

Antibacterial Activity and Nutritional Content of Fresh and Dried Date Fruits (*Phoenix Dactylifera*) L

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ABSTRACT

The study was aimed to compare the antibacterial activity and nutritional content of fresh and dry date fruits. The antibacterial activity was examined using disc diffusion assay. While the nutritional content was examined using proximate analysis for carbohydrate, ash contents and moisture content, nitrogen, crude protein, crude fibres and lipid; and mineral composition was evaluated using the standard Association of Analytical Chemists (A.O.A.C) methods. The extract showed higher activity against *S. aureus* in both fresh and dried date fruit extract with the inhibition zone of 17 and 15 mm respectively. While the extracts were less active against *E. coli* with 11 and 9 mm zones of inhibition of fresh and dried date fruit extract respectively. The result of the proximate composition showed that the fresh fruit contained higher values in the carbohydrate (95.00%), ash contents (3.30%) and moisture content (68.50%) than the dried date palm fruit with (92.02%), (0.50%) and (5.00%) respectively. On the other hand, the dried date Palm fruit also showed higher value in the crude protein (4.30%) and nitrogen (0.69%) than the fresh fruit with 1.14% and 0.18% respectively. It has also been shown that the fresh fruit contained higher concentration of sodium (3.50%), phosphorus (0.61%) and potassium (0.61%), while that of the dried fruit contained high value in magnesium (0.07%) content, and both contained same value of calcium (0.04%).

Keywords: Antibacterial activity, *Phoenix dactylifera*, disc diffusion assay, proximate analysis, zone of inhibition

INTRODUCTION

Food related illnesses are still considered to be a major concern for food industries, consumers, and food safety consultants. Recently, there is an increasing trend towards the utilization of natural materials as a replacement for the synthetic ones. As the synthetic substances and their products are more complex when compare to natural substances. Food antimicrobials are the supplementary compounds in foods that obstruct the growth of pathogenic microorganisms or even kill them. These practices have been improved in the last one and half decades as the food processors quest for better tools to improve food safety especially those relying on the utilization of natural derivatives from plants as antimicrobial agents. [1] Plants are used medicinally in different parts of the world and are a source of many potent antibiotics. Almost 20% global plants have been pharmacologically or biologically screened, and a substantial amount of novel antibiotics introduced to the market are acquired either from semi-synthetic or natural resources. [2] Date palm (*Phoenix dactylifera* L.) is an important member of the Palmaceae family grown mostly in semi-dried and dried regions of the world. It is commonly consumed in various parts of the world as it constitutes a vital constituent of the diet and considered a staple food in the Middle East and North Africa. [3-7] The World Food and Agricultural Organization reported that there are approximately 90 million date palms globally and each tree can survive for over 100 years. And about 64 million of

such trees are found in Arab countries, which yield 2 million tons of dates annually. [8] Dates have been found to be used in traditional medicine. It served as a deterrent and astringent in intestinal problems, it is used in the treatment of bronchial catarrh, cold, sore throats, fevers, edema liver, abdominal troubles and gonorrhoea, and it has been found to neutralize alcohol intoxication. [2] The date fruit is composed of a seed enclosed by a pericarp (fleshy) which constitutes between 85- 90% of the entire date fruit weight. [9] The fruits of date palm comprise of a high percentage of carbohydrate, fat, salts and minerals, protein, vitamins and a high amount of dietary fibre. [8,10,11] Previous studies reported that a date possesses high nutritional values. [3,5,7-10,12] Different parts of date plant were screened for their antibacterial activities in different parts of the world. The extract from leaf, [13,14] fruit, [1,11,15,16] endocarp, [17] seeds, [18] bark, [19] spathe, [4] pit [13] and syrup [20] of date palm were evaluated for their antibacterial activities against various gram negative and positive bacteria including, *Escherichia coli*, *Enterococcus faecalis*, *Klebsiella pneumoniae*, *Salmonella enteritidis*, *Shigella flexneri*, *Serratia marcescens*, *Pseudomonas aeruginosa*, *Listeria monocytogenes*, *Bacillus subtilis*, *Staphylococcus aureus*, *Streptococcus pyogenes* and *Lactobacillus brevis*. All the aforementioned studies were either focused on antibacterial activities or nutritional value, but very few studies combined both nutritional values and antibacterial activity. Thus, the objective of this study is to screen the antibacterial activities and nutritional content and of fresh and dried date fruits.

MATERIALS AND METHODS

Sample collection and preparation

The two date fruits (Fresh and dried) samples were obtained from central market, Sokoto state, Nigeria in July, 2016. They were then brought to the Agric. Chemical Laboratory, Usmanu Danfodiyo University, Sokoto. One hundred gram of fresh date was

homogenized using a mechanical blender with 500 ml of sterile distilled water. The dried fruits were grinded into powder using mortar and pestle. One hundred gram of dried date powder was dissolved 500ml of sterile distilled water. The mixtures of both samples were left at room temperature overnight. The mixture was then filtered using a Whatman No. 1 filter paper and was then centrifuged at 5000 rpm for 10 min at 5°C. Furthermore, the clear extracts were then filtered to sterilize using a 0.45 µm size membrane filtered. The sterile extracts were transferred to a sterile screw cap bottles and labeled Sample A (fresh) and B (dried) and stored at 4°C.

Antibacterial activity

The antibacterial activities of the fresh and dried date palm fruits were evaluated using the diffusion disc assay. The bacterial strains include of *Staphylococcus aureus*, *Bacillus subtilis*, *Salmonella* spp and *Escherichia coli* were pre-cultured in nutrient broth overnight at 37°C in incubator. Thereafter, the turbidity of the bacterial suspension was adjusted to 0.5 McFarland standards. One hundred micro liter of each bacterial strain was spread on the nutrient agar (NA) surface using a sterile cotton swab. The sterile paper discs of 5 mm, were impregnated with 20 µL of aqueous extracts and 50 µg/mL chloramphenicol was used as positive control. All plates were then incubated for 24 h at 37°C. Thereafter, the diameters of inhibition zones were measured. [16]

Proximate Analyses

Moisture content was determined by vacuum oven (method 934.06), protein by Kjeldahl nitrogen (method 920.152), and ash by direct analysis (method 940.26) were determined according to the Association of Official Analytical Chemists' methods. [21] The crude protein percentage was estimated by multiplying the total nitrogen content by a factor of 6.25. [21] The lipid content was determined by Bligh and Dyer method. [22] Dietary fibers content was determined using the AOAC enzymatic-gravimetric official method (991.43). [21] Total

carbohydrates were calculated by subtracting the total percent values of other measurements from 100. Proximate analyses were expressed as grams per 100 g of fruit weight. Minerals such as Sodium (Na), Potassium (K), Calcium (Ca), Magnesium (Mg), and Phosphorus (P) in dates were determined according to the AOAC method 985.35, [21] using an atomic absorption (AA) spectrometer.

RESULTS

The result of antibacterial activity of fresh and dried date palm fruits are shown in Table 1. The aqueous crude extract of fresh and dried date palm fruits tested against

gram positive and negative bacteria on disc diffusion agar displayed different degrees of growth inhibition. The extract showed higher activity against *S. aureus* in both fresh and dried date fruit extract with the inhibition zone of 17 and 15 mm respectively. This followed by *B. subtilis* with the inhibition zone of 16 and 13 mm (fresh and dried date respectively). Fresh and dried date extract showed activity with zones of inhibition of 14 and 11 mm against *Salmonella* spp. The extracts were less active against *E. coli* with 11 and 9 mm zones of inhibition of fresh and dried date fruit extract respectively.

Table 1 Antibacterial activity of fresh and dried date palm fruits

Extract	Inhibition zone (mm)			
	<i>B. subtilis</i>	<i>S. aureus</i>	<i>E. coli</i>	<i>Salmonella</i> spp.
Fresh date	16	17	11	14
Dried date	13	15	9	11
Distilled water (-ve control)	-	-	-	-
Chloramphenicol (+ve control)	18	16	23	25

Proximate composition

The proximate composition of fresh and dried dates summarized in Table 2 showed Carbohydrate to be the predominant component in both fresh and dried date, with 95.00% in fresh date and 92.02% in dried date. The moisture content was higher in fresh date (68.50%) than in dried date (5.00%). The crude protein content of the fresh and dried date was 1.14% and 4.30% respectively. The nitrogen content was higher in dried date (0.69%) than in fresh date (0.18%). Ash content of was 3.30% and 0.50% in fresh and dried date respectively. The fibre content of fresh date (1.20%) was higher than dried date (0.70%). The lipid content in both date samples was 0.50%.

Table 2 Proximate Composition (%) of Fresh and Dried Date Palm Fruits

Parameter	Fresh Fruit (A)	Dried Fruit (B)
Moisture	68.50	5.00
Crude Protein	1.14	4.30
Nitrogen	0.18	0.69
Ash	3.30	0.50
Crude Fiber	1.20	0.70
Carbohydrates	95.00	92.02
Lipid	0.50	0.50

Mineral Composition

The mineral compositions of fresh and dried dates are summarized in Table 3. It has been showed that sodium content is higher in fresh date (3.5 mg/100g) than in dried date (1.83 mg/100g). Magnesium content was 0.04 mg/100g and 0.07 mg/100g in fresh and dried date respectively. Potassium and Phosphorus content was higher in fresh date (4.50 mg/100g and 0.61 mg/100g respectively) than in dried date (3.00 mg/100g and 0.49 mg/100g respectively). Calcium content in both date samples was 0.04 mg/100g.

Table 3 Mineral Composition of Date Palm Fruit

Element mg/100g	Fresh Fruit (A)	Dried Fruit (B)
Sodium	3.50	1.83
Magnesium	0.04	0.07
Potassium	4.50	3.00
Phosphorus	0.61	0.49
Calcium	0.04	0.04

DISCUSSION

The obtained results in this study indicate that all the plants extract possesses potential antibacterial properties against the organisms tested; however, aqueous extract of fresh date was found to be effective

against both gram positive and negative bacteria. These results are in line with those obtained by [1,11,15,16] who proved that date palm fruit possesses antibacterial activity against several bacterial isolates. The highest antibacterial activity of date samples on *S. Aureus* in present study is in agreement with previous studies. [16,20] *E. coli* was less sensitive to the extracts in present study which is in line with previous study. [2,15] In the present study, all the tested date extracts were found to be less effective than Chloramphenicol which is the standard antibiotic. The moisture content of the dried fruit was 5%, this result is in an acceptable value relatively for the dried date palm, which was 5%. [23] While the moisture content of the fresh fruit was found to be 68.5%, the result was relatively high in moisture content and it was found to be similar to the finding by El Arem *et al.* (2011) that found the moisture content of date at ripening stage to be 75.11%. [9] The moisture content of dates decreases as they ripen. [10] Ahmed & Ahmed (1995) found that the moisture in date palm fruit varies based on ripening stages, Kimri stage had the average moisture content of 83.6%, Khalal stage had average moisture content of about 65.9%, and this continues to drop through the Rutab stage (43%) and then to the Tamr stage (24.2%). [24] Carbohydrate is the predominant component in both the fresh fruit and the dried fruit samples ranging in concentration from 95–92.03% respectively. This result indicate that the date palm fruit has higher carbohydrate content compare to the previous studies, 83.41%, [3] 77.34% -84.45%, [12] 73.00% [8] and 80.67%. [23] The variation shown between the present and previous studies in carbohydrate concentration of the date palm fruits may be ascribed to differences in cultivar, harvest/post-harvest factors in growing environment, such as temperature, humidity among others. [25] The results showed that the fiber content of this date palm fruit is lower than that obtained by Al-shahib & Marshall (2002) with mean value of 6.4-11.5%. [26] The ash content of the

fresh date was higher compared the one reported by [27] for Dora date palm fruit (1.4%), but was in close range with that obtained for the dried date palm fruit. The Crude protein content obtained for the two samples in this study is in agreement with previous studies, dried date palm fruit (4.94%); [23] 1.47%, 1.61% and 1.68% for Fard, Khasab and Khalas respectively. [3] Date fruits are a good source of different minerals with concentrations close to the average minerals nutrient intake. The Potassium concentration was highest among all the minerals in both fresh and dried date samples (4.50 and 3.00% respectively); followed by Sodium with 3.50 and 1.83%; then Phosphorus with 0.61 and 0.49% in fresh and dried date samples respectively. The finding is found to be higher than that of the study by Ismail & Altuwairki (2016). [11] On the contrary, Phosphorus, potassium, Sodium, content obtained from the present study was found to be lower compared to the one reported previously. [7,8,3,23,25] Other minerals such calcium and magnesium were detected in small concentrations. Even though the mineral content is lower in this study, each mineral is beneficial to the health, because they are important components of teeth, bones, blood, soft tissues, nerve cells, muscle, and hemoglobin. They are as well vital to overall physical and mental well-being. [3] The differences in the minerals level among dates may be as result of genetic differences, harvesting season, soil mineral availability, and environmental as well as climatic factors. [7]

CONCLUSION

Humans' quest for a balanced diet demands the search for local food materials that could be produced to meet up with human nutritional needs. Based on the results from present study, it can be concluded that fruit of date palm possess broad spectrum of antibacterial activity. The results also suggest that fruit can be used as an alternative source of food and should be incorporated into our diet, especially the

fresh date palm which showed more nutritional value than the dried fruit as their consumption could be essential in prevention of diseases.

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How to cite this article: Mainasara MM, Sanusi SB, Maishanu HM et al. Antibacterial activity and nutritional content of fresh and dried date fruits (*Phoenix dactylifera*) L. *International Journal of Science & Healthcare Research.* 2017; 2(1): 15-20.
