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NUTRITIONAL ASSESSMENT OF AJWA DATE FLESH AND PITS IN COMPARISON TO LOCAL VARIETIES

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ABSTRACT

The study was designed to characterize ajwa flesh and pits and make their comparison with locally available date cultivars. Correlation between proximate characteristics and within different minerals was analyzed while cluster analysis technique was used to evaluate similarity between sugar contents of date varieties. The results indicated ajwa flesh as richest source of moisture (22.8 %), ash (3.22 %), glucose (54.5%), fructose (52.03%), maltose (22.5%), and galactose (12 .2%) contents while ajwa pits have highest amounts of crude fat (7.8%), crude fiber(51%), TDF(53.9%), IDF(34.6), and SDF(19.5%). Highly significant correlation of crude fat with crude fiber and crude protein was observed while crude protein also exhibited positive correlation with crude fiber. Date flesh was found better source of mineral as compared to pits whereas potassium was found rich in both parts. Highly significant negative correlation of Na and positive correlation of Zn and Ca with all other minerals was observed. Cluster analysis of sugar suggests highest similarity of fructose, maltose and galactose and least similarity of sucrose under cluster III and cluster I. The work identifies variability among flesh and pits of ajwa date and local date varieties for their nutritional traits that can be used in fortification of different food products.

Key words: Ajwa, HPLC, Dendogram, Glucose, Minerals.

INTRODUCTION

Datepalm is extremely famous and oldest cultivated mankind's plant in worldwide due to its significant nutritional, health and economic benefits besides its aesthetic and ecological value. Traditionally, fruit of this plant is consumed in different countries of Arab Gulf regions as staple food due to its nutrients like minerals, vitamins, carbohydrates, dietary fibers, phenolic contents and antioxidant activity (Al-Farsi *et al.*, 2007), some of which also have protective role against many diseases like diabetes, obesity, cardiovascular diseases and diabetes (Vayalil, 2011). Among these nutrients date flesh part generally contains digestible sugars like glucose and fructose while pits are rich source of dietary fibers, minerals, and bioactive components which are important in prevention of many diseases (Al-Farsi and Lee 2008; Najafi, 2011). However due to less work on nutritional properties of pits, people are less aware for their benefits hence a large quantity of pits are wasted.

Ajwa date can be distinguished from other date varieties due to higher nutritional properties and also being favorite date of Holy prophet (PBUH). However, there is a little work on compositional analysis of ajwa flesh and pits, so the project was designed to make a comparison between nutritional properties of pits and flesh of ajwa date and also with locally available date cultivars This work will provide a baseline to future study on comparative nutritional potential and mineral contents of ajwa flesh and pits and will also reveal nutritional enrichment of ajwa date in comparison to locally available date varieties.

MATERIALS AND METHODS

Preparation of Samples: The ajwa date samples were procured from well reputed stores of Pakistan and were botanically identified from Department of Botany, PirMehr Ali Shah Arid Agriculture University, Rawalpindi while local date varieties (Aseel and Zaidy) were procured from Date Palm Research Center, Jhang, Punjab, Pakistan. The samples were brought to the Department of Food Technology, PirMehr Ali Shah Arid Agriculture University, Rawalpindi. Dates samples were washed with distilled water to remove extraneous material followed by drying while pits were grinded through high speed grinder. Samples were stored at refrigerator temperature in sealed glass packaging until used for further analysis.

Proximate Analysis: Total moisture (method No. 44-19), ash (method No 08-01), protein (method No.46-10) and crude fat (method No. 30-20)were determined according to methods recommended by AACC (2000) while crude fiber was determined as described in method No 926.09 of AOAC (2005) .Soluble, insoluble and total dietary fibers were determined by following AOAC (2000) method No. 991.43. Briefly, samples (1g in duplicate)

were stirred with 40 mL phosphate buffer at pH 8.2 and then were heated at 100ºC by adding 40µl alpha-amylaze. After cooling (60 ºC) samples were digested with 100 µl protease solution and 200 µl amyloglucosidase and were placed at 60ºCfor 30mins. Finally, samples were filtered, washed with 95% ethanol and left for drying. Residues were weighed for insoluble dietary fiber while Soluble Dietary Fiber (SDF) were precipitated from filtrate using four volumes of 95% ethanol. This was followed by filtration and residues were dried and weighed for SDF. Total dietary fiber was calculated by adding soluble and non -soluble DF together.

Characterization of Sugars: Flesh and pits samples of all date cultivars were analyzed separately for five sugars through HPLC technique according to method of AACC (2000) using refractive index detector, acetonitrile-water (70:30) as mobile phase and normal phase column with flow rate of 1ml/min at 30 ºC temperature. Higher peak areas were measured to calculate the sugars concentrations.

Determination of Mineral Profile: Zinc, calcium, manganese and magnesium were quantified using atomic absorption spectrometry while sodium and potassium were determined through flame photometer according to the methods of AOAC (2003). Wet digestion of samples was carried out according to Shumaila*et al*. (2009). Briefly, in a glass tube 1 g of dried sample powder (pit or flesh) dissolved in 12 ml HNO_3 and 4 ml of per-chloric acid was added for digestion in fume hood at temperature of 250-300 ºC for approx. 1 hour till appearance of white fumes. The digested material was added to volumetric flask and volume was made to 100ml with distilled water and stored till further analysis.

Determination of Anti-Nutritional Factors: Total oxalates were determined by following method of Day and under worth (1986). Briefly, 1 g date flesh and pits sample separately was taken in conical flask and 75ml of 15N sulphuric acid was added and was stirred continuously with magnetic stirrer for 45mintues following by its filtration through watsman's filter paper and filtrate was titrated with 0.1N $KMNO_4$ solution until pink color**.**

Statistical Analysis: Correlation matrix was used to study the relationship for all possible combinations of five proximate variables. Clustering of sugar parameters into similar groups was performed using ward's method based on Euclidean distance. Scatter plot and correlation analysis were used to study relationship between different mineral elements. Minitab Version 15 and R studio software was used for statistical analysis and graphical representation.

RESULTS

Proximate Analysis: Wide variation pattern between flesh and pits is evident for crude fat, protein, crude fiber, TDF, IDF and SDF values while relatively low variation has found for moisture and ash contents (Fig. 1). Flesh has higher moisture content as compared to pits in all date cultivars in range from 22.8% -16.7% with highest value in ajwa flesh and lowest in zaidy while in pits it varies from 14.3% (ajwa pits) to 7.74% (zaidy pits) . Similarly, flesh parts of date cultivars were found to have ash content in range of 1.74% (zaidy flesh) to 3.2% (ajwa flesh) while for pits, values were observed highest in ajwa pits(2.8%) and lowest in aseel pits (0.9%) with significant differences among all cultivars. A varying array in flesh and pits of all date cultivars for crude protein is also apparent (Fig. 1). Among pits, zaidy pits have highest (6.7%) and aseel pits have lowest (2.68%) values of crude protein. For flesh parts, ajwa flesh showed highest percentage (2.94%) of crude protein followed by zaidy (2.91%) and aseel variety (2.68%). Significant variations in flesh and pits of all date cultivars for protein contents can be seen while non-significant differences among flesh parts are visible (Fig. 1). Statistically higher crude fat observed in pits as compare to flesh portion. Ajwa pits have elevated level of (7.8%) of crude fat, trailed by aseel pits (7.5%) and zaidy pits (4.4%). For flesh parts of date varieties, zaidy flesh have highest percentages of crude fat (0.50%) followed by ajwa flesh (0.47%) with minor difference from aseel flesh (0.46%) with non- significant differences.

Significant variations can be seen in flesh and pits for crude fiber. In pits, Crude fiber was determined maximum in ajwa pits (51%) followed by aseel pits (40.3%) and zaidy pits (32.6%). In flesh parts crude fiber was in order of: ajwa flesh (9.01%)>aseel flesh (5.94%)>zaidy flesh (4.8%). SDF value varies within pits being highest in ajwa (19.5% and lowest in zaidy variety 8.87% in (ajwa) while for flesh values ranged between 4.5% - 1.38 % in ajwa flesh and zaidy flesh, respectively (Fig.1). The percent insoluble dietary fiber also showed substantial differences between flesh and pits of all varieties but within parts the results were insignificant. Pits have IDF range between 34.6% (ajwa) – 27.4% (zaidy) while in flesh parts of all cultivars highest value was also in ajwa (8.19%) and lowest in zaidy (5.16%). Pits also demonstrated significant differences of total dietary fiber percentages than flesh, but non-significant within pits of all varieties being highest in ajwa variety (53.9%) and least in zaidy (36.2%) pits. Same trend was observed for flesh parts, maximum in ajwa (12.73%) and minimum in zaidy variety (6.54%).

Irrespective of date parts (flesh and pits) and based on date cultivars, histogram showed that most of the cultivars contained moisture in range of 11-15 %, ash

contents between 1.5 -2.3%, Protein contents were between 2 to 4 % and 5.5 to 7%, crude fat varied between 0 to 8% and crude fiber have a range of 15 to 20% for maximum variables and for less between 50 to 60% with highly non-substantial variances (Fig. 2). Moisture has positive correlation with only ash contents while other proximate parameters viz. protein, crude fat and crude fiber correlated negatively with a values of 0.82,0.76,0.65 respectively. Ash with protein and fat contents showed negative correlation in range of 0.22-0.20 respectively while exhibited moderate correlation with crude fiber contents. In the same context, highly significant positive correlations were observed between crude fat and crude fiber (0.97), crude protein and crude fat (0.95) and between crude protein and crude fiber percentages (0.89) as evident in Fig. 2.

Sugar Contents: Major variations for sugars were found among flesh and pits of all date cultivars. Ajwa flesh has highest percentage of glucose (54.5%) followed by fructose (52.03%), maltose (22.5%), and galactose (12 .2%) except sucrose which was highest in zaidy flesh (14.1%). Among pits, ajwa pits were rich source of glucose (20.15%), fructose (16.1 %), maltose (6.1 %) and glactose (3.4%) while zaidy pits (3.1%) have higher percentage of sucrose.

Ward, sdendogram based on Euclidean distance coefficient placed five sugars for date cultivars into three main clusters. Third cluster contain four main sugars, maltose, galactose and fructose have highest membership of 99.9% with cluster II. Second cluster contains glucose sugar, at similarity level of 96.7% with fructose. Cluster I comprising sucrose sugar, have highest inter cluster distance with Cluster II and Cluster III with minimum similarity of 49.7% with cluster II (Fig. 3).

Mineral Profile: Data on mineral profile indicated that dates of all varieties are rich source of minerals but variations exist between pits and flesh portion for their mineral constituents. Within the pits, zinc (1.91 mg/g), calcium (2.0mg/g) magnesium (0.8mg/g), and potassium (4.6 mg/g) were observed at highest concentration in Ajwa. While manganese and sodium were highest in aseel pits (0.078mg/g) and zaidy pits (0.13mg/g), respectively (Fig. 4). Flesh part of ajwa was also rich in minerals with comparatively higher concentration of calcium (2.0 mg/g), magnesium (1.5 mg/g), and potassium contents (6.45 mg/g). Whereas, sodium and manganese contents were highest in aseel flesh (3.1 mg/g) and zaidy flesh (1.87mg/g) respectively (Fig. 4).

Pearson's correlation coefficients showed many significant correlations among mineral elements in both parts of date varieties which will be helpful in selecting date varieties based on single attribute. In flesh parts, Zn exhibited highly significant positive correlation with Mg (0.99), Ca (0.96) and K (0.72), with increasing linear trend. However, have highly significant negative correlation (-0.97) with Na and moderately negative correlation with Mn (-0.43) in decreasing manner (Table 1, Fig. 5). Similarly, Ca has highly significant positive (0.95) relationship with Mg and moderately positive with K (0.54) in increasing manner while strongly correlated with Na (-0.98) in decreasing way (Fig. 5, Table 1). Likewise, Mg showed highly significant negative correlation with Na (-0.97) and moderately negative with Mn (-0.45) while significantly positive with K (0.73). In the same context, Mn was significantly correlated with K (-0.92) with decreasing trend and moderately positive correlated with Na (0.43) while negative non-significant correlation was observed between Na and K (Table 1, Fig. 5).

In pits, highly significant positive correlation of Zn with Ca (0.99), Mg, and K (0.88) while negative with Na (-0.89) is evident (Table 2, Fig. 6). Similarly, Ca exhibited strongly positive linear correlation with Mg (0.99) and K (0.87) while significantly negative with Na (-0.88). In the same way, intensely positive linear relationship between Mg and K (0.90) can be observed (Table 2, Fig. 6) while Mg showed highly significant decreasing correlation with Na (-0.86). Moreover, Mn has negative non-signification correlation with K (-0.05) and significant negative relation with Na (-0.68) in decreasing manner while K and Na (-0.63) has non-significant and negative relationship (Table 2, Fig. 6).

Anti- nutrients: Box plot (Fig. 5) revealed variations for oxalate contents in date varieties and their parts. In flesh parts, zaidy flesh (5.19%) have highest amount while ajwaflesh(2.20%) have lowest amount. Same trend was observed in pits, being higher in Zaidypits(3.70)and lowest(1.05%) in ajwa pits.

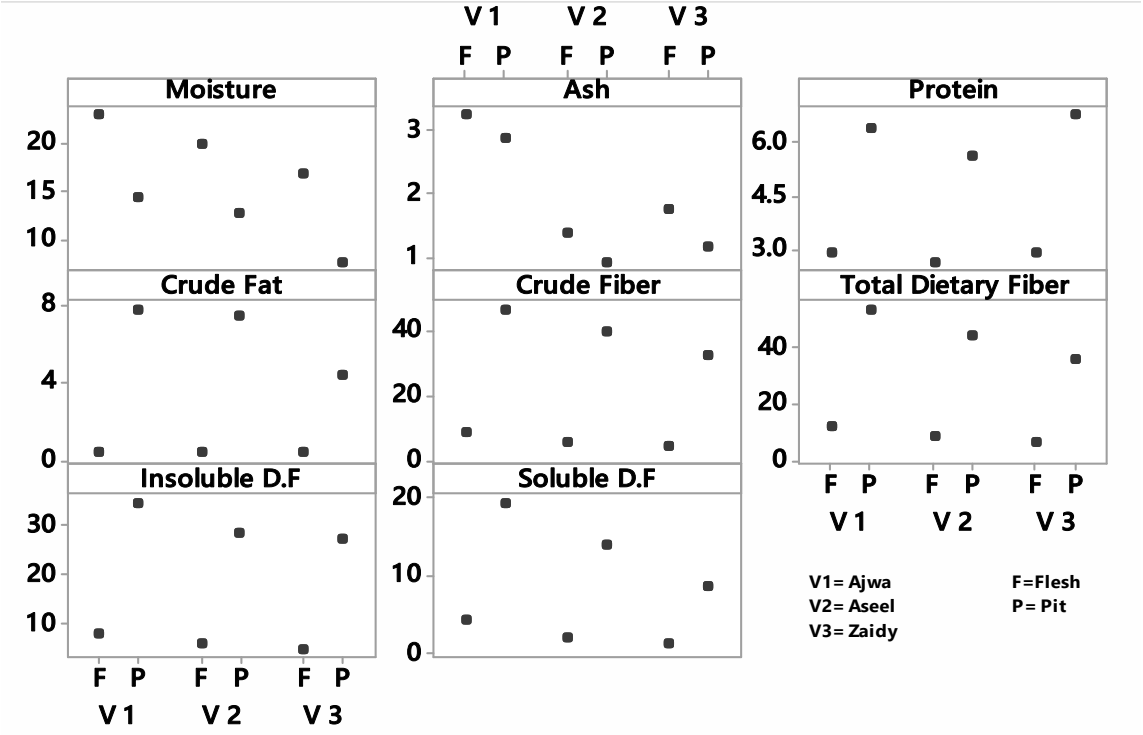

Fig.1. Proximate analysis of date varieties

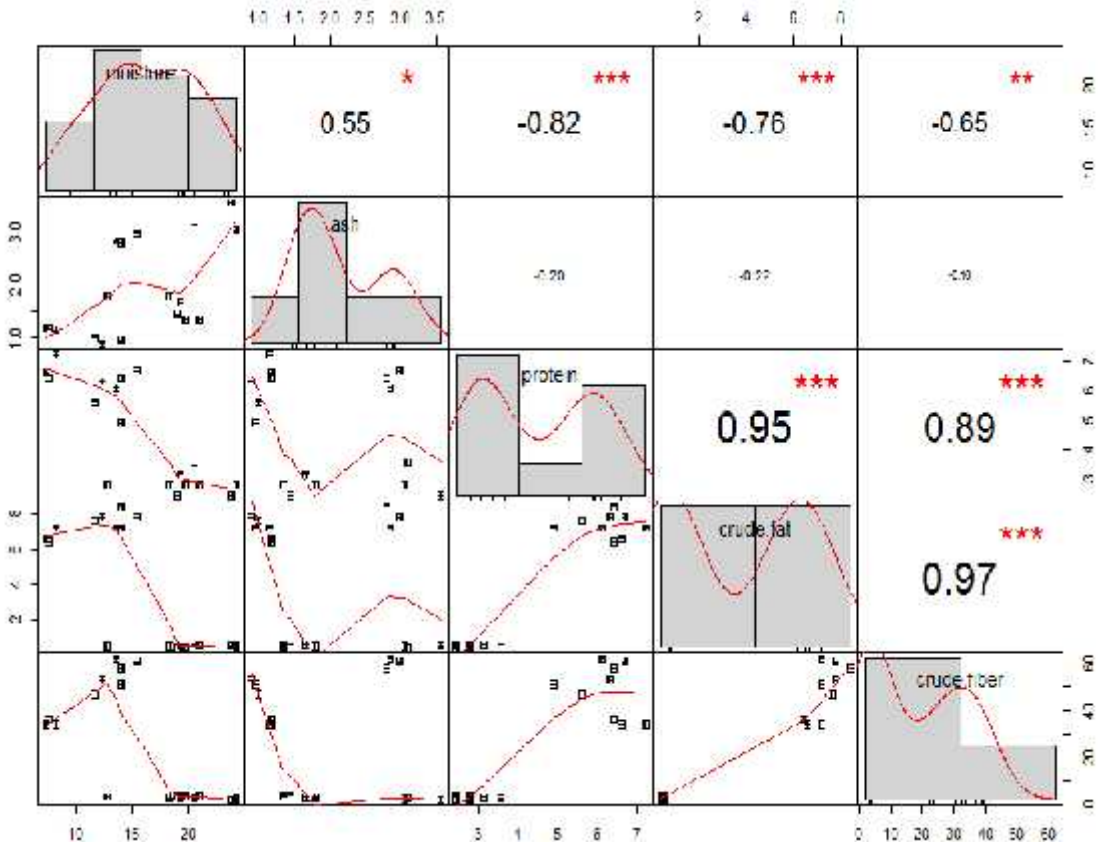

Fig.2. Relationship among proximate parameters

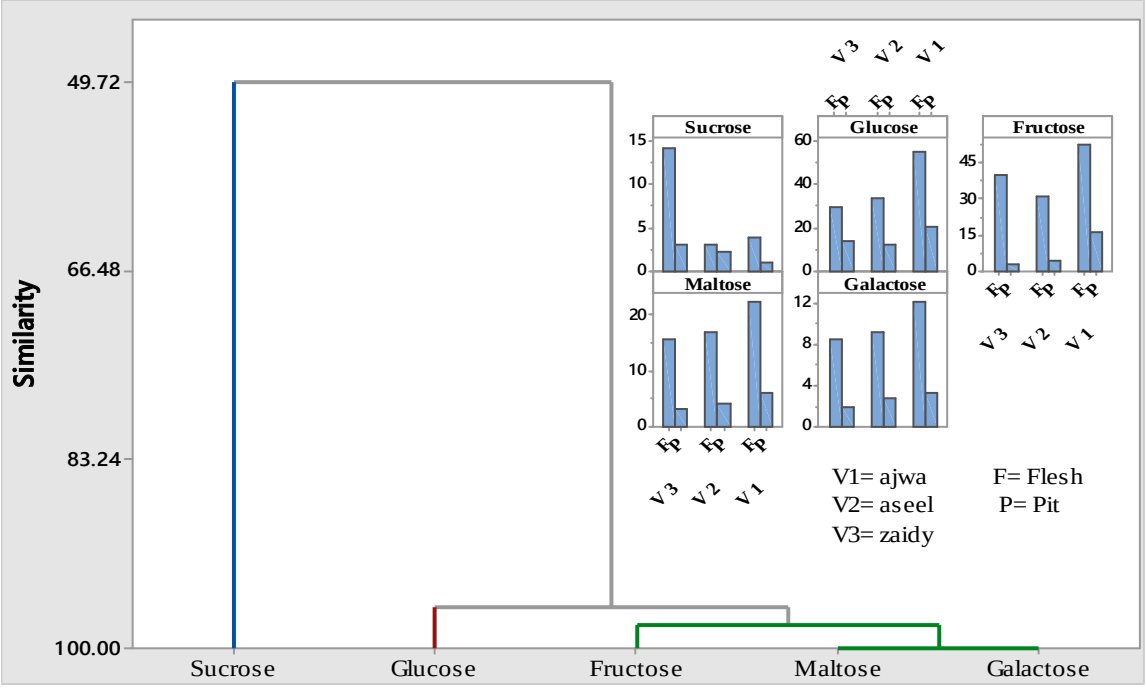

Fig. 3. Dendogram for sugars of date varieties

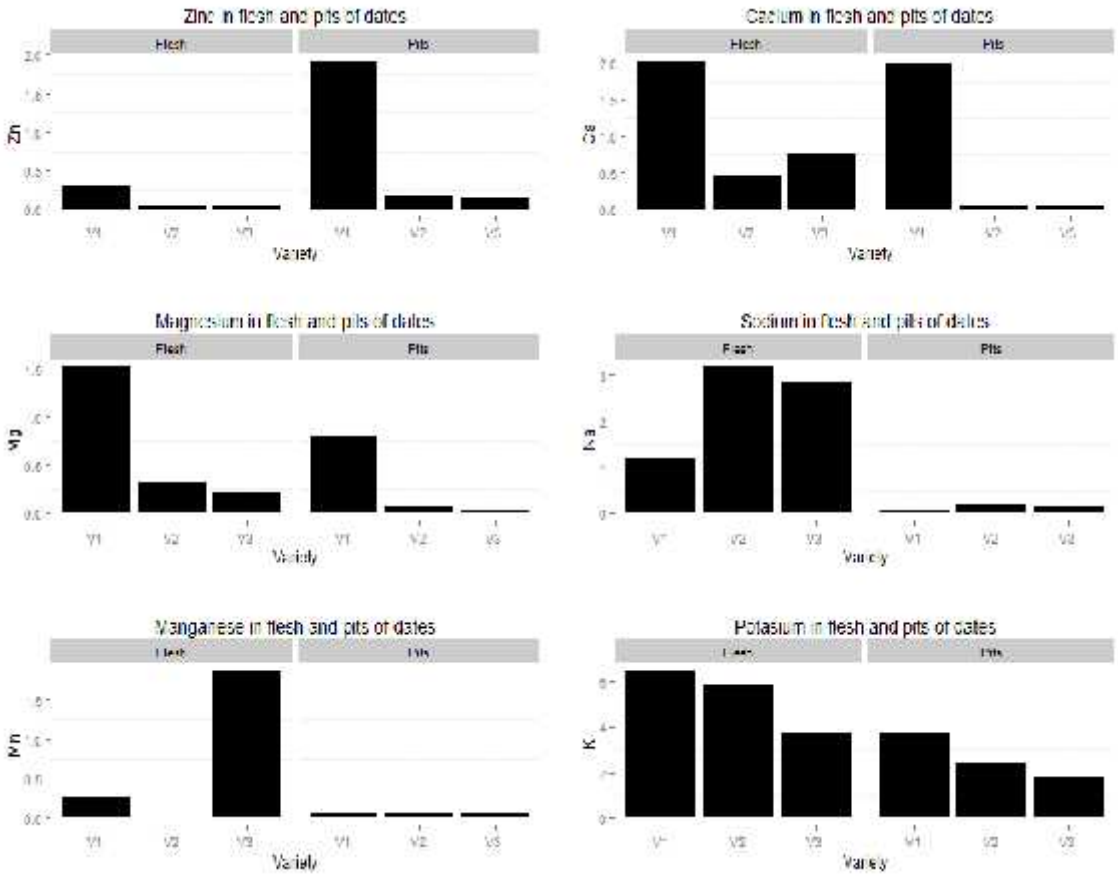

Fig. 4. Mineral profile of date varieties

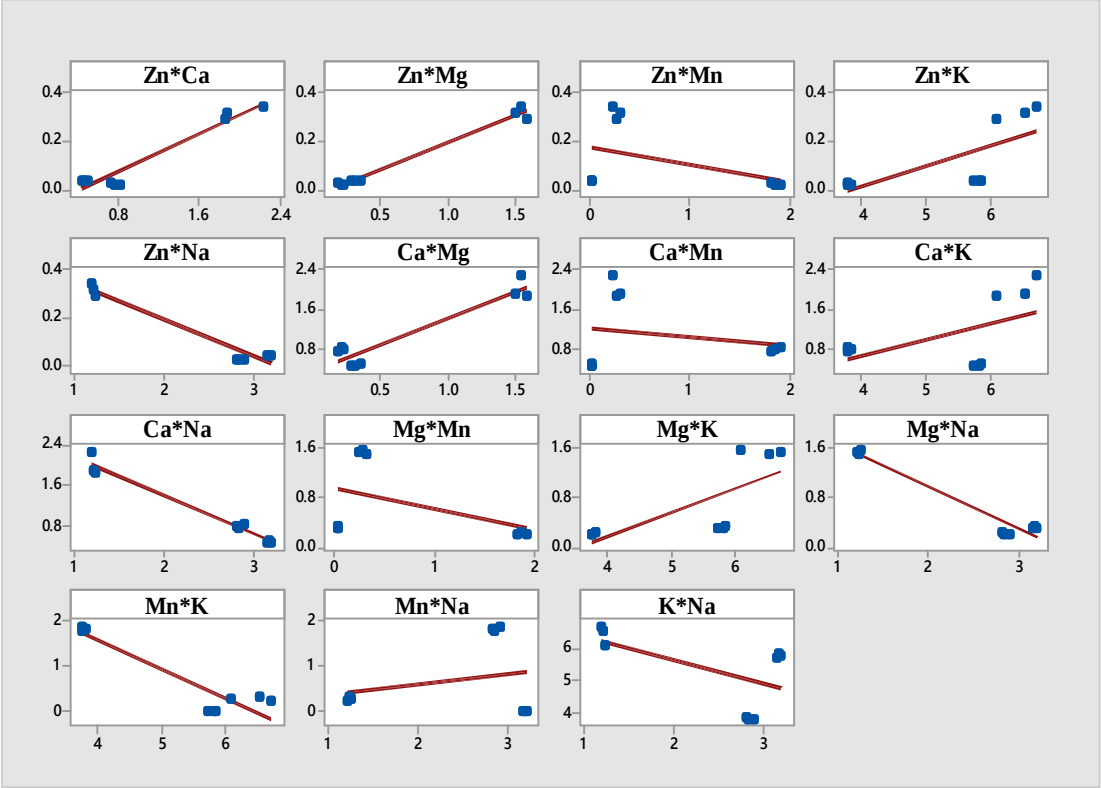

Fig. 5. Scatter plot of minerals in flesh parts

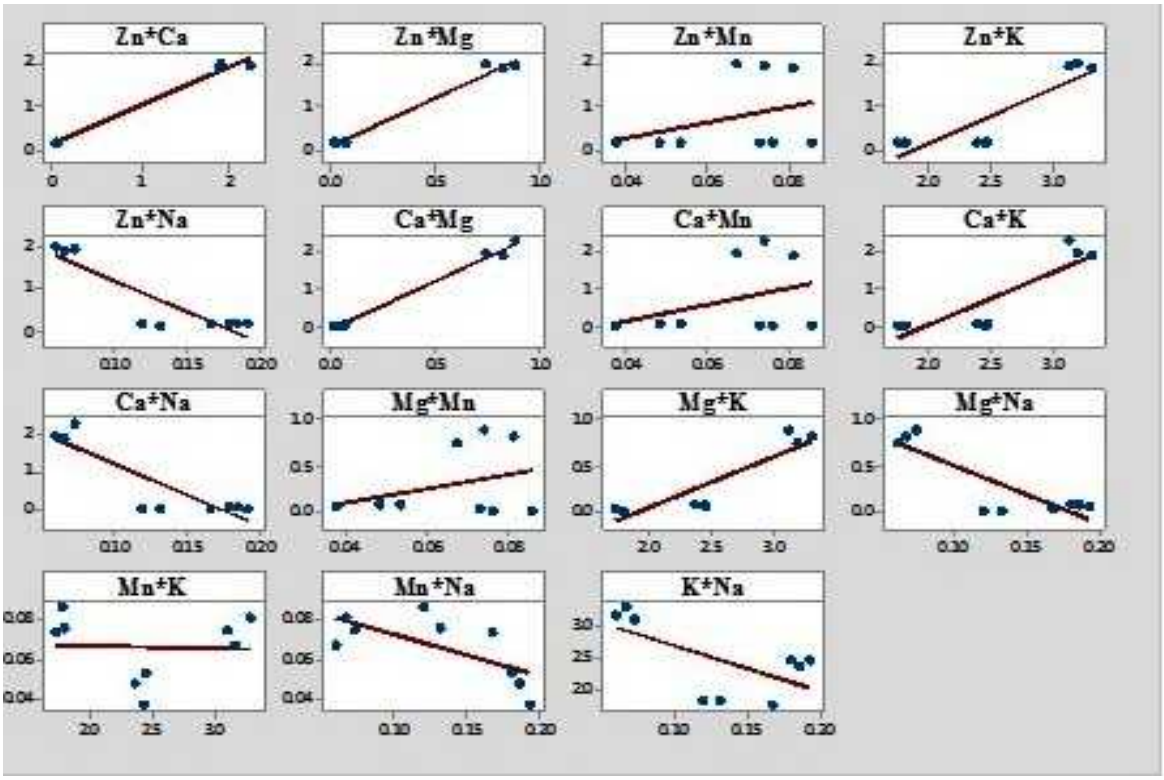

Fig. 6: Scatter plot of minerals in pit parts.

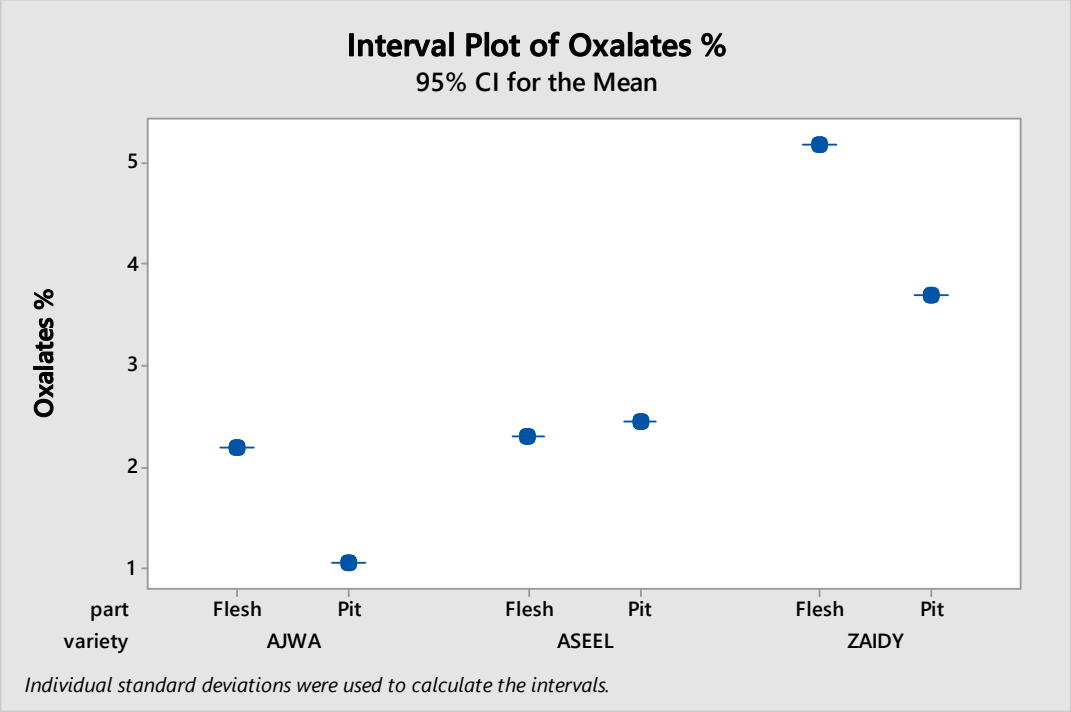

Figure 1. Anti-Nutritional factors of Date varieties and Parts

Table 1.Correlation coefficients of minerals in flesh parts.

	Zn	Ca	Mg	Mn	K	Na
Zn		0.96*	0.99**	-0.43	0.72*	-0.97**
Ca			0.95*	-0.2	0.54	-0.98**
Mg				-0.45	0.73*	-0.97**
Mn					-0.92**	0.23
K						-0.56
Na						

Table 2.Correlation coefficients between minerals in pits parts.

	Zn	Ca	Mg	Mn	K	Na
Zn		0.99**	0.99**	0.34	0.88*	-0.89*
Ca			0.99**	0.35	0.87*	-0.88*
Mg				0.35	0.90*	-0.05
Mn					-0.05	-0.68*
K						-0.63
Na						

DISCUSSION

Various nutritional components such as moisture, ash, protein, fat, crude fiber and dietary fibers are important in composition of date flesh and pits. Among these, Moisture content is perhaps important one in deciding shelf life of food items. The results of this study suggest higher shelf life of pits as compared to flesh. Based on the results on moisture content, date pits can be stored for longer period of time than flesh and will be less susceptible to microbial spoilage and enzymatic reactions (Swaya*et al.*, 1983). The vital role of protein and fat in human diet cannot be ignored as they are in major three nutrients providing 4 and 9 Kcal per gram, respectively. The crude protein and fat contents of date flesh of all varieties were lower than date pits this may be due to difference in genetic makeup of these varieties. Higher protein contents of date pits from these varieties can be advantageously used in diet plan of children of

growing ages. Ajwa flesh and zaidy pits were found as a better source of protein. These pits appeared as non-conventional source of protein and may be used as alternative material in food products (Salman *et al.*, 2010). Similarly, ajwa date pits seemed to be the foremost source of crude fat and can be a good nutritive supplementary source for human diet (Devshony*et al.*, 1992). Moreover, alimentary importance of crude and dietary fibers has increase concentration of researchers towards their protecting role against many maladies as high cholesterol, obesity, diabetes, hypertension and hyperlipidemia (Kris-ethertone*t al.*, 2002). Dates are renowned for higher level of crude fibers, soluble, insoluble and total dietary fibers in pits and flesh but there is always some variation due to variable moisture content and genetic variability among cultivars. Higher level of crude fiber, IDF, SDF and TDF contents in ajwa pits make it suitable for incorporation in dietary supplement (Habib and Ibrahim 2009). This study also recommends further researches on traits of date parts due to major variability among flesh and pits for their fiber contents.

In correlation analysis of proximate components, highly significant correlation coefficients between crude fat-crude fiber, crude fat-crude protein and crude fiber - crude protein percentages and less nutritional factors (oxalates) revealed that cultivars can be selected based on single attribute for more studies on these characteristics however, negative correlation of moisture with all proximate characteristics in date cultivars and their parts concludes that dried dates can have higher proportions of these attributes than fresh dates (Hamza *et al.*, 2014). In study of compositional properties, ash contents cannot be neglected as they specify presence of inorganic compounds (minerals) in form of salts and oxides in food. Higher values for ash in flesh parts as compare to pits indicate higher concentration of minerals in flesh of each variety. On percentage basis these may be raised in dried form. Among date samples, ajwa flesh have maximum quantity of calcium, magnesium and potassium but aseel and zaidy flesh were richest in sodium and manganese (Eman, 2015). Differences in mineral contents among varieties were due to genetic variation, geographical conditions, soil, and environmental conditions in which they grow. However, both parts (flesh and pits) in all date varieties were rich in potassium, which is important for cellular and nerve functioning and also has protective role against cardiovascular diseases (Ozcan, 2004) However, low amount of Na in tested date parts can be beneficial against cardiovascular diseases and high blood pressure (El-sohaimy and Hafeez 2010). Scatter plots indicated a highly significant negative correlation of Na while strongly positive relation of Zn and Ca with all other minerals in both parts. Based on this, higher amounts of minerals (Zn, Ca, Mg, Mn and K) will predict lower quantity of Na while increase in quantity of Mg, Mn and K will forecast higher values for Zn and Ca in both parts of date cultivars.

Aside from proximate and mineral components, sugar contents are major nutritive components providing energy to human body cells. As expected flesh parts contain higher level of sugars as compare to pits. There is a big variety of sugars including reducing (glucose, fructose, maltose and galactose), non-reducing (sucrose), monosaccharaides and oligosaccharide (sucrose). Ajwa flesh can be a ready source of energy due to high amounts of glucose and fructose while low amount of sucrose (non-reducing sugars) make it acceptable for diabetic patients (Nadeem *et al.*, 2011; Nazir*et al*., 2007). Dendogram based on Ward's methods classified sugar contents in to three clusters. Cluster III showed higher similarity (99.9%) of three sugars, fructose, maltose and galactose with glucose, while cluster II exhibited similarity (96.7%) of glucose with fructose. Cluster 1 showed minimum similarity (49.1%) between sucrose and glucose. These results suggest that quantity of sugars in date cultivars and parts can be combined for glucose, fructose, maltose and galactose contents while wide distance of sucrose with other sugars discourages the sucrose as the basis for grouping sugars.

Conclusion: Comparative analysis between flesh and pits of all varieties showed higher proportions of crude protein (zaidy), crude fat (ajwa), crude fiber (ajwa), TDF(ajwa), IDF(ajwa) and SDF (ajwa) in date pits than flesh while ajwa flesh was richest source of ash and sugar contents (glucose, fructose, maltose and galactose). Both parts of all date varieties were found good source of minerals especially potassium being maximum in ajwa flesh. In scatter plot and correlation analysis of minerals in both parts of all varieties, Na was significantly negative correlated with all other minerals while Zn and Ca exhibited significantly positive correlations with other minerals. This study will provide awareness to common consumers regarding the nutritional and health beneficial effects of date pits so that their wastage can be minimized. Higher nutritional and less anti nutritional components in date flesh and pits specifically ajwa date emphasize their use in food industry as functional ingredient in food products and supplements.

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