Assessment of Nutrient Quality and Spoilage Fungi Of Date Palm Fruit (*Phoenix dactylifera* L.)

[1]Agbagwa, S. S.; [1]Chuku, E. C., [2]Chibuike, P. M. & [1]Onuchukwu, M. A.
[1]Department of Plant Science and Biotechnology, Rivers State University Port Harcourt.
[2]Department of Microbiology, Rivers State University Port Harcourt.

D.O.I: 10.56201/ijasmt.v8.no4.2022.pg5.13

ABSTRACT
Study of the nutrient quality and spoilage fungi of date palm fruit (Phoenix dactylifera L.) was carried in Plant Science and Biotechnology and Microbiology Departments in Rivers State University. Nutrient composition investigation revealed availability of proximate, mineral and vitamin components. Highest proximate content was recorded for carbohydrate (54.5 ± 0.00%) while ash recorded lowest value (0.55 ± 0.05%). Potassium and Iron recorded highest (200 ± 0.00mg/100g) and lowest (4.55 ± 0.05mg/100g) values respectively for mineral element screening. In addition, vitamin A (80 ± 0.00mg/100g) and thiamin (0.05 ± 0.00mg/100g) were the vitamins recorded in date palm fruit samples. However, several phytochemicals including oxalate, saponin, tannin, carotenoid, polyphenol, flavonoid and lignant were seen in appreciable concentration. Three fungal organisms viz: Rhizopus sp, Candida sp and Aspergillus niger were isolated from spoilt date palm fruit. Highest incidence (50%) was seen for Candida sp whereas A. niger recorded the lowest incidence (10%). Generally, date palm fruit is rich in several nutrients.

Keywords: *Date palm (Phoenix dactylifera), fruit, nutrient and spoilage fungi.*

INTRODUCTION

Date palm (*Phoenix dactylifera*) is a member of the Arecaceae family and is mostly cherished for it sweet edible fruit (Gotch *et al.,* 2006). The plant is found in the subtropics and tropics including Africa and Asia with over 19 species (Krueger, 2007).

Date palm is a tall evergreen palm with a height range of 15 to 40m and a rooting system of 6m in depth. The fruits are fleshy with sweet pericarp and they are regarded as one seeded berry with an oblong shape. The plant is dioecious with several fronds (Zaid *et al.,* 2002). The plant grows in areas with little or no rainfall and lengthy summer of over 32^0C optimum temperature. Date is tolerant to salty soil and heavy winds but grows better in loamy soils (Janick and Paul, 2008, Chao *et al.,* 2007).

Date palm is cultivated in different ways including vegetative propagation, chance seedlings and tissue culture technique (Zaid and De Wet, 2002; Glasner *et al.,* 2002; Gurevich *et al.,* 2005). The plant is mostly grown because of its fruit that serves as a staple food (Zohary and Hopf, 2000).

Literatures have shown date palm fruit to be a good source of nutrient as it contains carbohydrate, protein, lipid, fibre, ash, calcium, phosphorus, potassium, magnesium, iron and vitamins A and thiamin (Zamir *et al.*, 2018; Vayalil, 2012; Dahaim *et al.*, 2021). The plant also possesses phytochemicals (oxalate, saponin, polyphenol and flavonoid) that are medically and pharmaceutically important (Shaba *et al.*, 2015; Savoia, 2012). These nutrients play a vital role in human and animal health as date palm fruits are consumed by man and prepared as feeds for animals (El-Juhany, 2010). Other parts of the plant are also processed into different house hold products including baskets, syrups and thatch (Alhomidy *et al.*, 2011).

This cherished fruit is also faced with the challenge of spoilage by pathogenic microorganisms including fungi and bacteria. The activities of these organisms do not only reduce the fruit quality and appearance but also its marketability (Cao *et al.*, 2002).

It is on this premise this research was embarked to assess the nutrient and associated spoilage fungi of date palm fruits sold in Port Harcourt, Rivers State.

MATERIALS AND METHODS

Sample Collection

Healthy and spoilt samples of date palm fruits were bought from fruit garden market Port Harcourt, Rivers State. They were immediately transported to the Department of Plant Science and Biotechnology, Rivers State University for further studies.

Determination of nutrient components of date palm fruit

Healthy fruit samples of date palm fruits were sent to the Food Science and Technology Laboratory for the determination of nutrient composition. The methods of AOAC, (2005) was used for the analysis.

Preparation of media

Sterilization of conical flask, slides, Petri dishes and all the equipment needed for the experiment was carried out in the laboratory. The glass wares were sterilized in the oven at 120^{o}C for an hour after washing with soap, while other equipment were surface sterilized with 70% ethanol to reduce microbial contamination (Chuku, 2009). Inoculating loops and scalpels were sterilized by dipping for 20 seconds in 70% ethanol and heated to red hot. The mycological medium used was Sabouraud Dextrose Agar prepared in a conical flask using the standard method. The mouth of the flask was plugged with non-absorbent cotton wool and wrapped with aluminium foil. The conical flask containing the mycological medium was autoclaved at 121^{o}C and pressure of 1.1kg cm-3 for 15 minutes. The molten agar was allowed to cool to about 40 ^{o} C and dispensed into Petri dishes at 15mls per plate and allowed to further cool and solidify.

Isolation of fungi from spoilt date palm fruit

The direct plating method of Mehrotra and Aggarwal, (2003) was adopted were 0.5cm of the samples showing visible signs of spoilage by moulds was cut from the healthy portions of the nut up to the points where rot had established and inoculated onto Sabouraud Dextrose Agar in Petri dishes onto which ampicillin was added to hinder the growth of bacteria in triplicate. The inoculated plates were incubated for 5 days at ambient

temperature of 25^{o} C ± 3^{o} C. The entire set up was observed for 7 days to ensure full grown organisms. Pure culture of isolates was obtained after a series of isolations**.**

Identification of fungi from date palm fruit

Microscopic examination of fungal isolates was carried out by the needle mount method (Cheesebrough, 2000). The fungal spores were properly teased apart to ensure proper visibility. The well spread spores were stained with cotton blue-in-lacto phenol and examined microscopically using both the low and high power objective. The fungi were identified based on their spore and colonial morphology, mycelia structure and other associated structures using the keys of (Barnett and Hunter, 1998).

Determination of percentage incidence

The percentage incidence of fungal occurrence was determined by the formular stated below (Chuku *et al*., 2019):

$$\frac{X}{Y} \times \frac{100}{1} = \% \text{ incidence}$$

Where:

X= total number of each organism in a variety

Y= total number of all identified organism in a variety

Statistical analysis

Data obtained were subjected to mean and standard deviation analysis with the aid of SPSS software version 22.

RESULTS AND DISCUSSION

Table 1: Proximate Composition of Date Palm Fruit

Parameter	Composition (%)
Moisture	35.3 ± 0.2
Ash	0.55 ± 0.05
Lipid	1.75 ± 0.05
Fibre	5.5 ± 0.1
Carbohydrate	54.5 ± 0.00
Protein	2.9 ± 0.1

Table 2: Mineral and Vitamin Composition of Date Palm Fruit

Parameter	Composition (mg/100g)
Calcium	48.3 ± 0.1
Iron	4.55 ± 0.05
Magnesium	114.5 ± 0.5

Phosphorus	85.5± 0.5
Potassium	200 ± 0.00
Sodium	125 ± 0.00
Thiamin	0.05 ± 0.00
Vitamin A	80 ± 0.00

Table 3: Phytochemical Composition of Date Palm

Parameter	Composition (%)
Oxalate	0.01 ± 0.00
Saponin	0.01 ± 0.00
Tannin	0.09 ± 0.00
Carotenoid	20.15 ± 0.05
Polyphenol	7.18 ± 0.03
Flavonoid	3.21 ± 0.01
Lignant	1.7 ± 0.00

Table 4: Fungal isolates from date palm and their percentage incidence

Fungal isolates	Percentage incidence (%)
Aspergillus niger	10
Candida sp	50
Rhizopus sp	40

The result of date palm fruit proximate composition presented in Table1 shows the occurrence of moisture, ash, lipid, fibre, carbohydrate and protein. The proximate composition assessed in the present study are of great concern as several researchers have reported the availability of these parameters in different plants and plant materials through continuous research. Notwithstanding, the result of the current study shows that carbohydrate recorded highest value (54.5 ± 0.00) while ash had lowest value (0.55 ± 0.05). The high and low contents of carbohydrate and lipid in date palm have also been confirmed by early researchers as they indicated the abundance of carbohydrate (Zamir *et al.*, 2018; Hasnaoui *et al.*, 2010). Al-Gboori and Krept, (2010) has implicated date palm fruit to be a good source of nutrient as they profiled its proximate content. However, they reported higher values than those recorded in the present study.

Abiodun *et al.*, (2019) also revealed the nutrient quality of date palm fruit but reported lower moisture (8.16 ± 2.46%) and higher protein, ash and carbohydrate contents. A similar report was also documented by Abdulrahman *et al.* (2020) for various accessions of date palm fruits with moisture having lowest value compared to other reported parameters. On the contrary, the findings of the present study are higher than the values reported by Shaba *et al.*, (2015) for date palm fruits.

Date palm fruit has served as a staple food as it is easily accessible by the poor and less expensive. Moreso, it provides several economic opportunities both to the great and small (Assirey, 2015).
In addition, carbohydrate, protein, lipid, fibre and other proximate nutrients play a vital role in the wellbeing of man through provision of energy and body building materials (El-Sohaimy and Hafez, 2010).

The mineral and vitamin composition result of date palm fruit presented in Table 2 indicates the availability of Calcium, Iron, Magnesium, Phosphorus, Potassium, Sodium, Thiamin and Vitamin A.
Date palm fruit has appreciable amounts of minerals and vitamins as shown in the present study and this result is in line with the reports of early researchers; although there exists variations in the values reported. The current study has shown that potassium was the highest mineral content (200 ± 0.00mg/100g) of date palm fruit, while iron recorded lowest value (4.55 ± 0.05mg/100g). This finding is in agreement with the report of Dahaim *et al.* (2021) for date palm fruits as they reported similar values for potassium and iron. Shaba *et al.* (2015) also investigated same mineral components for date palm fruit, and reported higher mineral values than those of their counterparts in the current study. Nevertheless, the mineral values of the present study are higher than those reported by Abdulrahman *et al.* (2020) and Hasnaoui *et al.* (2010) for date palm fruits.

The vitamin values of the present study revealed higher content of vitamin A (80 ± 0.00 mg/100g) than thiamin (0.05 ± 0.00mg/100g).
Early literature have implicated the presence of several vitamins including vitamins A and thiamin in date palm (AL-Goori and Krept, 2010; Vayalil, 2012). The vitamin values of the present study were higher than those reported by El-Sohainy and Hatz, (2010) for date palm fruits.
Generally, minerals and vitamins are very essential to both man and animals as they support various metabolic processes, act as active catalyst, promote proper vision, strengthen bones and constitute the blood component (Idowu *et al.*, 2020; Hamada *et al.*, 2002).

The phytochemical composition of date palm fruit presented in Table 3 show Oxalate, Saponin, Tannin, Carotenoid, Polyphenol, Flavonoid and Lignant to be present. The present study has shown different phytochemicals present in date palm fruits at appreciable concentrations. Although, highest phytochemical content (7.18 ± 0.03) was recorded for polyphenol and lowest content for oxalate (0.001 ± 0.00). The result of the current study agrees with the findings of Abiodun *et al.* (2019) as they also reported low concentrations for date palm fruit. On the other hand, the result of the present study disagrees with the report of Shaba *et al.* (2015) as they showed higher concentrations of phytochemicals in date palm. Phytochemicals play major role in the health of man as they are known to possess antioxidant, antimicrobial, antidiabetic and anticancer potentials; more so, many also serve as vitamin precursors (Dillard and German, 2000; Vayalil, 2002; Savoia, 2012).

The result of spoilage fungi incidence presented in Table 4 reveals *Rhizopus* sp, *Candida* sp and *Aspergillus niger* to associated with the spoilage of date palm fruit.

The present study has shown three fungal organisms associated with the spoilage of date palm with varying incidence. Highest incidence (50%) was recorded for *Candida* sp while lowest incidence (10) was seen for *A. niger*. The quality of consumable plant produce are of critical concern, hence several researcher have profiled pathogens that contaminate these produce (Risiquat, 2013).

The isolates from the present study agree with the report of early researchers as they implicated several yeast, mold and bacterial organisms to be responsible for the spoilage of date palm fruit. (Zamir *et al.,* 2018). Abass, (2013) also recorded *A. niger* to be responsible for date fruit spoilage in line with findings of the current study.

The present result disagrees with the report of Hasnaoui *et al.* (2010) as they indicated *A. niger* to be the most abundant fungal contaminant of date fruit. The activities of fungi and other pathogenic organisms affect not just the quality of plants and their products but also the marketability, gross income, smell and taste. Of a critical concern remains the negative impact on health as they are able to cause several diseases when consumed alongside with the produce (Al Jasser, 2010, Hameed and Abass, 2006).

CONCLUSION

Date palm is cherished because of its sweet taste, but the present study has also showed date palm fruit to have vital nutrients. Fungal organisms are also capable of causing spoilage of the fruit. Hence, proper and hygienic handling should be adopted to prevent microbial contamination

REFERENCES

Abass, M. H. (2013). Microbial contaminants of date palm (*Phoenix dactylifera L.*) in Iraqi tissue culture laboratories *Emir. J. Food Agric.*, 25(11), 875 – 882.

Abdulrahman, Y. S., Ahmed, F. O., Andrew, G. S.,Abdulazeez, D. O., Muhammad, A. B., Eloghosa, O. P. and Huisaini, A. R. (2020). Nutritional properties of some selected data plam (*Phoenix dactylifera* L) land races in Nigeria. *World J. Food Sci. & Tech.,* 4(1), 1 – 7.

Abiodun, I. K., Clinton, H. I., Osuchukwu, O. C. and Oluwaseun, A. M. (2019). Education of proximate, anti-nutrient and some mineral composition of *Phoenix dactylifera*. *Int. J. Inno. Sci. & Res. Tech.,* 4(5), 865 – 867.

Al Jasser, M. S. (2010). Effect of storage temperature on microbial load of some dates palm fruits sold in Saudi Arabia market. *Afri J. Food Sci.,* 4(6), 359 – 363.

Al-Gboori, B. and Krept, V. (2010). Importance of date palms as a source of nutrition. *Agricultural Tropica et Subtropica,* 43(4): 341 – 347.

Alhomidy, S.N. ; Basmaeil, S. ; Al-Owaimer, A.N. ; El-Waziry, A.M. ; Koohmaraie, M., (2011). Effect of feeding different amounts of discarded dates on growth and efficiency of digestions in sheep. *Aust. J . Basic Appl, science,* 5(3) : 636 – 640

AOAC, (2005). *Official methods of analysis of AOAC international*, 18th edition. Association of official analytical chemists, Washington, D.C., USA.

Assirey, E. A. R. (2015). Nutritional composition of fruit of date palm (*Phoenix dactylifera*) cultivars grown in Saudi Arabia. *J. Taibah Uni. Sci.*, 9, 75 – 79.

Barnett, H. L. and Hunter, B. B. (1998). *Illustrated genera of imperfect fungi*, 4th edition. American Phytopathological Society Press, St. Paul Minnesota, 218.

Cao, B.R. and Chao C.T. (2002). Identification of date palm cultivars in California using AFLP markers. *Hort. science* 37: 966 – 968.

Chao, C.C.T. and Krueger, R.R., (2007). The date palm (*Phoenix dactylifera* L.); overview of biology, uses, and cultivation. *Hort. science*, 42 (5): 1077 – 1082.

Cheesebrough, M. (2000). *Distinct laboratory practice in tropical countries* part 2. Cambridge University Press London, 143-156.

Chuku, E. C. (2009). Fungi responsible for the spoilage of plantain (*Musa paradisiaca*) at various ripening stage. *Acta Agronomical Nigeriana*, 9(1&2), 35-45.

Chuku, E. C., Agbagwa, S. S. & Worlu, C. (2019). Nutrient quality and associated spoilage fungi of English pear (Pyrus communis L.). *International Journal of Agriculture, Environment & Bioresearch*, 4(6), 317-325.

Cummings, J. H., Bingham, S., Heaton, K. W. and Eastwood, M. A. (1992). Fecal weight, colon cancer risk and dietary intake of non-starch polysaccharides (dietary fibre). *Gastroenterology*, 103: 1783 – 1789.

Dahaim, R., Hammoni, Z., Al Ghali, R., Smail, L. and Haromi, D. (2021). The mineral composition of date palm fruits (*Phoenix dactylifera* L.) under low to high salinity irrigation. *Molecules*, 26, 7361.

Dillard, C. J. and German, J. B. (2000). Phytochemicals: nutraceuticals and human health. *J. Sci. Food AGric*, 80, 1744 – 1756.

El-Juhany, L., (2010). Degradation of date palm trees and date production in Arab countries. Causes and potential rehabilitation. *Aust. J. Basic. Appl. Sci.*, 4 (8): 3998 – 4010.

El-Sohaimy, S. A. and Hatez, E. E. (2010). Iochemical and Nutritional characterization of date palm fruits (*Phoenix dactylfera* L.). *J. Appl. Sci. Res.*, 668), 1060 – 1067.

Glasner, B., Botes, A., Zaid, A. and Emmens J. (2002). Date harvesting, Packinghouse management and marketing aspects, In : Zaid, A. (ed.). Date palm cultivation. Food and Agriculture Organization Plant Production and Protection paper no. 156. Food and Agriculture Organization of the United Nations, Rome, Italy, 177 – 208.

Gotch, T., Noack D. and Axford G. (2006). Feral tree invasions of desert springs. Abstracts, Third International Date Palm Conference, Abu Dhabi, United Arab Emirates, 19 – 21 Feb., 2006,. 40. United Arab Emirates University, Al- Ain, U.A.E.

Gurevich, V., Lavi, U. and Cohen, Y. (2005). Genetic variation in date palms propagated from off shoots and tissue culture. *Amer, J. Soc. Hort. science*. 130 : 46 – 53

Hamada, J. S., Hashim, I. B. and Sharf, A.F. (2002). Preliminary analysis and potential uses of date pits in foods. *Food Chem.,* 76, 135 – 137.

Hameed, M. A. and Abass, M. H. (2006). Study of cytological changes associatedwith contaminated date palm *Phoenix dactylyfera* L. tissue cultures with fungi. *Basra Res. J.,* 32, 1 – 27.

Hasnaoui, A., Elhoumaizi, M. A., Asehraou, A., Sindic, M., Deroanne, C. and Hakkou, A. (2010). Chemical composition and microbial quality of Dates grown in Figuig Oasis of Morocco. *Int. J. Agri. Biol.,* 12, 311 – 314.

Idowu, A. T., Igiehon, O. O., Adekoya, A. E. and Idowu, S. (2020). Dates palm fruits. A review of their nutritional components, bioactivities and functional food applications. *AIMS Agric & Food,* 5(4), 734 – 755

Janick, J. and Paul, R.E., (2008). *The encyclopaedia of fruits and nuts*. CABI publishing series.

Krueger, R.R. (2007). Nutritional dynamics of date palm (*Phoenix dactylifera* L.). *Acta Hort.* 736:177-186.

Mehrotra, R. S. and Aggarwal, A. (2003). Pythopathological techniques in plant pathology: In *Plant pathology* 2nd edition. Tata McGraw-Hill publishing company limited, 821.

Reisiquat, R. O. (2013). Microbiological assessment of date fruits purchased from Owode market, in Otta, Kwara State, Nigeria. *J. Env. Sci. Toxicology & Food Tech.,* 4(3), 23 – 26.

Savoia, D. (2012). Plant derived antimicrobial compounds: atternatives to antibiotics. *Future Microbial*., 7, 979 – 990.

Shaba, E. Y., Ndamitso, M. M., Mathew, J. T., Etsunyakpa, M. B., Tsado, a. N. and Muhammad, S. S. (2015). Nutritional and antinutritional composition of date palm (*Phoenix dactylifera* L.) fruits sold in major markets of Minna Niger State, Nigeria. *Afri. J. Pure & Appl. Chemistry*, 9(8), 167 – 174.

Vayalil, P. K. (2012). Date fruits (*Phoenix dactylifera* L.): an emerging medicinal food. *Crit. Rev. Food SCi. Nutr.,* 52, 249 – 271.

Zaid, A. and De Wet, P.F. (2002). Date palm propagation, p. 73 – 105. In : Zaid, A. (ed.). Date Palm Cultivation. Food and Agriculture Organization Plant Production and Protection paper no. 156. Food and Agriculture Organization of the United Nations, Rome, Italy.

Zaid, A., De Wet, P.F. Djerbi M., and Oihabi A. (2002). Disease and pests of date palm, p.227 – 281. In: Zaid A. (ed.). Date palm cultivation. Food and Agriculture Organization Plant Production and Protection paper no. 156. Food and Agriculture and Organization of the United Nations, Rome, Italy.

Zamir, R., Islam, A. B. M. N., Rahman, A., Ahmed, S. and Faruque, M. O. (2018). Microbiological quality assessment of popular fresh date samples available in local outlets of Dhaka city, Bangladesh. *Int. J. Food Sci.*, 7840296.

Zohary, D. and Hopf, M. (2000). Domestication of plants in the old world: The origin and spread of cultivated plants in West Asia, Europe, and the Nile Valley. Oxford University Press, Oxon, UK.