taken}}$$

Total phenols

Total phenol content was measured as per the procedure given (Slinkard and Singleton, 1977). 0.5 ml of fruit sample was combined with 0.5 ml of Folin-Ciocalteu's phenol reagent and incubated for five minutes at room temperature. Then 2 ml of 20 per cent sodium carbohydrate was added into this solution. The solution was kept in a water bath for 10 minutes. The absorbance was recorded at 765 nm using a UV spectrophotometer. Total phenols were estimated using pyrocatechol as a standard. The total phenol content was calculated by comparing the absorbance against the standard response curve generated using gallic acid. The results were expressed as mg gallic acid equivalents (GAE) per 100 g.

Total flavonoids

Flavonoids were estimated using quercetin as a standard. 0.5 ml of fruit extract was mixed with 0.3 ml of 5% sodium nitrate solution and incubated for 3 minutes. The mixture was added with 0.3 ml of 10% aluminium chloride and 2 ml of 1 M sodium hydroxide solution. After six minutes of incubation, the absorbance was measure at 415 nm using a spectrophotometer. The total flavonoids were expressed as mg quercetin equivalent (QE) per 100 g.

Total tannins

The Folin - Denis method was followed to determine the total tannins. 0.5 ml of fruit extract was mixed with 0.5 ml of Folin - Denis reagent and 1 ml of sodium carbonate solution. The absorbance was recorded at 700 nm using a spectrophotometer. Total tannins were expressed as tannic acid equivalent (TAE) per g.

Total antioxidants

The antioxidant activity was determined by the DPPH scavenging method. The total antioxidant was measured as per the procedure of Brand Williams method. One gram of fruit extract was mixed with 10 ml of 99% methanol and centrifuged at 5,000 rpm for 15 minutes. 3 ml of supernatant was mixed with 1 mil of 1 M DPPH (2,2-diphenyl-1-1-picrylhydrazyl). The solution was made up to 10 ml and kept in darkness for 30 minutes. The absorbance was recorded at 517 nm using a spectrophotometer. The total antioxidant capacity was expressed as radical scavenging activity (%).

$$\text{Radical scavenging acitivity (\%)} = \frac{A_o - A_s}{A_o} \times 100$$

Where, A_o - Absorbance of control, A_s - Absorbance of fruit sample

Total anthocyanins

The total anthocyanins present in the fruits were estimated by following pH differential method. The absorbance was measured at 520 and 700 nm in buffers at pH 1.0 and pH 4.5 using 0.2 M hydrochloric acid and sodium acetate (1 M) buffers where A = (A_{520} - A_{700}) pH1.0 – (A_{520} - A_{700}) pH 4.5. The total anthocyanins were expressed as µg cyanidin-3-rutinoside per g (mg C3G/100g).

Total carotenoids

5 mg of the sample was added to petroleum ether: acetone mixture (3:2) and centrifuged. The absorbance was measured at 450 nm using a UV spectrophotometer. The total carotenoids of the fruits were expressed in mg/ 100 g.

Ascorbic acid

5 ml of filtered fig fruit extract was mixed with 10 ml of 4% oxalic acid solution. It is titrated against 2, 2-diclorophenol indophenol dye. The ascorbic acid of the fruits was expressed in mg/100 g.

Statistical analysis

Statistical analysis of data was performed using AGRES software. The data was analysed using ANOVA at 5 per cent level of significance.

Results and Discussion

The data collected from two seasons were collected and mean values are presented. The physical characteristics of the fruits differed significantly among the cultivars (Table 1). The higher individual fruit weight (49.97 g) was recorded in the fig cv. Brown Turkey followed by Deanna (43.53 g) and Afghan (41.35 g). The fruit weight of 30.88 - 56.29 g and fruit length of 3.19-4.18 cm were reported in fig fruits (Simsek, 2009). The fruit length (5.83 cm) and the fruit diameter (5.71 cm) were higher in fig cv. Brown Turkey. The fruit length and the fruit breadth were higher in fig cv. Brown Turkey.

Titratable acidity and total soluble solids were found to be higher in fig cv. Afghan (0.22% and 16.3°Brix) and lower in Deanna (0.13% and 14.2°Brix). Similar results of titratable acidity (0.29%) (Kaul *et al*., 2018) and TSS (18.25-23.4%) in fig fruits were reported (Simsek, 2009). The major organic acid present in fig is citric acid. Organic acids act as substitutes for respiration and get converted into sugars during maturation and ripening (Paul *et al*., 2012). The increase in total soluble solids of fig fruits with advancing maturity could be due to the conversion of starch and other carbohydrates into soluble sugars (Sable and Waskar, 2020). The fruit quality parameters depend on the cultivars and ripening period (Polat and Caliskan, 2008). The fruit quality can also be improved with the application of farm yard manure (Mordogan *et al*., 2013). These physical properties of the fruits facilitate in determining and designing of equipments and machineries for processing and value addition.

Table 1 : Physical characteristics of fresh Fig fruits cv. Afghan, Deanna and Brown Turkey.

Varieties	Weight (g)	Length (cm)	Diameter (cm)
Afghan	41.35	4.73	4.28
Deanna	43.53	5.32	4.89
Brown Turkey	49.97	5.83	5.71
Mean	44.95	5.29	4.96
SEd	0.67	0.70	0.53
CD (p=0.05)	1.65	1.72	1.31

The phytochemical properties namely, total phenols, total flavonoids, tannins, antioxidants, total soluble solids, titratble acidity, total anthocyanins, total carotenoids and ascorbic acid of the fig cultivars were estimated. From the present study, it is clear that the three fig cultivars represent a range of total phenols and total flavonoids content (Table 2). Total phenols were found to be higher in fig cv. Brown Turkey (172 mg GAE/100 g) followed by Afghan (130.75 mg GAE/100 g) and Deanna (108.75 mg GAE/100 g). Similarly, the highest total flavonoids (16.25 mg QE/100 g) were recorded in Brown Turkey while Deanna recorded the lowest flavonoids (11.25 mg QE/100 g). Phenols are the most potent antioxidants (Caliskan and Polat, 2011) as they act as free radical scavengers and absorb oxygen radicals. Both dark and brown coloured fig cultivars possess considerable amounts of phenols and flavonoids (Solomon *et al*., 2006). The application of calcium also increases phenolic content.

The astringency of fig is due to the presence of tannins which promote rapid healing and the formation of new tissues. The total tannins were higher in fig cv. Afghan (6.55 mg CE / g) compared to the other two varieties. The dark coloured fig cultivars have high antioxidants than light coloured cultivars. The results of antioxidant capacity of fig cultivars were presented in Fig.1. The highest antioxidant inhibition of 50.36% was recorded in Afghan as compared to Brown Turkey (20.43%). Similar results of antioxidant (68.48%) in fig cv. Azenjar were recorded (Meziant *et al*., 2014).

The colour of the fig flesh was due to the relative concentrations of pigments namely anthocyanins and carotenoids. The fruit peel colour in fig was strongly influenced by the total anthocyanin content. Reddish-purple to blue colour of many fruits and vegetables is due to the presence of anthocyanin pigments. The anthocyanin pigments are water soluble and have been used as natural

Table 2 : Phytochemical properties of fresh Fig fruits cv. Afghan, Deanna and Brown Turkey.

Varieties	Total phenols (mg GAE /100 g)	Total flavonoids (mg QE /100 g)	Total tannins (mg CE/g)	Total soluble solids (°Brix)	Titratable acidity (%)	Total carotenoids (mg/100 g)	Ascorbic acid (mg/100g)
Afghan	130.75	12.33	6.55	16.3	0.22	0.12	11.53
Deanna	108.75	11.25	3.29	14.2	0.13	0.12	10.46
Brown Turkey	172.00	16.25	4.61	18.2	0.15	0.27	13.71
Mean	137.17	13.28	4.82	16.23	0.17	0.17	11.90
SEd	0.20	0.15	0.08	0.15	0.006	0.006	0.09
CD (p=0.05)	0.50	0.37	0.21	0.38	0.01	0.01	0.22

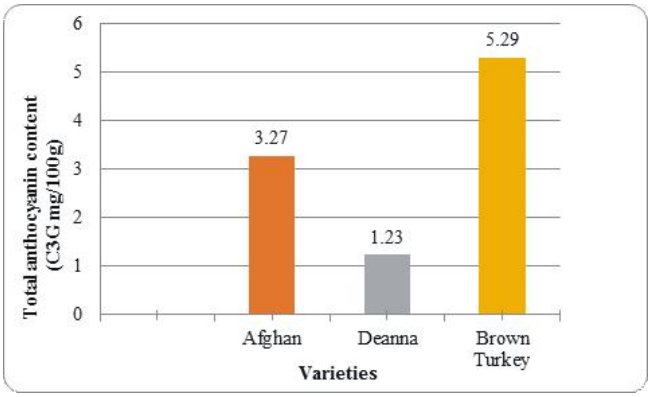

Fig. 1 : Total anthocyanin content of Fig cv. Afghan, Deanna and Brown Turkey.

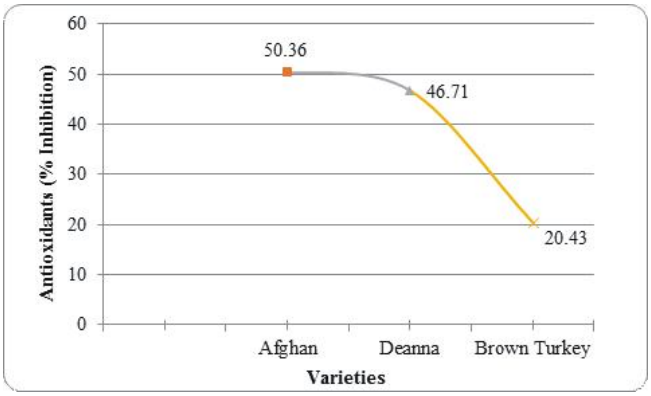

Fig. 2 : Antioxidants (% Inhibition) of Fig cv. Afghan, Deanna and Brown Turkey.

food colorants for a long time (Piga*et al*., 2002). The results of anthocyanins were presented in Fig. 2. The results showed a significant difference among varieties evaluated. The total anthocyanin was also highest in fig cv. Brown Turkey (5.29 mg C3G/100 g) and lowest in Deanna (1.23 mg C3G/100 g). Among varieties, the higher quantity of total carotenoids (0.27 mg/100 g) and ascorbic acid (13.71 mg/100 g) was recorded in Brown Turkey whereas the lower values of total carotenoids (0.12 mg/100 g) and ascorbic acid (10.46 mg/100 g) were recorded in Deanna.

Conclusion

In recent decades, a strong attention is given to antioxidant activity of fruits. Besides commercial fruits, minor fruits are gaining importance as potential food supplements. This study showed considerable variations in fig cultivars *viz*., Afghan, Deanna and Brown Turkey. The important antioxidant capacity of the fig fruits is due to the presence of phenolic compounds. These bioactive compounds acting as natural antioxidants are well known to have a positive impact on human health. The collected data will be useful for further studies to improve the nutritional content of fig accessions.

Statements and declarations

No potential conflict of interest was reported by the authors.

Acknowledgements

The authors are thankful to Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India for providing all facilities and guidance for this research work.

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