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EVALUATION OF NUTRITIONAL COMPOSITION OF TWO DATE PALM (Phoenix dactylifera L.) VARIETIES AS INFLUENCED BY PACKAGING MATERIALS IN SOKOTO STATE-NIGERIA

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ABSTRACT

A study to evaluate the nutritional composition of Date Palm (*Phoenix dactylifera* L.) Fruits (Deglet and Al-nakheel) as influenced by packaging materials was conducted in the Biochemistry Laboratory of Usmanu Danfodiyo University, Sokoto. The Date Palm Fruits were randomly collected from a standard vendor at Sokoto Central Market in Sokoto, Nigeria which were packaged in paper carton and cotton sacks. The laboratory analysis was conducted using Standard Analytical Methods. The results of the study revealed packaging materials could influence the nutritional composition of the Deglet date fruits. Significant differences were observed, especially in date fruits packaged using carton in all the measured parameters except for Ash content that gave statistically similar results in both carton and cotton sacks. The study further indicated that, Al-nakheel packaged using carton had significant effect in all the measured parameters except for crude protein that gave similar values in both carton and cotton sack. This study provides some basic results that could be helpful in future development of short- and long-term preservation methods for better handling and industrialization of date fruits. Further research on the influence of packaging materials on date fruits nutritional quality is highly recommended.

Keywords: Date palm fruits; Deglet; Al-nakheel; packaging materials

INTRODUCTION

Date Palm (*phoenix dacttylifera)* is one of the oldest trees from which man has derived benefit and it has been cultivated in North Africa and the Middle East for at least 5000 years (Zohary and Hopf, 2000; Jaradat, 2011; Chao and Krueger, 2007). It was certainly domesticated by 3000 B.C. in Mesopotamia, and may even have been cultivated as early as 5000 B.C. (Mahmoudi *et al*., 2008). During the past three centuries, dates were also introduced to new production areas in Australia, India/Pakistan, Mexico, southern Africa, South America, and the United States (Chao and Krueger, 2007). Date palm is believed to have been introduced into Nigeria in the early 8th Century by Arab

traders from North Africa. The world production of date fruits has increased from about 4.6 million tons in 1994 to 7.68 million tons in 2010 and expectations are that their production yield will continue to increase (Al-Farsi and Lee, 2008; Ashraf and Hamidi-Esfahani, 2011; Tang *et al*., 2013). This indicates that the consumption and demand for date fruits are increasing every year and the production of date fruits is also increased to meet the increasing demands.

Many storage technologies are available and being used throughout the world to prolong the market life, maintain a high quality product and add value to dates in order to enhance the market competitiveness and economic value of edible product (Al-Yahayai and AlKharusi, 2012). When stored at some specific conditions, date fruits can be subjected to various quality degradation phenomena such as sugar crystallization at the surface of the dates, drying of soft dates, hydration, fermentation or surface color change and biological alterations due to the development of micro-organisms. Temperature is one of the most important factors which affect the shelf life and the quality of date fruits. Temperatures which are low, but not low enough to cause chilling-injury can slow down physiological activity. The Food and Agriculture Organization (FAO) has conducted several activities to prolong the storage of date fruits using refrigeration.

Since quality parameters of date fruits are affected by storage, it is very important to understand the effect of storage conditions on the nutritional composition of date fruits. The literature contains many studies on the effect of storage on different fruit and vegetable attributes (Ismail *et al*., 2008). Unfortunately, few studies are focused on the influence of packaging materials on nutritional composition of date palm fruits. Therefore, the aim of this study was to evaluate the nutritional composition of date palm (*Phoenix dactylifera* L.) fruits (Deglet and Al-Nakheel) as influenced by packaging materials

MATERIALS AND METHODS

Study Area

Research was conducted at Biochemistry Laboratory of Usmanu Danfodiyo University, Sokoto situated between Longitude 5^0 11'E to 5^0 14'E and Latitude $13^0$8'N to 137'N (Annonymous, 2015). Sokoto lies between Longitude $4^0$8'E to $6^0$54'E and latitude 12^0N to $13^0$58'N with an altitude of 351m above sea level within Sudan Savanna Region of Nigeria. The climate of the area is hot, semi-arid tropical type. It is characterized by a long and severe dry season lasting from October to May, and short but intensive wet season from May/June until September. The rainfall pattern is characteristically distributed with a peak in August. Sokoto falls under the Sudan savanna agro-ecological zone. The area has annual rainfall range of 550-700 mm and mean annual temperature ranging from 38 to 42^0C or more around April. The lowest mean temperature in December-January (Harmattan period) is about 13-15^0C. The mean maximum temperatures are highest generally from Mach to June. The mean relative humidity reaches its peak of over 90% in August and lowest in December and January (10-30%) (SERC, 2014). There are hot humid days during the raining days (Adejuwon, 2016). The soil of the area is sandy loam. Wind direction is North-West and south-west for dry and wet seasons respectively (SERC, 2014).

Sampling and Collection of Materials

Date fruit samples were randomly selected from a standard vendor at Sokoto Central Market in Sokoto, Nigeria (Deglet and Al-nakheel). The samples were collected at Tamer stage (29 weeks) of maturity (which is solid, dark brown in colour and a wrinkled appearance) packaged in a carton and cotton sack containing about 10 kg fruits, respectively. A 2-way factorial experimental design with three replicates was employed with two types of packing materials (Carton and Cotton sack) and two date cultivars (Deglet and Al-nakheel) as variables.

Proximate Analysis

The Nutritional compositions of the date palm fruit (Deglet and Al-nakheel) were determined using standard analytical methods described by Association of Official Analytical Chemicals (AOAC, 2005).

Determination of Moisture Content

A clean Petri dish was weighed using weighing balance (W1) and 5g of the sample was also weighed (W2) into a pre-heated Petri dish and placed in the oven for drying at regular temperature of 80ºC for 24hours to a constant weight. The content and the dish were allowed to cool in a desiccator before weighing as (W3) in triplicate.
Percentage moisture is determined by:

$$\text{Percentage Moisture} = \frac{\text{W1} - \text{W3}}{\text{W2}} \times \frac{100}{1}$$

Determination of Ash Content

Empty crucible was weighed using weighing balance and 5g of the sample was weighed in to the crucible and then transferred to the muffle furnace and ashed at 600ºC for 3 hrs. The ash was determined by weighing in triplicate.

$$\text{Percentage Ash} = \frac{\text{weight of crucible and ash} - \text{weight of crucible}}{\text{weight of crucible}} \text{ x } 100$$

Determination of Crude Protein (Micro kjehdahl method)

Digestion: 2g of sample was collected and put in a clean dry 500 ml kjehdahl flask. Catalyst and 20 ml conc. H_2SO_4 were added and mixed gently by swirling under tap water. 10g of anhydrous Na_2SO_4 and 1g of $CuSO_4$ was mix together and 3.0g of it was introduced into the flask. The entire mixture was boiled gently in kjehdahl flask in a fume cupboard until charred particle disappeared and a green solution is obtained. Then, 40 ml of 2% boric acid was measured out into a 250 ml beaker and indicator was added. 10 ml of the digest was place in the distillation flask and 30 ml of 40% NaOH was added to 10ml of the digest slowly from a syringe and titrate the distillate with 0.1N until the end point.

$$\text{Percentage Nitrogen} = \frac{\text{Tv} \times \text{N} \times 0.014 \times \text{DF x } 100}{2 \times 10}$$

TV= titer value
0.014= Nitrogen factor
N= Normality of HCL (0.1)
DF= Dilution factor (50)

Determination of Crude Lipid

The soxhlet apparatus was set up and 5g of the sample was weighed into a thimble and the mouth of porous thimble was covered with cotton wool in order to distribute the dropping N-hexane which extracts the sample. The thimble was then placed in the extraction chamber and the flask was heated for 3hrs after which the flask was removed with care and the n-hexane in the flask was allowed to evaporate and the extraction flask containing the oil was weighed to know the content of the crude lipid.

Crude lipid is given by = $\frac{w2-w1}{w3} \times \frac{100}{1}$

W1= weight of empty flask
W2= weight of flask + oil
W3= weight of sample

Carbohydrate Determination

The carbohydrate content was calculated using the following formula: Available carbohydrate (%), = 100 – [protein (%) + Moisture (%) + Ash (%) + Lipid (%)]

Data Analysis

Independent sample t-test was used to determine the variation between the two packaging materials using SPSS version 20.

RESULTS AND DISCUSSION

Nutritional Composition of Deglet and Al-nakheel as Influenced by Packaging Materials

Packaging material could influence the nutritional composition of the Deglet date fruits (Table 1). Significant differences were observed, especially in date fruits packaged using carton in all the measured parameters except for Ash content that gave statistically similar result in both carton and cotton sacks. Results in Table 2 indicated that, Al-nakheel packaged using carton had significant effect in all the measured parameters except for crude protein that gave similar values in both carton and cotton sack. The reasons for these different results could be due to the difference of the collecting origin and cultivar of date fruits, heterogeneous processing methods, conservation between collection and analysis and the different materials used in packaging the date fruit. Studies on the change of nutritional compositions in date fruits have been reported. Ihsanullah *et al*. (2005) suggested that moisture content of date fruits packed in white polythene decreased from 14.1 to 9.7% over 5 months period. Moisture levels of fruits have been reported to remain more or less constant

under low temperature storage, but prolonged storage often leads to a decrease in moisture content (Omoigho and Ikenebomeh, 2000; Zare *et al*., 2002).

Table 1: Nutritional composition of Deglet as influenced by packaging materials

Packaging Materials	Nutritional Composition (%)				
	Moisture	Ash	Crude Protein	Lipid	Carbohydrates
Carton	22.53±0.13	3.86±0.13	3.29±0.13	33.87±0.13	36.44±0.18
Cotton Sack	10.40±0.23	3.47±0.13	2.63±0.15	0.26±0.07	83.23±0.29
t-value	45.50	2.12	3.39	225.39	-135.57
p-value	0.000	0.101	0.028	0.000	0.000

P-value statistically significant ($p<0.05$)

However, significant increases in moisture content in Deglet (Table 1) were observed, which could be attributed to differences in genetic factor, heterogeneous processing methods and conservation between collection and analysis. The result supports the findings of Ogungbenle (2011) who reported different moisture content in date fruit cultivars. Date fruits in carton packages also showed higher moisture content values compared to those in cotton sack packages. The reason for these results might be due to the higher inhibition of oxidant reactions in carton packing.

Al-nakheel (Table 2) showed higher percentage of Ash content when packaged using carton. The finding of this study is in agreement with Elsohaimy and Hafez (2010). Higher lipid content in both Al-nakheel and Deglet packaged using carton, this variation could be attributed to preservatives added during packaging or the genetic makeup of the species. Dates are particularly rich in carbohydrates. Sugars in dates are the most prevalent compounds (Mayo Wilson *et al*., 2011) as they provide a rich source of energy to humans. The average energy of fresh and dried dates is 213 and 314 kcal/100 g, respectively (Al-Farsi and Lee, 2008). This study revealed higher carbohydrate content in both Deglet and Al-nakheel packaged using cotton sack which was in accordance with the reported observations by Ismail *et al*. (2006). The increase in concentration of carbohydrates packaged using cotton sack may be linked to decrease in the water content of date fruits in cotton sack compared to carton. Variations in the carbohydrate concentration of date fruit can be attributed to differences in cultivar, processing methods and the type of packaging material used (Ali *et al.,* 2009 and Saffi *et al*., 2008). When stored at some specific conditions, date fruits can be subject to various quality degradation phenomena such as sugar crystallization at the surface of the dates, drying of soft dates and hydration.

Table 2: Nutritional composition of Al-nakheel as influenced by packaging materials

Packaging Materials	Nutritional Composition (%)				
	Moisture	Ash	Crude Protein	Lipid	Carbohydrates
Carton	19.07±0.13	13.73±0.13	2.40±0.12	38.00±0.23	26.73±0.18
Cotton Sack	17.33±0.13	5.33±0.13	2.40±0.12	0.67±0.13	74.27±0.18
t-value	9.19	44.55	0.00	140.00	-190.56
p-value	0.000	0.000	1.000	0.000	0.000

P-value statistically significant ($p<0.05$)

CONCLUSION

Overall results showed that packaging materials could affect the nutritional composition of the tested date cultivars. This study provides some basic results that could be helpful in future development of short- and long-term preservation methods for better handling and industrialization of date fruits. Further research on the influence of packaging materials on date fruits nutritional quality is highly recommended.

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