

Anti-nutritional Factors in Some Date Palm (*Phoenix dactylifera* L.) Varieties Grown in Pakistan

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Abstract

Twenty one Pakistani date palm (*Phoenix dactylifera* L) varieties were investigated for their level of anti-nutritional factors. All observations were made at tamr stage (maturity) of fruit. Significant differences were recorded in the level of anti-nutritional factors among varieties. Tannin contents range from 0.22±0.01-0.87±0.01% dry fruit weight basis in date cultivars. The highest mean value was recorded in case of Desi red small (0.87±0.01%) and lowest tannin content was observed in Aseel (0.22±0.01%), Dhakki (0.25±0.01%) and Hillavi (0.28±0.01%). Maximum phytate content was found in Dora desi (0.77±0.01%) and minimum value was recorded in cultivar Dora (0.30±0.01%). Oxalate content ranged from 3.63±0.01-6.49±0.01% (on dry matter basis) among date cultivars. Maximum mean value for oxalate content was found in Simple basraywal (6.49±0.01%) and lowest value was recorded in Dora (3.63±0.01%). Results proved that all these date varieties are suitable for consumption and processing due to their low level of anti-nutrients.

Key words: date varieties, anti-nutrients, phytate, oxalate, tannins

Introduction

Fruit are known as vital to equilibrate our diet to avert several diseases. Date (*Phoenix dactylifera* L.) is a primal plant and it has been cultivated for its edible fruit. The date has played an imperative role in the history of mankind. It is one of the trees mentioned in the Holy Quran (Ismail et al., 2008). It is a nutritious assimilative and energy producing fruit. The date palm was described as the “tree of life” in the Bible due to its outstanding dietetic value; high fruit yields and extended shelf life under natural conditions (Augstburger et al., 2002).

In Pakistan, date (*Phoenix dactylifera* L.) production was 557.6 thousand tones during the year 2007-08 (GOP, 2008) and is among top ten date producing countries in the world. More than 150 date varieties are produced in Pakistan. Some common cultivars are Dhakki, Aseel, Zahidi, Begum Jangi, Halavi and Khudravi (Nazri, 1995).

Date flesh contains substantial amount of carbohydrates (73.5 %), ash (1.5 %), protein (2.3 %), and lipids (0.2 %). Unsaturated fatty acids in date flesh include palmitoleic, linoleic, oleic and linolenic acids. Dates also contain vitamins A, C, B1, B2, folic acid and nicotinic acid in

addition to fifteen mineral elements (Al-Shahib and Marshal, 2003). Elemental fluorine in date flesh does care for teeth against decay. Selenium facilitates to prevent cancer and is important in immune task. One hundred grams of date flesh contains 39 mg calcium, 1.0 mg iron, 43.24 mg magnesium, 56.80 mg phosphorus, 655 mg potassium, 0.85 mg sodium, 0.29 mg zinc, 0.29 mg copper and 0.30 mg manganese (Awan and Sohail, 1999). The polysaccharides from date fruit have been used as a functional constituent and provide bioactive compounds in the formulation of drugs (Puri et al., 2000). These have also been identified as having anti-oxidant and anti-mutagenic properties and help in controlling cardiovascular diseases (Vayalil, 2002). Its consumption decreases serum triacylglyceride levels and oxidative stress during the month dates eaten suggest the reason for the significantly unaffected serum cholesterol level (Rock et al. 2009).

Dates are also a rich source of antioxidants, mainly carotenoids and phenolics (Al-Farsi and Lee, 2008). The antioxidant property of date varies depending upon the contents of phenolic components, vitamin C and E, carotenoids and flavonoids. The average contents of phenolics range from 193.7mg/100g for fresh dates to 239.4mg/100g for dried dates. The phenolics increase after drying of some date varieties might be due to the

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degradation of tannins by heat and maturation of the enzymes during the drying process which leads to the release of phenolic compounds (Biglari et al., 2008).

However, regular eating of dates builds up the body, delays wrinkle formation, impedes premature graying of hair and provides a glistening healthy look to the skin (Bauza, 2002). These are thought to firm the gums in infants with teething problems (Zaid, 1999) and useful in ameliorating cough, burning sensation, nephropathy, rheumatism, bronchitis, gastropathy and sexual weakness (Selvam, 2008). Moreover, consumption of pulp of date fruit provides antitussive, demulcent, expectorant, diuretic, laxative and restorative properties. Immunity against common cold is thought to increase and asthma is diminished by the consumption of dried dates every morning (Zaid, 1999).

Chemical composition of the dates indicates nutritional and health benefits are important for consumers. Evaluation of local varieties helps to enhance date industry by propagating premium varieties that satisfy the consumers. Considering the aforementioned essentials, the present study is planned to evaluate and assess the suitability of indigenous date varieties for the consumers and processors.

Material and Methods

The present study was carried out in the Post Graduate Labs, National Institute of Food Science & Technology, University of Agriculture, Faisalabad, Pakistan.

Procurement of raw materials. Twenty one commercially available date palm varieties, all at tamar stage (stage of full maturity), Karblain, Aseel, Zaidy, Dhakki, Dora, Shungust, Choharay, Khopra, Karblai sindh, Desi green, Desi basraywal, Desi simple, Desi red small, Desi small, Desi basray, Dora basraywal, Dora desi, Simple basraywal, Aseel sindh and Hillavi were collected from "Date Palm Research Center, Jhang" Horticulture garden, Directorate of Horticulture, Ayub Agricultural Research Institute, Faisalabad for this study. Samples were selected randomly without any preference to size, shape, color, appearance and firmness and stored at 4°C. Analytical grade chemicals were purchased from Sigma Aldrich (Seelze, Germany) and Lab-Scan (Dublin, Ireland) available in the local market of Faisalabad.

Determination of anti-nutritional factors. Total oxalate, phytate and tannin contents of the date varieties were determined by using following procedures.

Total oxalate. Total oxalate was determined by adopting the procedure as explained by Day and Underwood (1986). One gram date powder was taken in conical flask and 75mL of 15N H₂SO₄ were added into it. The solution was stirred carefully and intermittently with the help of magnetic stirrer for 1 h. It was filtered by using Whatman No.1 filter paper. 25mL of the filtrate were then collected and titrated against 0.1N KMnO₄ solution till a faint pink color appeared that persisted for 30 sec.

Phytate content. Phytate content in dates was determined by following the procedure described by Haug and Lantzsch (1983).

Preparation of standard solutions. 0.15g Sodium phytate was dissolved in 100mL de-ionized water to prepare stock solution. Standard phytate solution was prepared by diluting the stock solution in 100mL volumetric flask in the range of 1.2-11.7mL stock solution (1.2, 2.7, 4.2, 5.7, 7.2, 8.7, 10.2, 11.7mL) and made the volume with 0.2N HCl. Standard ferric solution was prepared by dissolving 0.2g of Fe(NH₄)₂(SO₄)₂·6H₂O in de-ionized water and volume was made to 1000mL with 2N HCl. 2,2-bipyridine solution (10g) and 10mL thioglycolic acid were dissolved in 100mL de-ionized water to make standard 2,2-bipyridine solution and volume was made to 1000mL.

Procedure. 0.06g sample was taken in a test tube and 10mL 0.2N HCl solution was added for extraction by shaking for one hour. The extracted solution (1mL) was taken in a test tube along with 2mL ferric solution and covered with a cap. The test tube was heated after fixing with a clip in a water bath for half an hour. Then test tube was allowed to cool at room temperature in a ice water bath for 15 min. 4mL solution of 2,2-bipyridine was added into the test tube and the contents were mixed thoroughly. The absorbance was recorded at 519nm with spectrophotometer (Irmeco U-2020) against de-ionized water after 60 sec. The method was calibrated with reference solution as a substitute for the sample solution for each set of analysis.

Tannin contents. Tannin contents of date varieties were estimated by using Folin-Danis method (Schanderi, 1970).

Preparation of standard solutions. Folin-Danis reagent was prepared by dissolving 100g Sodium tungstate and 20g phosphomolybdic acid in 750mL distilled water in a 1000mL volumetric flask and then 50mL phosphoric acid was added in the solution. The contents of flask were refluxed for 2 h and volume was made to 1000mL with distilled water. 350g of Sodium carbonate were dissolved in 1000mL distilled water at 70°C to prepare carbonate solution. Sodium was allowed to stand overnight and then it was filtered through glass-wool. 100g of tannic acid were dissolved in distilled water to prepare standard tannic acid solution and volume was made to 100mL. Stock solution (5mL) was taken in 100mL volumetric flask and volume was made with distilled water to obtain the working solution of 50µg/mL of tannic acid.

Procedure. 500mg ground dates sample was taken in a 250mL conical flask and 75mL distilled water was added into it. It was boiled for 30 min and then centrifuged at 2000rpm for 20 min. The supernatant was collected and diluted to 100mL with distilled water. Then 1mL sample extract, 5mL Folin Danis reagent and 10mL sodium carbonate were taken in a 100mL flask containing 75mL water and volume was made up. Flask was shaken well and absorbance was measured by spectrophotometer (Irmeco U-2020) at 700nm after staying for 30 min. A blank solution was prepared in which water was used instead of sample

and standard graph was produced by using 0–100µg of tannic acid.

Results

Date palm varieties grown in Pakistan were analyzed for their anti-nutritional level to evaluate their suitability for consumption as table purpose and processing in the industry. **Tannin content of date varieties.** Highly significant ($p < 0.01$) differences existed in tannin content among date varieties. The results of tannin content have been presented in the Table 1.

Table 1. Mean values for phytate, oxalate and tannins content in date varieties (%)*

Varieties	Phytate	Oxalate	Tannins
Aseel	0.48±0.01ij	3.97±0.01q	0.22±0.01r
Aseel Sindh	0.43±0.01k	5.55±0.02g	0.36±0.01op
Choharay	0.53±0.01h	4.35±0.01o	0.46±0.01kl
Desi basray	0.39±0.01l	5.18±0.01jk	0.67±0.01ef
Desi basraywal	0.35±0.01m	4.13±0.01p	0.73±0.01d
Desi black	0.73±0.01b	6.26±0.01c	0.55±0.01ij
Desi green	0.64±0.01de	5.82±0.01e	0.43±0.01lm
Desi red small	0.69±0.01c	6.38±0.01b	0.87±0.01a
Desi simple	0.45±0.01jk	5.64±0.01f	0.78±0.01c
Desi small	0.61±0.01ef	5.45±0.01h	0.48±0.01k
Dhakki	0.52±0.01h	4.44±0.02n	0.25±0.01qr
Dora	0.30±0.01n	3.63±0.01s	0.58±0.01hi
Dora basraywal	0.45±0.01jk	5.23±0.01j	0.83±0.01b
Dora desi	0.77±0.01a	5.32±0.01i	0.63±0.01fg
Hillavi	0.50±0.01hi	4.72±0.01m	0.28±0.01q
Karbalai Sindh	0.47±0.01ij	6.12±0.01d	0.69±0.01de
Karblain	0.57±0.01g	4.68±0.01m	0.39±0.01no
Khopra	0.33±0.01mn	3.78±0.01r	0.54±0.01j
Shungust	0.63±0.01de	5.16±0.01k	0.34±0.01p
Simple basraywal	0.67±0.01cd	6.49±0.01a	0.61±0.01gh
Zaidy	0.58±0.01fg	5.01±0.01l	0.42±0.02mn

Means with different letters in each column differ highly significantly ($p < 0.01$)

*= dry weight basis

Tannin contents range from 0.22±0.01–0.87±0.01% dry fruit weight basis in date cultivars. The highest mean value was recorded in case of Desi red small (0.87±0.01%) followed by Dora basraywal (0.83±0.01%) and Desi simple (0.78±0.01%) whereas lowest tannin content was observed in Aseel (0.22±0.01%), Dhakki (0.25±0.01%) and Hillavi (0.28±0.01%).

Phytate content of date varieties. Highly significant ($p < 0.01$) differences existed in phytate content among date varieties. Phytate contents in date varieties range from 0.30±0.01–0.77±0.01% dry fruit. Results show that maximum phytate content was found in Dora desi (0.77±0.01%) and Desi black (0.73±0.01%), while

minimum value was recorded in cultivar Dora (0.30±0.01%), Khopra (0.33±0.01%) and Desi basraywal (0.35±0.01%).

Oxalate Content of Date Varieties. Statistical analysis shows that highly significant ($p < 0.01$) variations existed in oxalate content among date varieties. The mean values for oxalate content ranged from 3.63±0.01–6.49±0.01% (on dry matter basis) among date cultivars (Table 4.12). Data revealed that maximum mean value for oxalate content was found in Simple basraywal (6.49±0.01%) followed by Desi red small (6.38±0.01%) and Desi black (6.26±0.01%) while lowest value was recorded in Dora (3.63±0.01%), Khopra (3.78±0.01%) and Aseel (3.97±0.01%).

Discussion

Tannins are polyphenolic compounds having astringent and bitter taste that can be felt after eating unripened fruit. They are known to bind protein and alkaloids and made the meal difficult to digest. Consumption of tannin in large doses may cause bowel irritation, damage the liver, stomach and kidney irritation and gastrointestinal pain, chelate minerals and makes them unavailable to the body. Its prolong consumption may lead to iron deficiency that cause anemia, however tannins reduce the bioavailability of only plant sources iron i.e. non-hem iron by making complexes (McGee and Harold, 2004; Karamac, 2009). The results of present study are corroborated with the previous findings. Tannin content was higher in Desi red small, whereas lower in Aseel, Dhakki and Hillavi. They are mainly involved in the darkening of date fruit after harvesting through non-enzymatic browning. Dates are found astringent with 1.30% tannin content at kimri stage of development. As the development process proceeds, the tannin contents tend to start precipitated and astringency decreases during khalal stage. However, minimum tannin content has been estimated at tamr stage (fully matured) of fruit (Tafti and Fooladi, 2005).

Phytate is storage form of phosphorus and abundant in foods having high fiber content. Human body is unable to digest phytate like non-ruminant animals. It doesn't provide phosphorus but it chelates metal ions like iron, zinc, calcium and magnesium and vitamin niacin and makes them unavailable to the body and thus cause mineral deficiency and pellagra (Ali et al., 2010). Phytic acid also acts as phyto-nutrient by providing antioxidant properties. Phytate plays a role in preventing colon cancer and other type of cancer by reducing oxidative stress (Vucenic and Shamsuddin, 2003). Oxalic acid ($H_2C_2O_4 \cdot 2H_2O$) is a dicarboxylic acid with ability to chelate cations like potassium, sodium, calcium and magnesium. These chelated compounds are called oxalates, salt of oxalic acid. Potassium and sodium salts of oxalic acid are soluble in water, whereas, calcium oxalate is insoluble and

recipitates out in the excretory system of the kidneys and responsible for the formation of kidney stone (Coe et al., 2005). However, use of probiotics promotes excretion of oxalic acid from the body (Lieske et al., 2005).

The results of present investigation are also in line with the findings of Umaru et al. (2007) with minor differences that might be due to difference in cultivar, soil type, cultural practices and environment. The results proved that anti-nutritional compounds in date varieties are under safe limit and recommended for consumption. Similarly, Umaru et al. (2007) analyzed sixteen fruit for anti-nutritional factor and reported that dates contain $0.93 \pm 0.21\%$ tannin, $0.52 \pm 0.03\%$ phytate and $6.90 \pm 0.91\%$ oxalate contents.

Conclusion

The results of this study regarding the chemical composition that relates to nutritional and health benefits are important for consumers. Evaluation of local date varieties would propagate knowledge regarding premium varieties which is necessary for exporters and the consumers. It is concluded that Dates in general and the Aseel, Dhakki, Hallavi and Dora varieties in particular are beneficial which may be included in our regular diet, without any chances of adverse effects.

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