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Exploring the Proximate and Elemental Proportion of Date Palm Seeds *(Phoenix Dactylifera L.)* as an Alternative Mean of Beverages Formulation

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Abstract: *Date palm seeds powder will be considered as nourishing and commercially valuable by-product of date palm fruit processing. The seeds powder was analyzed to determine its elemental and proximate proportions, the study analysed the date palm seed powder contained 25.52% ash, 58.73% Fixed Carbon 10.23% moisture, and 5.52% volatile matter respectively. It further revealed most abundant mineral elements found in the date seed was macro elements such as potassium is highest with (490.53mg/L) followed in descending order by phosphorus (172.01mg/L) down to sodium (29.77mg/L) and microelements of date seeds (zinc, copper, lead, iron, cadmium and manganese) which were in varying concentration. Zinc concentrations of date seeds were at the high levels compared with those of others (0.28- 0.01 mg/L) while cadmium was negligibly showed no traces and manganese was undetected.*

Keywords: *Proximate, Elemental, Date palm, Beverages and Nutrients.*

1.0 INTRODUCTION

The Date Palm ***(Phoenix dactylifera L.)*** is one of the oldest cultivated plants and has been utilized as food for over 6000 years. It is a valued food crop in Middle East and is regarded to be one of the most important fruit tree especially in North African, the Middle Eastern and Asian countries. The fruit contributes to the economy and social life within these regions (Bastway, et al 2008) and it is considered as an important constituent of their diet (Vayalil, 2002). Date Palm ***(Phoenix dactylifera L.)*** farming in Nigeria started since 17th century through the trans-Sahara trade route from North Africa (Jafarpour, et al 2017) by Muslim pilgrims on pilgrimage to the Holy cities of Mecca and Medina as it is a major food to break their fast. Although Nigeria is not one of the leading Date Palm producers in the world, the crop strives in Northern parts of the country especially in regions above latitude 10^{o} north of the equator. Date Palm is mainly important for its fruit, that contains pulp, embedded inside of which is a hard kernel (Al-Shahib 2003). Despite the invaluable roles of date Palm in human life, the Nigerian date palm industry (production, processing and marketing) has been forced

to give up with lack of awareness of the nutritional importance of Date Palm (Jafarpour, *et al* 2017).

Date palm ***(Phoenix Dactylifera L.)*** plays a major role in the economic and social life of the people in the date producing countries (Basuni *et al*., 2010). Date Palm ***(Phoenix Dactylifera L.)*** is a flowering plant species belongs to the palm family of Arecaceae (Chitra devi venkatachalam *et al.,* 2016). The Date Palm ***(Phoenix Dactylifera L.)*** fruit is composed of a fleshy pericarp and seed that is usually oblong ventrally grooved, with a small embryo and a hard endosperm. Date seeds constitute about 10-15% of the weight of date fruit. The world production of Date Palm ***(Phoenix Dactylifera L.)*** was 7.5 million tons in 2011 (Guizani et al., 2014), meaning that approximately 750 thousand tons of date seeds were produced during that year. A large number of date seeds are being obtained from the date industries or the waste products annually. The Date Palm ***(Phoenix Dactylifera L.)*** fruit consists of a seed and a thickly pericarp. The date seed which also known as pit or stone is 10-15 % weight of date fruit. As a date seeds were found as good sources for nurition, economy and industry, [(Sirisena *et al.,* 2015); & (Golshan Tafti *et al.,* 2017)].

1.1 STATEMENT OF PROBLEM

Beverages are one of the fantastic diets and are integral part of our daily needs, providing us with necessary nutrients, keep us hydrated and give us social connections. Selecting the right beverage option can have a positive impact on our health and environment. We consume beverages for a lot reasons. Hydration is one of the most important reasons why we consume beverages, alongside the food we eat; we also need beverages to maintain the fluid levels of our bodies. Beverages not only quench our thirst but also provide us nutrients, energy and necessary hydrations. It will complement us with nutrients that other foods might not be able to provide in the same magnitude. Frequent drinking of sucrose influenced beverages is associated with weight gain, tooth decay/cavities, heart disease, obesity, type 2 Diabetes and kidney disease.

Therefore, this study will focus on the important chemicals (both micro and macro elements) and proximate available in the sample Date Palm ***(Phoenix Dactylifera L.)*** Seed which in return aim at substitutes of the readily available beverages with high content of health risk substances like caffeine and sugar.

1.2 OBJECTIVES OF THE STUDY

The main objective of the study is to investigate the proximate and elemental analysis Date Palm ***(Phoenix Dactylifera L.)*** seed powder as an alternative mean of Beverage formulation.

The specific objectives are:

1. To determine the distribution of products when the sample is heated under specified condition.
2. To conduct a screening in other to know the constituents of sample.
3. To ascertain the elemental composition of sample.

MATERIAL AND METHOD

Area of Study

The study area is Maiduguri metropolis Areas of Borno State lies within the latitudes 11° 46' 18" N and 11^0 53' 21"N and longitudes 13°02' 23" E and 13°14' 19"E. It occupies a total land mass of 50,778sq.km (Ministry of Land and Survey, 2008). It shares common boundaries with Konduga Local Government Area to the North and North-west and Jere Local Government Area to the South. Maiduguri Metropolis has an estimated population of 870,000 with annual growth rate of 2.96% T.A. Ladan *et al* (2022).

Method of Data Analysis

Practical experiments:

Practical experiment was conducted in different laboratories within and outside Maiduguri, date palm seeds samples was taken at different grams and analyzed in the botanical Laboratory of University of Maiduguri, and was proceeded to Chemistry laboratory and science laboratory technology for their physical and chemical properties.

Treatment: Date palm seeds were collected from the Date palm fruit which was purchased. The seed was treated accordingly, grinded to fine powder and kept at room temperature in the tight container throughout the process in other to carry out the analysis. All chemicals in this study were purchased in recognized chemical store to ascertain its standard and Sample chemical analysis was followed according to the official methods of analysis described by the Association of Official Analytical Chemist (A.O.A.C.).

Data was collected on each analysis and properly recorded for proper documentation and subsequently analyzed as described by the Association of Official Analytical Chemist (A.O.A.C.).

MATERIALS:

1) Date Palm Fruits
2) MARS 5 Microwave Oven
3) PFP7 Flame photometer
4) Desiccator
5) Kenwood Ultima Blender
6) Atomic Absorption Spectroscopy (AAS)
7) Reagents:

a) Sulphuric Acid (Conc) H_2SO_4
b) Nitric Acid (Conc) HNO_3
c) Hydrochloric Acid (Conc) HCl
d) Sodium Hydroxide $NaOH$
e) Potassium Hydroxide KOH
f) Magnesium Oxide MgO
g) Barium Chloride $BaCl_2$
h) Bisodium Carbonate Na_2CO_3
i) Ammonium Sulphate $(NH_4)_2SO_4$

j) Calcium Chloride $CaCl_2$
k) Barium Sulphate $BaSO_4$
l) Mercuric oxide HgO
m) Potassium sulphate, K_2SO_4
n) Boric acid H_3BO_3
o) Petroleum ether (*Ligroin*) $(H_3C)_2$-$CH3$

METHODOLOGY:

Sample Preparation

Bulk quantities of the date palm fruit Sukur was used in this study. It was purchased at Monday Market Maiduguri, Borno State, Nigeria. The sample was manually cleaned to remove foreign materials, broken or immature fruits and kernels. Sample was spread on cleaned, light metallic tray of a thin layer at room temperature for 5 days after which their moisture content was determined, following the procedure adopted by Aviara et al. (2007). This involved oven drying at 105 ±2 °C until a constant weight was reached. All chemicals (reagents) used during this study were all of the analytical reagent grade. The analysis was carried out at the General Chemical Analysis Laboratory, department of Science Laboratory Technology, Ramat Polytechnic Maiduguri, Borno state, Nigeria. The Sample was keenly analyzed chemically according to the official methods of analysis described by the Association of Official Analytical Chemist (A.O.A.C.)

Methods of Analysis:

There are two methods and these are as follows:

1. Proximate analysis. *The proximate analysis determines only the moisture, fixed carbon, volatile matter and ash percentages.*

2. Elemental Analysis: - *The ultimate analysis determines all seed component elements, solid or gaseous.*

Moisture Content:

Moisture content was carried out by placing a 250g of grounded date seed of size 200-micron size in an uncovered crucible and it was placed in the oven kept at 110 ±2 °C for one hour. Then the sample was cooled to room temperature in a desiccator and weighed again. The process of heating, cooling and weighing was repeated 3 times till the constant weight of the sample was ascertained.

The percentage moisture is given by:

Moisture content = [(Loss in weight of date / Weight of sample initially taken) × 100%]

Ash Content:

Ash content calculated by weighing the residue obtained after burning a 250g of date palm seed in an open crucible (i.e in the presence of air) at 750 °C in a muffle furnace till a constant weight is achieved.

Ash content = [(Weight of residue ash formed / Weight of date palm initially taken) × 100%]

Volatile Matter:

Volatile Matter of Date seed was the loss in weight of moisture free grounded date palm seed when heated in a covered crucible in a muffle furnace at 950 °C for 10 minutes. Volatile matters were if properly analysed will be the methane, hydrocarbons, hydrogen and carbon monoxide, and incombustible gases like carbon dioxide and nitrogen found in date. Thus the volatile matter is an index of the gaseous fuels present. Typical range of volatile matter is 20 to 35%.

Volatile matter = [(Loss in weight of moisture free date /Weight of moisture free date) × 100%]

Carbon Content:

Carbon was determined directly by deducting the total sum of moisture, volatile matter and ash percentages from 100.

Percentage of *Carbon in date palm = [100 - (% moisture + % volatile matter + % ash)]*

RESULTS AND DISCUSSION

Table 1: Proximate analysis date palm seed

Sample (Date Palm Seed)	**Values (%)**
ASH Content	25.52
Carbon Content	58.73
Moisture Content	10.23
Volatile Matter	5.52

Proximate Analysis of Date Palm Seed results obtained showed that date palm seed powder contained 25.52% ash, 58.73% Fixed Carbon 10.23% moisture, and 5.52% volatile matter respectively as shown in table 1above.

Table 2: Elemental analysis date palm seed

Sample (Date Palm Seed) (Elements)		**Values mg/L**
Zinc	(Zn)	0.47
Copper	***(Cu)***	0.28
Lead	***(Pb)***	0.05
Iron	***(Fe)***	0.01
Cadmium	***(Cd)***	0.00
Manganese	***(Mn)***	-
Sodium	***(Na)***	29.77
Potassium	***(K)***	490.53
Calcium	***(Ca)***	51.95
Magnesium	***(Mg)***	101.23
Phosphorus	***(P)***	172.01
Chlorine	***(Cl)***	-

Elemental Analysis of Date Palm Seed Results obtained showed that seed contained both micro and macro elements. The results of this study clearly show that date seeds have important mineral contents as shown in table 2. The most abundant mineral elements found in the date seed was macro elements such as potassium is highest with (490.53mg/L) followed in descending order by phosphorus (172.01mg/L) down to sodium (29.77mg/L). More so the study further revealed that microelements of date seeds (zinc, copper, lead, iron, cadmium and manganese) which were in varying concentration. Zinc concentrations of date seeds were at the high levels compared with those of others (0.28- 0.01 mg/L) while cadmium was negligibly showed no traces and manganese is undetected as shown in Fig 2. These obtained findings from this study are in close agreement with earlier results of Mexico date seeds (R.Salomon-Torres (2019).

Conclusion

The study on the proximate and elemental proportions of date palm seeds (Phoenix dactylifera L.) highlights their potential as a valuable alternative for beverage formulation. The findings revealed significant nutritional and elemental properties, with high fixed carbon content (58.73%), substantial ash (25.52%), and minimal volatile matter (5.52%). The seeds are rich in essential macroelements, particularly potassium (490.53 mg/L) and phosphorus (172.01 mg/L), along with notable microelements like zinc and copper. These attributes underscore the seeds' potential for functional beverage development, offering a caffeine-free and low-sugar alternative to conventional drinks. This research validates the nutritional and commercial prospects of date palm seeds, advocating their utilization in addressing health-conscious consumer demands and reducing reliance on sugar-laden and caffeinated beverages. The study establishes a foundation for further exploration of date seeds as a sustainable, nutritious ingredient in the food and beverage industry.

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