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**DEPARTMENT OF HORTICULTURE**



# POSTHARVEST HANDLING OF THE EDIBLE PARTS (LEAVES AND FRUITS) OF THE DESERT DATE (*Balanites aegyptiaca)*

## A CASE STUDY IN THE JIRAPA AND NADOWLI DISTRICTS OF THE UPPER WEST REGION OF GHANA.

**A Thesis submitted to the Department of Horticulture, Kwame Nkrumah University of Science and Technology in partial fulfillment of the requirements for the degree**

**Of**

**MASTER OF SCIENCE (POSTHARVEST TECHNOLOGY)**

**BY**

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**November, 2011**

## DECLARATION

I hereby declare that the submission is the result of my own work towards the MSc. Postharvest Technology programme, and that to the best of my knowledge, this study contains no material_neither previously published by another person nor submitted for the award of any Degree of the University, except where acknowledgements have been made in the text. Any opinion or views expressed and errors found in the work, however, entirely are my responsibility and do not necessarily represent the organizations or individuals who have been cited in this work.



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## DEDICATION

This research is dedicated to God Almighty for giving me energy, courage and seeing me through all my education. To my lovely wife, Kaburi Noella and my twins Ferdinand and Ferran Ninfaa for the patience they had for me while I studied in school.

**ACKNOWLEDGEMENTS**

Many people have directly or indirectly contributed immensely to make this study a reality. My foremost and profound gratitude goes to the Almighty God who granted me the desired intelligence, favour, strength, ability and opportunity to complete this work. My outermost gratitude specially goes to my supervisor Dr. B.K Maalekuu for his dedication, patience and willingness to ensure quality of my work improved via appreciative criticism and suggestions. I am truly indebted to him for his wonderful inspiration and keen interest he showed in my work.

I am very grateful to all the tutors of the Department of Horticulture, KNUST for their immense contributions they have brought me to this end.

I am especially grateful to all students of Horticulture whose criticism and suggestions aided in shaping the work. Akurugu Gordon, Isaac Adarkwa, Philip Attim, I thank you all for all your contributions to the success of this work.

I am indebted to all sources from which I have drawn the information. I also register my profound appreciation to all friends especially Mahama Salifu, Iddrisu Harrisu and others who in varied ways contributed to the success of this course.

Finally, my gratitude goes to my mother, who supported me in prayers throughout the programme.

## ABSTRACT

The study was conducted in the Nadowli and Jirapa Districts of the Upper West Region of Ghana, with the objectives of documenting the uses of the desert date, determining the methods of harvesting the leaves and the fruits since the plant is very thorny, identifying the methods of processing and preserving the fruits and the leaves and determining the nutritional composition of the leaves and fruits.

Cutting down and plucking the leaves and standing by the tree and plucking leaves were the two major methods of harvesting the leaves while the fruits are allowed to fall to the ground and then picked.

The leaves and the dry fruits are edible; the leaves are eaten as vegetables in soup or added to a prepared meal called 'koose', the leaves are processed and preserved by boiling and drying while the fruits are dried and preserved or the coat peeled off and soaked in water for a drink.

The roots are poisonous and used for fishing. The stem of the plant is used for fuel and can also be carved into mortars and pestles.

Nutritionally, the leaves contain 41.41% moisture, 17.06% protein 16.02% fibre, 30.92% carbohydrates and 231.02 Cal/100g of energy while the fruits contain 24.63% moisture, 3.85% protein, 8.72% fibre 59.53% carbohydrates and 277.02 Cal/100g of energy.

The desert date plant grows in the wild and has various uses in the area, therefore the people should be encouraged to eat and cultivate it.

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# CHAPTER ONE

## 1.0 INTRODUCTION

*Balanites aegyptiaca* also known as the Desert date in English, 'dattier du desert' in French, 'heglig' in Arabic, 'mjunju' in Swahili, 'tanni' in Fulfulde, 'adua' in Hausa and 'cungo' in Kanuri (Hall and Walker, 1991) is one of the most widely distributed trees in Africa. Although found almost everywhere in the continent, very high concentrations of the tree are most prevalent in sahel and sudan savanna zones of West Africa and semi-arid regions of East Africa (Shanks and Shanks, 1991). Two accessions of the tree with fruit, nut and kernel shapes that corroborate the findings of Launert (1963) are common in North Eastern Nigeria.

Every part of *Balanites aegyptiaca* tree has economic importance. Its roots and bark are pounded and dipped in rivers for fishing, the wood as yoke for draught animals and hand implements, while humans eat the leaves and flesh of the ripe fruit because they are very rich in carbohydrates and vitamins. The most important part of the *Balanites aegyptiaca* tree is the nut, also called stone (Shanks and Shanks, 1991). The nut is obtained after the removal of the flesh and pulp of the fruit and it contains a kernel with oil and protein contents ranging from 30–60% and 20–30% respectively. The oil is good for cooking as it has an acceptable scent and taste (Hall and Walker, 1991), and does not smoke excessively when heated (Shanks and Shanks, 1991). The kernel meal remaining after oil extraction can be used as livestock feed (Abu-Al-Futuh, 1983).

*Balanites aegyptiaca* has been found to have high potential for industrial applications because saponins, which are used as basic raw material in the manufacture of soap, candle, chemicals and cosmetics as well as pharmaceutical products, can be extracted

from any part of the tree. Proper understanding of the mechanical properties of *Balanites aegyptica* nut is considered necessary in the design of appropriate machines for different postharvest operations such as cracking, cutting, crushing and grinding.

Processing of *Balanites aegyptiaca* fruit involves soaking it in cold water for three days or hot water for a day and washing off the pulp to obtain the nut. The nut is sun-dried for two days if cold water was used and for eight hours if hot water was used to soak the fruit. The kernel is obtained from the nut by cracking with stone on top of another stone or metal. Oil is extracted from the kernel by heating its meal in a pan over an open fire or boiling it in a pot containing water. The most difficult and risky aspect of all the operations is the cracking of the nuts to bring out the kernel



### 1.1 Problem Statement and Justification

Information gaps exist for some plant species, though various efforts are made by a number of people to unearth the potentials of some traditional food plants in Africa (Abbiw,1990). The author also maintains that only 15% of tropical species have been catalogued and only 1% is intensively screened for possible benefits to humanity. The desert date (*Balanites aegyptiaca)* which is an indigenous African plant has various uses and benefits and the land of the Upper West Region is naturally endowed with this multipurpose tree. Because the tree grows in the wild, no efforts have been made to cultivate it in Ghana especially in the Upper West Region. Numerous economic activities revolve around this plant, yet little or no research has been undertaken to bring to fore the contribution of the various products of *Balanites aegyptiaca* in the area. It is anticipated that people will be enthused in making maximum use of the desert date at the end of the study.

## 1.2 OBJECTIVES OF THE STUDY.

The objectives of the study were to:

1. Document the uses of the Desert date (*Balanites aegyptiaca* ) in the Jirapa and Nadowli Districts of the Upper West Region.

2. Identify the various methods of harvesting the leaves and fruits.

3. Identify the methods of processing and preserving the leaves and fruits.

4. Determine the nutritional components of the fruits and leaves.

# CHAPTER TWO

## 2.0 LITERATURE REVIEW

### 2.1Taxonomy and Nomenclature

*Balanites aegyptiaca* belongs to the family Balanitaceae. Its synonyms are; *Ximenia aegyptiaca* L. (excl. *Balanites roxburghii planch*), *Agialida senegalensis Van Tiegh, Agialida barteri van Tiagh, Agialida tom-buctensis van Tiegh. Balanites ziziphoides milber. et schlechter, Balanites Latifolia (van Tiegh)*



### 2.2 Vernacular/Common Names

*Balanites aegyptiaca* is commonly called the desert date, Soap berry tree, thorn trees, Jerico balsam, simple-thorned torchwood (English), heglig (Arabic), and corona di Jesus (Spanish).

### 2.3 Botanic Description

According to (Grace *et al.*, 2007) *Balanites aegyptiaca* is a deciduous or semi-deciduous tree up to (20-25) m tall, rarely a shrub; trunk straight, frequently fluted; bark smooth, yellowish brown, mottled or grey,becoming roughly fissured; crown rounded,spreading,sometimes with low branches remaining close to the trunk for some distance ; branchlets usually yellow to greyish green ;spines 3-4(-15) cm long, often often on the upper bole and branches as well as the younger stems ,frequently branched, often appearing forked. Leaves arranged spirally, 2-foliolate; stipules triangular, up to 3mm long, sometimes corky with brown hairs , persistent;petiole and petiolules usually densely pubescent leaflets usually asymmetrical, elliptical to broadly ovate, rounded to obtuse,acute or shortly acuminate,leathery, glabrous or variously pubescent on both surfaces, eventually glabrescent. Inflorescence an

axillary fascicle-like chime, (1- ) 3-7-flowered, indumentum yellowish green to buff, sessile or with short peduncle. Flowers bisexual, 5-merous, often scented: pedicel 0.5-1 cm long; sepals ovate to obovate, 5 mm long, reflexed after anthesis, pubescent outside but with glabrous margins; petals oblong- lanceolate to oblanceolate, (5- ) 7-8 (-9) mm long, reflexed after an thesis, green or greenish yellow, hairy inside; stamens 10,free; disk annular, succulent; ovary superior, densely and stiffly hairy, 5-celled, style terete or taering. Fruit a one seeded drup, oblong-ellipsoid, depressed at both ends, or ovoid, obtuse apically,4-6(-8) cm long, ripening reddish brown, the skin firm but thin, eventually brittle, containing spongy and fibrous.



### 2.3.1 Other Botanic Description

*Balanites* comprises 9 species, most of them in Africa, but one species each in India and Myanmar. The distribution of two African species extends into the Arabian Peninsula, *Balanites aegyptiaca* also occurring in Jordan. *Balanites maughamii* is closely related to *Balanites wilsoniana* Dawe & Sprague which occurs from Côte d'Ivoire to Uganda, and differs in its caducous stipules, inflorescences borne above the leaf axils and silvery grey indumentum of the petiole and young growth. Within *Balanites maughamii* 2 subspecies are recognized: subsp. *maughamii* and subsp. *acuta* which are primarily distinguished by leaflet shape and pubescence. Leaflets on fertile shoots of subsp. *maughamii* are rounded or obtuse and pubescent, whereas those of subsp. *acuta* are acute to shortly acuminate and glabrous. Subsp. *maughamii* occurs throughout the southern part of the range, north to Lindi District, Tanzania, whilst subsp. *acuta* is concentrated in south-eastern Kenya and eastern Tanzania (Grace *et al.*, 2007*)*.

## 2.4 Ecology

*Balanites maughamii* occurs from sea-level to 1000 m altitude; subsp. *maughamii* generally occurs in dry open woodland, frequently along rivers, near springs and around pans, sometimes on seasonally waterlogged floodplains, typically on sandy- or clay-loam. Subsp. *acuta* is found most commonly in mixed, usually coastal, evergreen forest or coastal thicket, up to 500 maltitude. It frequently occurs on more alkaline and less well-drained soils than subsp. *maughamii*. (Grace *et al.*, 2007*)*



## 2.5 Growth and Development

Growth of *Balanites maughamii* follows the growth model of Champagnat: a shoot lengthens due to the activity of an apical bud. Initial growth is upright, but soon the shoot becomes drooping or pendulous under its own weight. A lateral bud then resumes upright growth and the pattern of growth and curvature repeats itself. Subsp. *maughamii* flowers from September to November and fruits from November to March; subsp. *acuta* flowers from November to April with the first mature fruits appearing in February. (Grace *et al.*, 2007*)*

### 2.5.1 Soil Requirements

Found on varied soils, it prefers valley soils but will grow in sand, sandy loams, clays, cracking clay, black cotton, alluvial, gravelly, and stony soils (RSCU, 1992). *Balanites aegyptiaca* is known to tolerate heavy clay soils (Teel, 1984).

### 2.5.2 Influential Factors

Ecologically very flexible with excellent persistence. It withstands occasional flooding and is adaptable to a wide range of sites (Von Maydell, 1986) and climatic conditions, but it cannot tolerate prolonged waterlogging (Kew, 1984). It has good

drought tolerance (Hall, 1991) and is not damaged by grass fires (except young trees), due to a deep tap root and thick bark. Invades areas having periodic fire and areas with heavy livestock activity. Young plants are fairly termite resistant, but *Bunea alcinoe* defoliates the tree.

### 2.5.3 Propagation and Seed Treatments

Seedlings, cuttings, potted stock and root suckets are parts used for propagation.

Fruit turns from green to yellow when ripe, each containing one pit. These can be stored for up to a year if kept air dry and insect free. When ready to plant, soak the fruit overnight in lukewarm water until the pulp can be removed. Recommended pre-treatments include: intestinal scarification; boiling 7 to 10 minutes and cooling; soaking 12 to 18 hours in hot water; soaking for 24 hours in warm water; and soaking overnight in warm water (FAO, 1988).

### 2.5.4 Seedling Management

Does not withstand transplanting well because of the deep tap root. For best results plant in a container with the seed vertical (stem end down) (Teel, 1984). Plants should remain in the nursery for 18 to 24 weeks before out planting at the beginning of the rainy season.

Because of the vigorous tap root, direct sowing at the end of the dry season is recommended. Average rooting success from stem cuttings is about 60 to 70%. Seeds passed through the intestinal tract of ruminants germinate particularly well and can be gathered where livestock are kept overnight.

### 2.5.5 Planting Types

Traditionally it has been, and still is, actively managed. It is planted in agroforestry along the banks of irrigation canals and as a boundary marker. The tree attracts numerous insect species and could be used in agroforestry as a trap tree (IFS, 1989). *B. aegyptiaca* is worth considering for difficult sites, where water is the main limiting factor.

### 2.5.6 Growth Cycle and Management

Slow growing but very resilient. Fruit and foliage appear at the height of the dry season (Hall, 1991). It produces seed in August and September. The first fruit is harvested between 5 and 8 years with the yield increasing until 25 years. It can live for more than 100 years.

Requires weeding and protection from browsing up to the initial fruiting period (at least 3 years). Weeding is important due to slow growth, (FAO, 1988) as high grass can compete for light. Weeds can also impede regeneration and grass fires can destroy young plants.

The roots spread far, and throw up suckers at a considerable distance from the trunk (Stewart and Brandis, 1972).

### 2.5.7 History of Cultivation

Booth and Wickens (1988) reported that there are plantings of the species in the Cape Verde Islands, Curacao, the Dominican Republic and Puerto Rico. Planting have been reported in India. Individual trees are planted extensively in Africa and a small plantation has been established in Niger, Chad and Northern Nigeria.

### 2.5.8 Reproduction Biology

Flowering behavior varies. There is no definite time for flowering in the Sahel, although flowering most likely takes place in the dry season. Flowering in Nigeria is between November and April with ripe fruits becoming available in December and January and occasionally later, from March to July. Elsewhere, fruiting and foliage production occur at the peak of the dry season. Pollination is presumable by insects as flowers are scented and flower structure facilitates insect activity (FAO, 1993) .



## 2.6 Fruits

The fruit pulp though bitter, is edible. It produces fruit even in dry years which makes it a highly appreciated food source in dry areas. Pounded fruits make a refreshing drink which becomes alcoholic if left to ferment. The American Heart Association (AHA) has recommended limiting the intake of trans fats (FAO, 1993)

## 2.7 Uses of Products

### 2.7.1 Ethno medical Uses

Macerated fruit mixed with millet to make porridge is given to women, after childbirth and during lactation, to give them energy, strength and to increase milk production. The oil released from the seeds by boiling is used in the treatment of headache and influenza. It is also used after childbirth and during lactation to release stomach colic and facilitate milk production ( Abdelmuti *et al.*, 1954)

### 2.7.2 Food

The fleshy pulp of both unripe and ripe fruit is edible and eaten dried or fresh. The fruit is processed into a drink and sweetmeats in Ghana, alcoholic liquor in Nigeria, a soup ingredient in Sudan. Young leaves and tender shoots are used as a vegetable,

which is boiled, pounded, then fried or fat added to prepare it. The flowers are a supplementary food in West Africa and an ingredient of 'dawadawa' flavouring in Nigeria. Flowers are sucked to obtain nectar (Stewart and Brandis, 1972).

### 2.7.3 Fodder

The fresh and dried leaves, fruit and sprouts are all eaten by livestock. As shown in an experiment in Burkina Faso, *B. aegyptiaca* contributed up to 38% of the dry-matter intake of goats in the dry season. Kernel meal, the residue remaining after oil extraction, is widely used in Senegal, Sudan and Uganda as a stock feed. The tree is lopped for fodder in India (Maharashta, Madhya Pradesh, Tamil Nadu and Rajasthan) (Stewart and Brandis, 1972).

### 2.7.4 Fuel

The wood is good firewood; it produces considerable heat and very little smoke, making it particularly suitable for indoor use. It produces high-quality charcoal, and it has been suggested that the nutshell is suitable for industrial activated charcoal. The calorific value is estimated at 4600 kcal/kg (Stewart and Brandis, 1972).

### 2.7.5 Timber

The wood is pale yellow or yellowish-brown. Heartwood and sapwood are not clearly differentiated. The wood is hard, durable, worked easily and made into yokes, wooden spoons, pestles, mortars, handles, stools and combs. It shows no serious seasoning defects and no tendency towards surface checking or splitting. The wood saws cleanly and easily, planes without difficulty to a smooth finish and is easy to chisel. It glues firmly and takes a clear varnish. The timber has traditionally been a minor product. The usually small log size and the prevalence of stem fluting make sawmill processing difficult (Grace and Sands, 2007)

### 2.7.6 Poison

An emulsion made from the fruit or bark is lethal to the freshwater snails that are the host of miracidia and cercaria stages of bilharzia and to a water flea that acts as a host to the guinea worm. A fish poison can be obtained from the fruit, root and the bark.

The active agent of the poison is saponin. The compound is toxic to fish but does not affect mammals and rapidly becomes inert, so that fish retrieved are edible. However, in the Fada region of Cote d'Ivoire, the poison is reported to damage the sight of fishermen after they have used it for 5-6 years (Tredgold, 1986)

### 2.7.7 Medicine

Decoction of root is used to treat malaria. Roots boiled in soup are used against oedema and stomach pains.

Roots are used as an emetic; bark infusion is used to treat heartburn. Wood gum mixed with maize meal porridge is used to treat chest pains. The bark is used to deworm cattle in Rajasthan (Tredgold, 1986)

The fruits have been used in the treatment of liver and spleen diseases. The fruit is also known to kill the snails which carry schistosomiasis and bilharzia flukes (Tredgold, 1986). The roots are used for abdominal pains and as a purgative. Gum from the wood is mixed with maize meal porridge to treat chest complaints.

## 2.8 Ghanaian Indigenous Leafy Vegetables

According to the Food and Agriculture Organization (FAO, 1988) as cited by Chweya and Eyzaguire (1999), traditional vegetables are a category of plants whose leaves, fruits or roots are accepted for use as vegetables. Indigenous leafy vegetables belong

to the group of crops which tropical research has rediscovered in recent years due to their nutritional and economic values. Indigenous leafy vegetables are largely under-exploited either because of ignorance or arrogance (Abbey and Timpo, 1990), with some being endangered despite their high potential and value in combating nutrition-related problems. Leafy vegetables are generally bulky and have low calorific values. When added to starchy staples, they help to reduce problems of obesity by reducing total energy of the food consumed and the high fiber content enhances digestion and thus prevents constipation (Grubben, 1977). It has been found that comparatively, the indigenous leafy vegetables are richer in nutrients than their exotic counterparts (Abbey and Timpo, 1990).

In Ghana, indigenous leafy vegetables have low economic value and social prestige because they are consumed by the resource-poor in the society. Cultivation of indigenous leafy vegetables is usually on a small scale and they are often found growing with other crops in an attempt to diversify the income base. Production is mostly done by women in home gardens and compound farms for the local market and for domestic use. Some of these vegetables are harvested from the wild for the Ghanaian daily diet, especially for low-income households with respect to their nutritional value. Their cultivation provides employment, income and security against risks of crop failure if applied in farming systems. Traditional vegetables are widely consumed and are crucial to food security, particularly during famines or natural disasters. The plants grow as weeds in the wild and /or cultivated areas, are semi-cultivated or cultivated or cultivated. If domesticated, they are crops that require few inputs. Most of the vegetables are gathered when in season, or grown in home gardens or intercropped with traditional staples. Indigenous leafy vegetables have unique

advantages within farming systems. They grow quickly and can be harvested within a short period. This makes them useful in nutrition-intervention programmers (Chweya and Eyzaguirre, 1999). During the rainy season when the indigenous leafy vegetables are plentiful, some communities preserve vegetables which contribute to household food security and are more easily marketed. The vegetables also offer variety in the diet and production systems, thus broadening the food base (Okigbo, 1984).



Women are the main experts in the use, processing and marketing of these vegetables. For women, they are an essential resource to sustain the family and ensure the health of the household. According to Chweya and Eyzaguirre,(1999) several vegetable production projects have shown that production of traditional leafy vegetables as a small-scale enterprise can be a significant money-earner for poor people, especially women having little capital, limited access to land and working under labor constraints. The cash they provide contributes significantly to food security at the household level and enables women to attain a degree of financial independence within the family budget.

The Gboma eggplant (*Solanum macrocarpon*) as one such important leafy vegetable in soup, stews, has high fibre content, enhances digestion and relieves constipation. It also adds taste and flavour to soups and stews and supplies minerals and vitamins lacking in starch staples (Chweya, 1997). The leaves consist of 86% water, 6% carbohydrates, 4.6% protein, 1.6% fiber,1% fat(Schippers,2000). The amino acid level of the leaf protein concentrate is also high. In Uganda, pregnant women use the leaves in diets to ease delivery of babies (Bukenya, 1994). The unique post-harvest characteristics of the leaves enable soups and stews prepared with leaves to be preserved up to 4 days, when heated twice daily (Schippers, 2000). Even though

*Solanum macrocarpon* is an important part of most indigenous Ghanaian dishes, very little work has been done in terms of research in order to improve upon the leaf quality as well as increasing the yield (Norman, 1992).

The African spinach (*Amaranthus spp.)* is a fast growing leafy vegetable with a high yield potential. The edible portion (leaves and young shoots) is rich in proteins. It is a good source of carotene, vitamin C, folic acid, iron calcium and other micronutrients. The amino acid composition compares well with that of the exotic spinach. The leaves and stems have a mild flavor and are used as spinach in stews and soups (Norman, 1992). Known as the Jew's mallow or the bush okra, *Corchorus olitorus* is similar to amaranthus in food value with high dry matter content *(*Fafunso and Bassir, 1977). The leaves and young shoots are used in stews and soups.



**2.9 Nutritional Status of Indigenous Leafy Vegetables.**

According to the International Institute of Rural Reconstruction (IIRR, 1995a), vegetables supply vitamins, essential amino acids, carbohydrates and proteins for good health. Dieticians indicate that adults require about 300 g of vegetables per day: 125 g of green leafy vegetables, 100 g of roots and tubers, and 75 g of some other vegetables.

**2.9.1Water Content of Vegetables**

The majority of vegetables contain a large quantity of water (Table 2.1). Vegetables such as lettuce, cucumber, tomato, etc, which are low in total food value, contain the most water, the average percentage being about 95. The dry vegetables have high food value and average only about 10 percent of water. The water in vegetables, whether it is much or little, is contained in cell-like structures surrounded by

cellulose, and it holds in solution the mineral salts and much of the nutrient of the vegetables and to some extent the materials that give vegetables their distinctive flavour. When water is lost from vegetables, some valuable vitamins, minerals and food materials are also lost. It is therefore essential that correct methods of preparation be chosen for the preparation of this food, so as to prevent the loss of valuable vitamins and mineral food materials (UASA National Nutrient Database, 2004).



**Table 2.1 Nutritional Status of Some Leafy Vegetables**

| | Water (ml) | Protein (g) | Carbohydrates (g) | Fat (g) | Fibre (g) |
|---|---|---|---|---|---|
| African Spinach (*Amaranthus spp)* | 89.0 | 3.6 | 4.0 | 0.1 | 1.3 |
| Long-fruited Jute *(Corchorus olitorus L.)* | 84.1 | 5.6 | 7.6 | 0.3 | 1.7 |
| Roselle (*Hibiscus sabdariffa L.*) | 85.0 | 3.3 | 9.0 | 0.3 | 1.6 |
| Gboma *(Solanum macrocarpon*) | 86.0 | 4.6 | 6.0 | 1.0 | 1.6 |
| Ceylon Spinach (*Basella alba*) | 85.0 | 5.0 | 5.0 | 0.7 | 1.5 |
| Cocoyam Leaf Stalks (*Colocassia esculenta*) | 93 | 0.5 | 6 | 0.2 | 0.9 |
| Cabbage (*Brassica oleracea*) | 90 | 2.6 | 6 | 0.4 | 1.0 |
| Lettuce (*Lactuca sativa*) | 96 | 1.0 | 2 | 0.4 | 0.4 |

(Source: IIRR (1995a), FAO (1988)

### 2.9.2 Carbohydrate Content of Vegetables

The carbohydrate content(Table 2.1) of vegetables is found in the form of starch and sugar . It is in the form of sugar in many of the vegetables when they are young or immature, but it turns into starch as they mature. This change can be easily observed in the case of peas. Young green peas are rather sweet because of the sugar they contain, while mature or dried peas have lost their sweetness and are starchy. The

starch that vegetables contain occurs in tiny granules, just as it is found in cereals, and is affected by cooking in the save way. One of the main sources of starch among vegetables is the potato, in which the starch grains are large and, if properly cooked, easily digest. Irish or white potatoes contain very little carbohydrate in the form of sugar, but in the sweet potato much of the carbohydrate is sugar. In either of these two forms ,starch and sugar-vegetables, carbohydrate is easily digested (UASA National Nutrient Database, 2004).



### 2.9.3 Protein Content of Vegetables

Vegetables as a class are generally low in fat (Table 2.1). In the case of some vegetables, the quantity of fat contained is so small that it is never considered in discussing their food value, while in others slightly larger quantities can to be found (UASA National Database, 2004).

### 2.9.4 Fibre Content of Vegetables

The special use of cellulose is to serve as bulk of the food containing it. In most vegetables, the cellulose varies greatly as to quantity, texture and the digestible portion. Younger vegetables are tenderer and perhaps more digestible, but as they grow older they harden and become tough. The quantity of cellulose that vegetables contain therefore depends largely on their age and condition. Generally those low in total food value contain larger quantities of fibre (Table 2.1) than those high in food value. This is because both water and cellulose, which are usually found together in large quantities, reduce the food value of vegetables (UASA National Nutrient Database, 2004).

### 2.9.5 Mineral Matter Or Ash In Vegetables

The mineral matter in vegetables is found in comparatively large quantities, the average amount being slightly over one percent.. The presence of ash in vegetables is of great value, because the mineral salts of both fruits and vegetables are essential in the diet of adults in order to maintain a healthy condition. The mineral salts of vegetables render the blood more alkaline instead of acidic, as do those contained in cereals and meat. A large number of vegetables, particularly those high in food value, such as green leafy ones, are very valuable for their mineral salts. The ash and fibre they contain are good for the growth and development of man. Minerals of all kinds are found in the water contained in vegetables, but significant among them are calcium, sodium, iron, phosphorus, and sulphur. Green leafy and salad vegetables are particularly high in iron. These minerals are easily lost if the method of cooking is not planned to retain them (UASA National Nutrient Database, 2004).

### 2.9.6 Stage of Maturity and Harvesting Frequency

Traditionally, leafy vegetables are harvested at the peak of their edible maturity with the leaves harvested frequently at their most succulent and tender age. To maintain the quality of vegetables they must be harvested at the right stage and handled properly. The time and stages of harvesting vegetable crops is dependent on weather conditions, distance to market, consumer requirements and the use for which the crop is required. According to the IIRR (1995b), vegetables should be harvested at the peak of their edible maturity stage and used promptly for the best nutrition, flavour, taste and appearance. Leafy vegetables should be frequently harvested at their most succulent and tender stage. Harvesting is sometimes done to meet specific market requirement. Some crops are required for special purposes. Frequent harvesting also makes for better quality but against this balance is the cost of harvesting frequency. A mean

must be struck between quality and cost, i.e., how infrequently harvesting be done without impairing quality.

Calub (1990) in a three-year experiment in the Philipines evaluated leaf and wood biomass production of *Bauhinia monandra, Erythrina orientalis* (syn. Variegate), *Gliricidia sepium, Leucaena leucocephala, Moringa oleifera and Pithecelobium dulce* at first cutting (6,9 and 12 weeks) and three cutting intervals (8, 12 and 16 weeks). Cutting height was 1m for all species. This study found no significant interaction effects between cutting interval and tree age at first cutting, but cutting interval as a single factor significantly influenced dry-matter yield. Over three years, *G.sepium, B. monandra*, and L. *leucoceplhala* produced the highest average dry-matter yields but a higher proportion was obtained from *M. oleifera*. No significant differences in dry-matter yields were observed in *E. orientalis* and *P. dulce*. Employing a 16-week cutting interval resulted in the highest total dry-matter yields in *G. sepium* and *B. monandra*, but the proportion of leafy biomass was significantly reduced.

# CHAPTER THREE

# 3.0 MATERIALS AND METHODS

## 3.1 Research Design

This chapter discusses the various methods used in carrying out the research from sampling of the study communities through to the collection, presentation of data and findings.

The profile of the upper west region is also discussed in relations to issues relevant to the topic. The case study approach was used in the study to identify the Jirapa and Nadowli Districts for the study.

Quantitative and qualitative approaches were used from planning and related institutions. These approaches helped in appreciating the usefulness of the existing literature in the study and the relevant contribution they make in unveiling in-depth information from respondents in their own language and environment.

## 3.2 Sampling Design

Both probability and non-probability sampling techniques were used. In sampling design, characteristics of population are vividly indicated. The sampling design for the study comprises the employment of purposive sampling and sample selection; this helped the researcher to have the idea about the existing social situation. An in-depth knowledge about the parameters of the population helps the investigator to determine the type of sampling design.

### 3.2.1 Purposive sampling

Purposive sampling was used under the non-probability sampling to collect data from people who use the desert date for various purposes in the region. The rationale behind employing this judgment sample was to identify communities that have intense use of the desert date.

Key informants such as herbalists, farmers (males and females), and anybody within the community who knew the plant and has used its products were identified and structured questionnaires administered separately.

### 3.2.2 Sample selection.

The multi-stage technique was adopted for the study. The first involved the selection of the Districts; the second involved the selection of the communities at random while the third involved a laboratory analysis of the edible parts of the plant.

In the Jirapa District, communities selected were Tizza, Ullo, Kaani, Duori, and Moyiri. While in the Nadowli District, communities selected were Kaleo, Loho, Duong, Daffiama and Sombo.

Two herbalists were interviewed in both Districts to find out the medicinal use of the plant while fifty questionnaires were administered in each district to other respondents on the uses of the plant in general. In all a total of 102 questionnaires were used for the study.

### 3.3 Research Tools

The study employed structured and semi-structured interviews and a proximate analysis of the leaves and fruits in the laboratory to find out the uses and the nutritional components of the plant. The essence of this activity was to ascertain the world view of persons with regards to the issue at hand.

### 3.4 Questionnaire Design

In general, the parameters considered in the design of the questionnaire included the social background of respondents, harvesting, uses, processing and preservation and medicinal uses of the desert date products. Two questionnaires were designed for people who use, process and preserve as well as the difficulties or constraints in harvesting the desert date (Appendix1) and the other for herbalists (Appendix2).

### 3.5 Nutritional composition Determination.

The research was concluded with an analysis of the nutritional composition of the leaves and the fruits at the laboratory of the Department of Renewable Natural Resources, Kwame Nkrumah University of Science and Technology (KNUST). Samples of the leaves were taken from the study areas for analysis. The samples were taken through the methodology described in section 3.6 to 3.10.

### 3.6 Crude Protein Determination by Kjeldahl Method

**Digestion**

Weigh 2g air dry sample into 500ml long-necked kjeldahl flask and 10ml distilled water to moisten the sample. Add 1 spatula full of kjeldahl catalyst (mixture of 1 part selenium + 10 parts $CUSO_4$ + 100 parts $Na_2SO_4$), followed by 20ml conc. $H_2SO_4$. Digest until the solution clear and colourless. Allow the flask to cool, decant the fluid into a 100ml volumetric flask and make up to the mark with distilled water.

**Distillation**

Transfer an aliquot of 10ml fluid from the digested sample by means of a pipette into kjeldahl distillation flask. Add 90ml of distilled water to make it up to 100ml in the distillation flask. Add or dispense 20ml of 40% NaOH to the content of the distillation flask. Collect distillate over 10ml of 4% boric acid and 3 drops of mixed indicator in a 200ml conical flask. The presence of nitrogen gives a light blue colour.

**Titration.**

Titrate collected distillate (about 100ml) with 0.1N HCL till the blue colour changes to grey and then suddenly flashes to pink.

A blank determination must necessarily be carried out without a sample.

**Calculation**

Weight of sample used, considering the dilution and the aliquot taken for distillation = 2g x 10ml/100ml= 0.2g

%N = 14X (A-B) X NX 100/(1000X0.2)

Where,

A=volume of standard HCL used in sample titration

B= volume of standard HCL used in blank titration

N=normality of standard HCL

% Crude Protein (CP) =% Total Nitrogen (NT) X 6.25(protein factor)

### 3.7 Crude Fat

Method:

Fold a piece of filter paper in such a way to hold the sample. Wrap around a second filter, which is left open at the top like a thimble. A piece of cotton wool is placed at the top to evenly distribute the solvent as it drops on the sample during extraction). Weigh into an extraction thimble/folded filter paper 2g of the dried sample (residue from dry matter determination can be used). Place the thimble inside the Soxhlet apparatus. Connect a dry pre-weighed solvent flask beneath the apparatus and add the required quantity of solvent and connect to condenser. The sample was extracted with petroleum ether for 4 – 6 hours. On completion, remove the thimble and reclaim ether using the apparatus. Complete the removal of ether on a boiling bath and dry flask at 105°C for 30 min. Cool in a desiccator and weigh.

Calculation:

Crude fat (% of DM)

$$= \frac{\text{weight of fat}}{\text{weight of sample}} \times \frac{100}{1}$$

### 3.8 Crude Fibre

**Method**

Transfer about 2 g of the dried, fat-free sample into a digestion flask. Add 200 ml of hot/boiling sulphuric acid, place the digestion flask under the condenser, and bring to, boiling within 1 min. Boil gently for exactly 30 min, use antifoam if necessary. At the end of 30 minutes, filter immediately through the linen and wash with boiling water until washings are no longer acidic. Transfer residue back to the digestion flask and add 200 ml hot sodium hydroxide solution. Replace under the condenser and again

bring to boil within 1 min. After boiling for exactly 30 min, filter through porous crucible and wash with boiling water, wash with about 15ml of 95% ethanol. Dry crucible and content at 110°C, to constant weight, cool in a desiccator and weigh. Ash at 550°C for 30 minutes, cools, and weigh. Calculate the weight of fibre by difference.

**Calculation:**

Crude fibre (% of fat-free DM)

$$= \frac{(\text{weight crucible} + \text{dried residue}) - (\text{weight crucible} + \text{ashed residue})}{(\text{weight of sample})} \times 100$$



### 3.9 Ash

**Procedure**

Preheat ash crucibles in an oven, cool in a desiccator and weigh. Weigh a 2 g sample into a dry, tared porcelain dish and then place in a muffle furnace at 600°C for 4 hours. Cool in a desiccator and weigh.

Calculation:

Ash (%)

$$= \frac{\text{weight of ash}}{\text{weight of sample}} \times 100$$

### 3.10 Moisture

**Procedure**

Weigh and place 2 g of the sample in a pre-weighed glass weighing can. Dry to constant weight at 100-105°C in a drying oven. Cool crucible plus sample in a desiccator and re-weigh.

**Calculation:**

$$\text{Moisture content (\%)} = \frac{\text{Weight fresh sample - Weight dry sample}}{\text{Weight fresh sample}} \times 100.$$

### 3.10.1 Pre-Treatment of Samples

### 3.10.2 Dry Ashing and Acid Digestion of Samples For, Na+, K+, and $Fe_2$+ Determination

The plant samples were ashed at 600 °C by placing a suitable weight (1.0 g) of the sample in a silica crucible and heating it in a muffle furnace for 4 hours. The ash residue was dissolved in dilute HCl (1:1), filtered through acid-washed filter paper in a 100-ml volumetric flask, and the volume was made up to the mark with distilled water.

### 3.10.3 Determination of Potassium (K+) and Sodium (Na+) By Flame Photometer Method (Model Jenway Pf p7)

Principle

When solutions of $K^+$ or $Na^+$ are drawn into a non-luminous flame, the ion in the solution burn and acquire energy hence move to higher energy level. After they return to lower energy level, radiations are emitted. The emission of radiation has a characteristic wave length depending on the element concerned. The emission is detected by specific filters and photocell. The emission is then converted to electrical signal which is read out on a meter. The intensity of the emission is directly proportional to the read out or the detection of the meter.

**Procedure**

Aspirate each serial standard starting from the least and note the readout. Aspirate the unknown and record the read out.

**Calculation**

Plot a standard or calibration curve from the standard values and generate the equation. From the equation the various concentrations of the unknown can be calculated.

### 3.10.4 Determination of Iron ($Fe^{2+}$) By 1, 10-Phenanthroline Method

**Principle**

In either acidic or basic medium 1, 10-phenanthroline cans complex $Fe^{2+}$ to form intense colour. This colour is then measured on spectrophotometer at 520nm. Addition of ascorbic acid or hydroxylamine hydrogen chloride reduces any fe3+ which might be in the unknown sample.

**Procedure**

To each 0.2ml of each serial standard/sample, add 1.0ml of ascorbic acid. Add 1.0ml of 1, 10-phenanthroline. Incubate at room temperature for 20 minutes. Read the absorbance at 520nm on the spectrophotometer.

**Calculation**

A standard or calibration curve is plotted from the standard values. From the equation of the curve (line) the concentration of the unknowns/samples are calculated

### 3.10.5 Determination of nitrogen free extract

Nitrogen Free Extract (NFE) was calculated on as fed basis by difference after analysis of all the other items method in the proximate analysis.

NFE = (100-% moisture + % crude protein + % crude fat + % crude fiber + % ash)

Energy calculation

The percent calories in the samples were calculated by multiplying the percentage of crude protein and carbohydrate with 4 and crude fat with 9. The values were then converted to calories per 100gm of the sample.

### 3.10.6 Total Carbohydrate calculation

The percent total carbohydrate in the samples were calculated by adding the percentage of crude fibre and nitrogen free extract

Total Carbohydrate = % Crude Fibre + % NFE



### 3.11 Study Area

The study was conducted in the Upper West Region of Ghana. The Upper West Region is located in the north-western corner of Ghana. It stretches from latitude 9°35'N to 11°N and from longitude 1° 25' West to 2° 50'W. The area falls under the Guinea savanna ecological zone. In the Guinea savanna the vegetation is characterized by pro-climax tree species. The vegetation is the savanna woodland comprising of scattered trees and sparse ground cover of grasses. The predominant trees also include *Parkia biglobosa* and *Vitellaria paradoxa* and other species like *Diospyros mespuliformis Daniella species* and *Balanitis aegyptiaca. Vitellaria paradoxa* and *Parkia biglobosa* are very common as they are protected for their economic value

The vegetation in the area has been degraded as a result of annual fires and human population pressure.

The climate of Upper West Region is characterized by short term single- peak rainfall regime and a long dry season from October to the end of April with temperature rising to between 36°c to 42°c. The rainfall pattern is a result of the region's location in the sub-equatorial zone with changing wind regimes in the course of the year. During the

dry season, the area is under the influence of the dry north-eastern trade wind (Harmattan). The relative humidity of the area during the dry season is normally low, less than 50% but rises steadily to about 80% in the wet season. The mean annual rainfall is about 1111mm and the rainfall distribution varies considerably from year to year.

In some years, the first rains start in April and May. This is followed by a short dry spell of about three to five weeks resulting in serious crop damage.



The geology of the area is dominated by sandstone, and the soils are the savanna ochrosols, which get eroded by wind or water. The area is generally undulating with few hills and has an altitude of about 180m to 450m above sea level.

# CHAPTER FOUR

## 4.0 RESULTS

### 4.1 Gender Distribution of Respondents

Figure 4.1 shows the number of males and females that harvest, use, process and preserve the desert date in the Jirapa and Nadowli Districts of the Upper West Region of Ghana. The figure shows that out of the hundred respondents, forty seven (47) are males and fifty three are females (53) which represent 47% and 53% respectively.

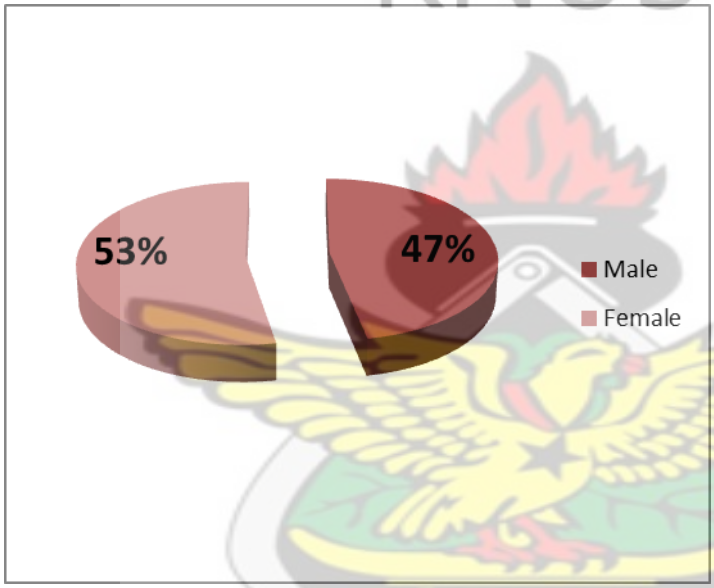


**Figure 4.1 Gender Distribution of Respondents**

### 4.2 Age Distribution of Respondents

Figure 4.2 shows the age distribution of respondents who harvest, use, preserve and process the desert date in the Jirapa and Nadowli Districts. The age brackets of 31-50 had the highest percentage fifty (50%). Whilst 16% are in the age brackets of 18-30 and 34% are in the age bracket of 50 and above.

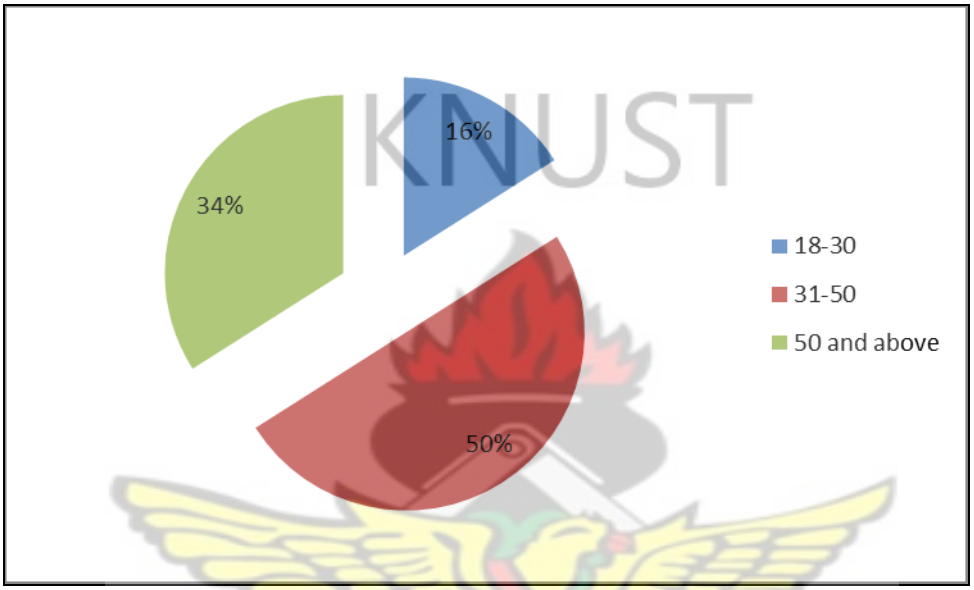


**Figure 4.2 Age Distribution of Respondents**

### 4.3 Educational level of respondents.

Figure 4.3 represents the educational level or background of respondents. The bar chart revealed that 61 respondents representing 61% had no formal education at all; thirteen of them (13) had middle/JSH certificate representing 13%, sixteen of them representing (16%) had primary education. The tertiary education which comprises of universities and colleges had a frequency of 10 respondents with a percentage of 10%. In all, 39% had some form of education.

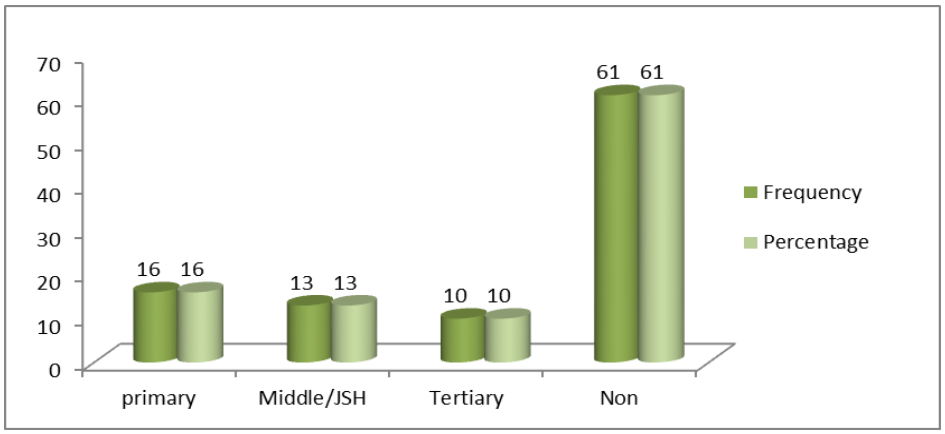


**Figure 4.3 Educational Levels of Respondents.**



### 4.4 Occupational Distribution of Respondents

All respondents met on the field had various occupations. The major occupation being farming which represents sixty percent (60%) of the population ,10% were pito brewers,8% teachers while 4% each of the population were food vendors and Shea butter extractors,5% were traders, 3% students and a least percentage of 1% were watchmen.

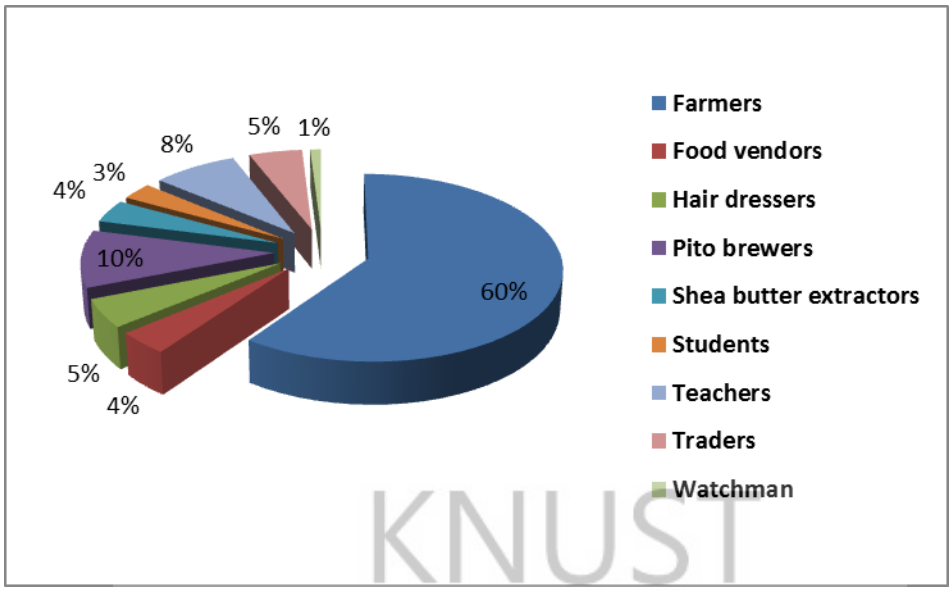



**Figure 4.4 occupations of respondents**

### 4.5 Methods of harvesting leaves of the desert date

The study conducted in the communities showed that 95% of the total population interviewed harvest the leaves of the plant for various uses. They however, have different methods of harvesting the leaves.

Figure 4.5 shows that ninety percent(90%) of the respondents harvest the leaves of the desert date by cutting down the branches and plucking the leaves, also, 6% stand and pluck the leaves and 4% of the population use go to hell to harvest the leaves.

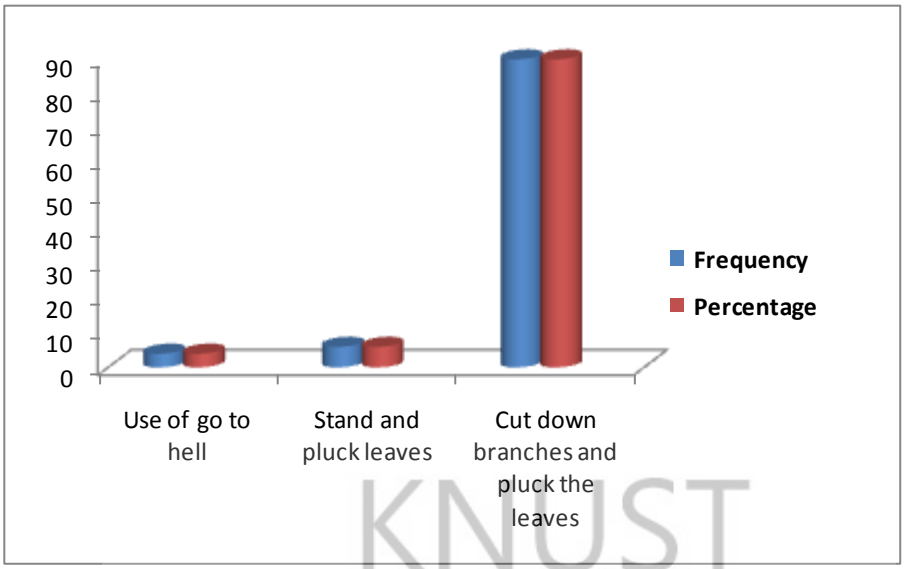


**Figure 4.5 methods of harvesting leaves of the desert date**

### 4.6 Production of edible leaves all year round

The survey also revealed that 82 respondents representing 82% of the population observed that production of leaves which are soft and is cooked and eaten as vegetable sprout from the nodes of the branches during the dry season with the peak production realized around January to March and 10% responded production of leaves is around July and September while 8% said the production is around April to June.

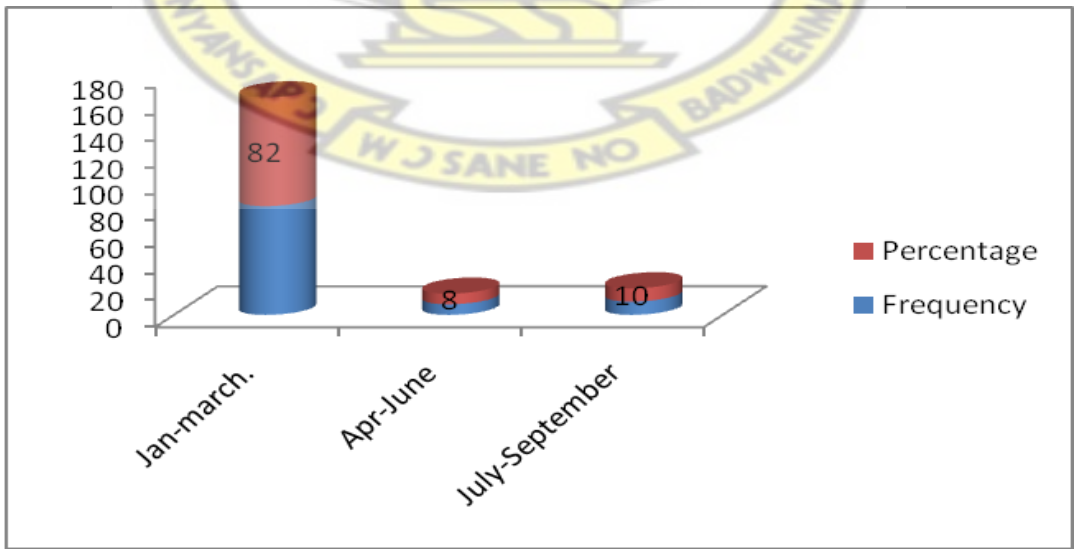


**Figure 4.6 production of leaves all year round**

### 4.7 Various processing methods of the leaves of the desert date

Table 4.1 shows the various processing method of the leaves of the desert date 68% of the respondents boil and dry the leaves to preserve, 17% boil to preserve while 15% dry to preserve

**Table 4.1 Various processing methods of the leaves of the desert date**

| Method | Percentage | Frequency |
|---|---|---|
| Drying | 15 | 15 |
| Boiling | 17 | 17 |
| Boiling and drying | 68 | 68 |
| Total | 100 | 100 |



### 4.8 Uses of the leaves.

Figure 4.7 shows that 71 respondents representing 71% of the total population boil the leaves and add it to an accompanied meal locally called 'koose', 19% boil the leaves and add maize or beans flour to it and eat it as a meal. While 10% cook the leaves with groundnut paste.

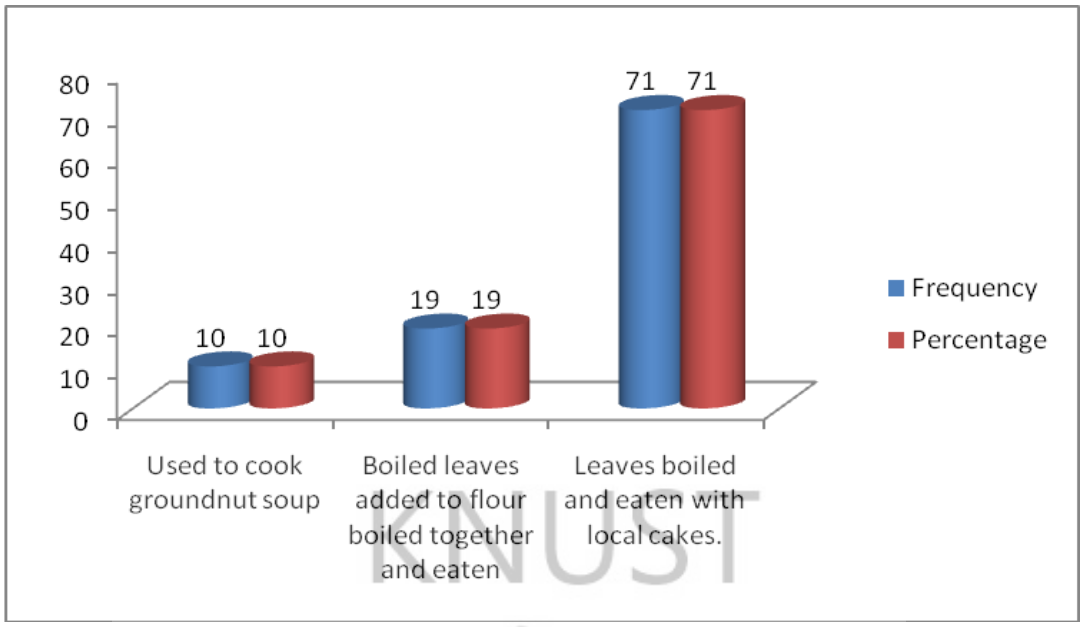


**Figure 4.7 uses of the Leaves**

### 4.9 Processing and preservation of the fruit

The duration of storage of dried fruits varied among the respondents in figure 4.8, the fruit of the desert date is preserved by drying. 48% of the respondents indicated that fruits could store for more than three months while 30% confirmed it can stay for between two and three months and 8% said it can stay between one and two months 14% of the respondents didn't know how long it could stay after drying.

The figure 4.8 shows a range of months it takes to preserve the fruits. 48% of the respondents revealed that when the fruit is well dried it can stay for more than three months.

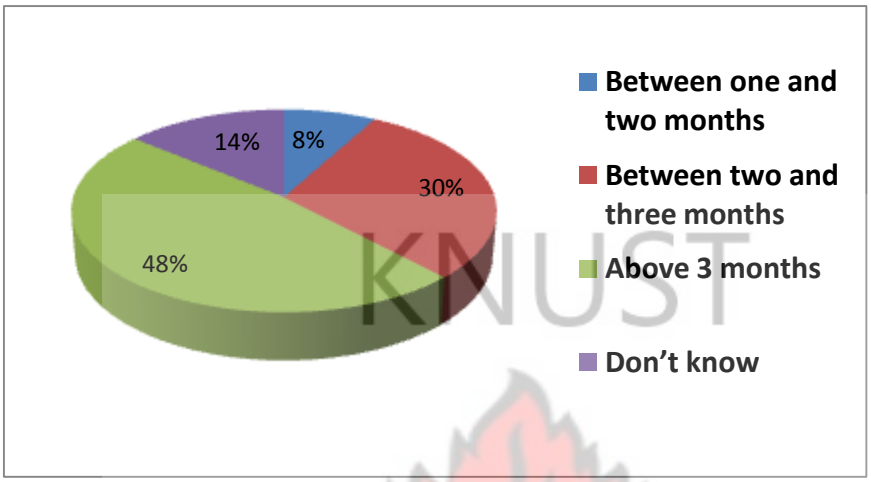


**Figure 4.8 range of preservation of products**

### 4.10 Edible uses of the fruit.

The fruit of the plant is edible as the whole of the population indicated in the survey. Seventy seven percentage indicated they peel the off the cover and lick and twenty three percentage peel of the cover soak in water to serve as a drink.

**Table 4.2 edible uses of the fruit**

| Uses | Frequency | percentage |
|---|---|---|
| Lick pulp | 77 | 77 |
| Soak in water and drink | 23 | 23 |
| Total | 100 | 100 |

### 4.11 Other Uses of the Plant

Figure 4.9 shows other uses of the plant. The study revealed that 48% of the populations used the stem of the plant for fire wood. Twenty (20%) percent burnt the stem as charcoal for cooking. Ten (10%) each of the population used it for fencing and fodder, respectively while four (4%) use it to make mortar pestles and handles of hoe'



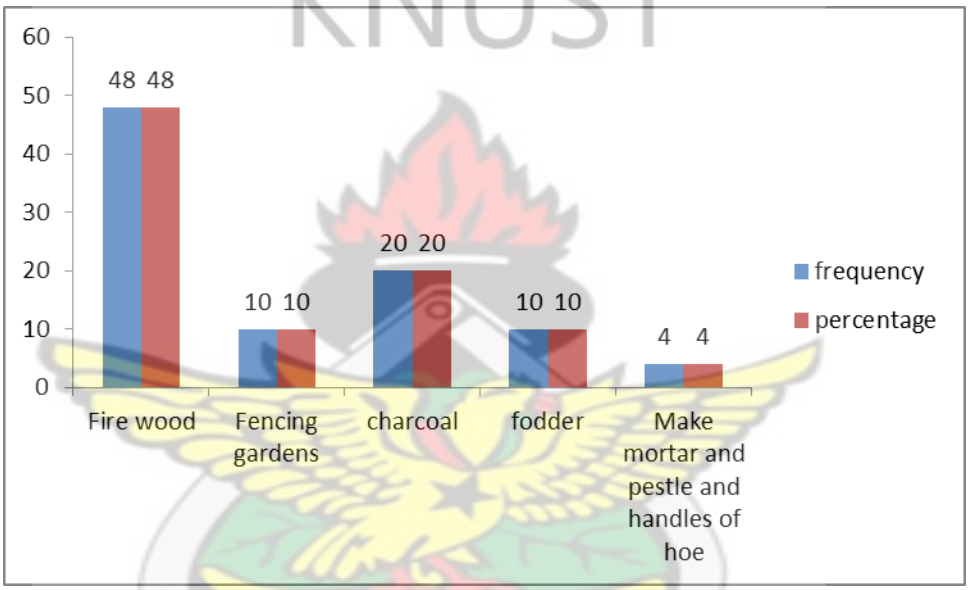


**Figure 4.9 Other uses of the plant**

**Table 4.3 medicinal uses of desert date**

| Treatment | Percentage | Frequency |
|---|---|---|
| Stomach pains | 48 | 48 |
| Enhance milk production in lactating mothers | 22 | 22 |
| malaria | 25 | 25 |
| fits | 5 | 5 |
| Total | 100 | 100 |

The leaves, fruits, and roots have medicinal uses. They are however added to ingredients for treating ailments.

Table 4.3 shows that 48% of the respondents use the desert date to treat stomach pains, 22% a lactating mothers take to enhance breast milk production, 25% used the leaves to treat malaria while 5% use it to treat fits.

**Table 4.4 Cultivation of the plant**

| Cultivators | Percentage | Frequency |
|---|---|---|
| Yes | 3 | 3 |
| No | 97 | 97 |
| Total | 100 | 100 |

The desert date grows mostly in the savanna areas and in the wild. Because it grows in the wild, no effort has been made to cultivate it in the study area as ninety seven percent (97%) of the respondents testified while 3% cultivate it.

### 4.12 Nutritional Components of leaves and fruits

The results of the proximate analysis of leaves and fruits of the desert date are presented in Table 4.5. It showed that the leaves and fruits have varied moisture contents of 41.41% and 24.63% respectively. The total energy for the leaves and fruits were 277.02Cal/100g and 231.02Cal/100g respectively. The ash content, which is a measure of the mineral content in food, had values of 8.27% and 10.63% for the leaves and fruits respectively.

The carbohydrate content in the leaves was found to be 30.92% whilst that of the fruit was 59.53%. Crude fibre values were also varied. Minerals (Na, K, and Fe) for the leaves and fruits were also different (Table 4.5)

**Table 4.5 Some nutritional components of leaves and fruits of the desert date**

| | % composition of leaves | % composition of fruits |
|---|---|---|
| Crude protein | 17.06 | 3.85 |
| Crude fat | 2.32 | 1.38 |
| Crude fibre | 16.02 | 8.72 |
| Carbohydrates | 30.92 | 59.53 |
| Moisture | 41.41 | 24.63 |
| Iron | 0.05 | 0.04 |
| Sodium | 0.03 | 0.06 |
| Potassium | 0.52 | 1.11 |
| Ash | 8.27 | 10.63 |
| Nitrogen free extract | 14.90 | 50.81 |
| Total energy | 277.02cal/100g | 231.02 Cal/100g |

Triplicate analysis of the desert date fruits and leaves

**Source: Faculty of Renewable Natural Resources laboratory (KNUST)**

**Table 4.6 t- test results comparing nutrient composition of leaves and fruits of the desert date**

Table 4.6 is a test of significant difference between the leaves and fruits. The results showed that there was significant difference ($P<0.05$) between crude fat for the leaves and fruits while the other parameters compared had no significant difference ($P<0.05$)

| Pair composition of F&L | PAIRED DIFFERENCE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | Std. deviation | Std. error mean | 95%confidence interval of diff. | | t | df. | Sig. (2-tailed) |
| | | | | lower | upper | | | |
| Crude protein | 8.95500 | 8.63377 | 6.10500 | -68.61638 | 86.52638 | 1.467 | 1 | .381 |
| Crude fat | .36000 | .02828 | .02000 | .10588 | .61412 | 18.000 | 1 | .035 |
| Crude fibre | 1.08700E1 | 4.45477 | 3.15000 | -29.15454 | 50.89454 | 3.451 | 1 | .180 |
| carbohydrates | 4.37250E1 | 20.93743 | 14.80500 | -144.39036 | 231.84036 | 2.953 | 1 | .208 |
| Moisture | 3.15200E1 | 11.15815 | 7.89000 | -68.73196 | 131.77196 | 3.995 | 1 | .156 |
| Iron | 1.079500E0 | .649831 | .459500 | -6.918001 | 4.759001 | -2.349 | 1 | .256 |
| Sodium | 6.643500E0 | 4.893886 | 3.460500 | -37.326321 | 50.613321 | 1.920 | 1 | .306 |
| potassium | -1.032500E0 | .881762 | .623500 | 6.889819 | 6.889819 | -1.656 | 1 | .346 |
| Ash | 7.95000 | 2.37588 | 1.68000 | -13.39642 | 29.29642 | 4.732 | 1 | .133 |
| Nitrogen free extract | 3.13550E1 | 26.09931 | 18.45500 | -203.13801 | 265.84801 | 1.699 | 1 | .339 |
| Total energy | 2.52520E2 | 31.81981 | 22.50000 | -33.36961 | 538.40961 | 11.223 | 1 | .057 |

**P<0.05 means there is significant difference between treatments but if P>0.05 means there is no significant difference between treatments**

# CHAPTER FIVE

# 5.0 DISCUSSION

## 5.1 Demographic Characteristics of Respondents

Gender plays a very important role in every community in Ghana and the Upper West Region is not an exception. Generally, men are engaged in farming than women but when it comes to harvesting, processing, preservation and uses of agricultural products in the domestic home, it is the females who are in charge. Thus the female dominance in the harvesting, processing, preservation and uses of the desert date plant in the study area.

The descriptive statistics from the research shows that 53% of the respondents, who harvest, process, preserve and use the desert date are females while 47% are males. This can be explained in terms of the role females play at home. They harvest the leaves as vegetables to cook and pick the fruits for their families.

Age also plays a very vital role in determining the productivity of agriculture. Both the youth and the elderly are in the front line of farming in Ghana and sub Saharan Africa. The findings brought to light that those who were in the age group of 31-50 years dominated with 50%. This age bracket dominated in the agriculture sector, as most people at that age have large families to take care of. Since the plant is edible it is harvested to feed families to ensure good health.

Most of the respondents in the area are illiterate so have no choice but to take advantage of anything they could do to earn a living. This was revealed as the statistics showed that 61% of those who harvest, process, preserve and use the plant have no formal education.

The number of the respondents reduced as they moved through the educational ladder from the primary school to the tertiary level. It also tells us that in the study area, as one goes higher in education the interest in agriculture reduces. This is typical in Africa where agriculture is considered to be for those who are not educated. This is seriously affecting agricultural productivity especially when it comes to postharvest handling of food crops. Most of our illiterate farmers are not aware of practices that lead to postharvest losses of food products as the desert date leaves are very perishable after harvest.



**5.2 Methods of Harvesting the Leaves**

The study revealed that three methods of harvesting existed in the harvesting of the leaves of the desert date. Majority of the respondents cut down the branches and detach the leaves, this they explained that the tree is thorny as such cannot be climbed. The thorny nature of the tree is confirmed by Tredgold (1986) who stated that the tree is thorny as such used to make livestock enclosures.

The findings also revealed that some respondents stand by the tree and detach the leaves(Plates 1and 2) , because some of the trees are short which is in line with Grace *et al.(* 2007) findings that the tree has round crown, spreading, and sometimes with low branches remaining close to the trunk.

**5.3 Production of Leaves**

Production of leaves mostly occurs between January and March which is the dry season. This confirms the information from FAO (1993) which stated that foliage production of the desert date occur at the peak of the dry season.

The production of fresh leaves in the dry season makes it an important plant in the study area as the leaves are always available at times that vegetables are scarce in the area.

### 5.4 Uses of the Leaves

Three distinct methods of using the leaves which is edible were revealed in the study area.

A very high percentage of 71 boil the leaves and add it to another meal called 'koose' or 'sense' made from ground beans flour and eaten.

Some also boil the leaves and add either fried maize flour or beans flour to it and boil again to form a meal popularly known as 'sewale'. Both the young and old enjoy the meal for it makes one drink a lot of water as such does not feel hungry all day.

Apart from these some also boil the fresh leaves or boil and dry the leaves and use it to prepare groundnut soup, it is either eaten alone or eaten with TZ (maize flour added to boiling water and stirred into balls). All these uses in terms of food have been confirmed by Stewart and Brandis (1972) that young leave and tender shoots of the desert date are used as vegetables.

### 5.5 Processing of the Leaves

The most common method of processing and preserving the leaves of the desert date is through boiling and drying. They indicated that young leaves are boiled to get soft and then dried. This extends the shelf life to more than four months. Others also boil the leaves to preserve but this can only stay for about two days or more with repeated daily heating.

### 5.6 Preservation of the Fruits

The fruit of the desert date is preserved by drying. When the fruits are well dried they are able to store for more than three months as 48% of the respondents testified. This is due to the fact that when it is well dried pests don't easily attack and destroy them.

### 5.7 Uses of the Fruits

Two main uses of the fruit were identified in the study area. Majority of the respondents peel off the cover/coat of the fruit and lick the pulp, others also peel off the coat/cover of the fruit, soak it in water overnight and taken as a drink. This agrees with the reported by Steward and Brandis (1972) that the fruit is processed into drink and alcoholic liquor in Nigeria.

### 5.8 Other Uses of the plant

Five major uses of the plant were identified. The desert date plant is used to make firewood, fence gardens, charcoal, fodder for livestock and for making mortar, pestle and handles of hoes. The results in figure 4.9 indicated that the plant is used for firewood in the study area. This is in line with Steward and Brandis (1972) who reported that the wood is good firewood; it produces considerable heat and very little smoke, making it particularly suitable for indoor use.

It was also revealed that the wood was used in making pestles, mortars and handles of hoes which Grace and Sands (2007) confirmed that the wood is hard, durable and can make pestles, mortars, handles, stools and combs.

Apart from these, others also revealed that the fresh and dried leaves are eaten by animals in the area as Steward and Brandis (1972) reported in their study that the fresh leaves and dry leaves, fruits and sprouts are all eaten by livestock. They further

revealed that in Burkina Faso, the desert date contributed up to 38% of the dry matter intake in goats in the dry season.

Because of the thorny nature of the branches 10% of the respondents use it to fence gardens around their homes to produce vegetables.

### 5.9 Medicinal Uses of the Plant

Herbal treatment of people in the study area is very common as herbalists in these areas use various parts of plants including the desert date. The leaves, roots, stems and fruits are used as herbs to cure ailments. Some herbalists interviewed in the area revealed that they treat malaria, fits, and stomach pains with the desert date.

Apart from these the roots of the plant are pounded and used for fishing because it is poisonous. This was reported by Tredgold (1986) that the compound is toxic to the fish but does not affect mammals and rapidly becomes inert, so that fish retrieved are edible. However, in the Fader region of Cote d'Ivoire, the saponin (active ingredient) is reported to damage the sight of fishermen after they have used it for 5-7 years.

### 5.10 Cultivation of the plant

Booth and Wickens (1988) reported that there are plantations of the species in Cape Verde Island, the Dominican Republic of Puerto Rica. Plantation has been reported in India, individual trees are planted extensively in Africa and a small plantation has been established in Niger, Chad and northern Nigeria. In Ghana and the study area in particular showed that no attempt has been made to grow the plant as 97% of the respondents indicated that it was a wild crop and there was need to grow to cultivate it.

**5.11 Nutritional composition of the leaves and the fruit of the Desert date.**

According to the International Institute of Rural Reconstruction (IIRR, 1995) vegetables supply various nutrients for good health. The Desert date understudied equally provides these nutrients which the body needs.

Despite the fact that it mostly grows in the savanna areas in Ghana where there is a prolonged dry season, the fresh leaves that are produced in the dry season are edible. This is hailed by the people because vegetables are scares in the dry season.

From the analysis, the leaves contain 41.41% of moisture, 17.34% of protein, 16.02% of fibre, and 30.92% of carbohydrates.

From the analysis it is clear that the leaves are a source of good health when eaten. This is confirmed by Abbey and Timpo (1990) that indigenous vegetables are under exploited either because of ignorance or arrogance, but that they have a high potential in combacting nutrition-related problems, which the desert date leaves also do. Again, it has been found that indigenous leafy vegetables are richer in nutrients than their exotic counterparts (Abbey and Timpo, 1990). People should therefore be encouraged to eat more of these indigenous vegetables.

The fruits of the desert date also have nutrients which are essential for the body; they have 59.53%of carbohydrates 231.02 Cal/100g of energy which humans need to work efficiently, 8.72% of fibre and 24.63% of moisture. These are evidence that the fruits and leaves of the desert date plant are good for the health of the people in the study area and Ghana as a whole.

# CHAPTER SIX

## CONCLUSIONS AND RECOMMENDATIONS

The findings of the study unearthed and deepened the understanding of some issues of concern with regards to the uses, processing and preservation, as well as the nutrients the plant provides to the body when eaten.

Women are the main experts in harvesting, uses, processing, preservation and marketing of the desert date. For women, they are an essential resource to sustain the family and to ensure the health of the household.

Cutting down branches and plucking the leaves and standing and plucking the leaves were the two major methods of harvesting the leaves while the fruits are allowed to fall to the ground and then picked.

The leaves and the dry fruits are edible, the leaves are eaten as vegetables in soup or added to local cakes, and the leaves are processed and preserved by boiling and drying while the fruits are dried and preserved or the coat peeled off and soaked in water for a drink.

The active ingredient (saponin) in the roots is poisonous but used for fishing. The stem of the plant is used for fuel and can also be carved into mortars and pestles.

Nutritionally, the leaves contain 41.41% moisture, 17.06% protein 16.02% fibre, 30.92% carbohydrates and 231.02 Cal/100g of energy while the fruits contain 24.63% moisture, 3.85% protein, 8.72% fibre 59.53% carbohydrates and 277.02 Cal/100g of energy.

The leaves and fruits of the desert date are harvested from the wild for the daily diets of people in the study area especially for the low-income households with respect to their nutritional and medicinal value.

The processing and preservation of the leaves and fruits provides employment to females in households in the area, income and food security against the risk of crop failure during the major farming season.

Based on the research undertaken, the following are worth recommending



- Fresh leaves sprout during the dry season, when vegetables are very scarce, as such more people should be encouraged to process and eat the leaves during the period.
- Indigenous vegetables are richer in nutrient than their exotic counter parts, as such more research into test for nutrients such as Vitamin A and C for the desert date should be done.
- The seed of the desert date has oil which is edible; this should be researched into to serve as oil to complement the groundnut and sheabutter oil in the area and Ghana as a whole.
- Bush fires are high in the study area and most of the desert date trees are at risk of being damaged, research into the cultivation of the desert date should be done to ensure proper growth and development of the tree in the area.

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## APPENDICES

### Appendix 1:

POSTHARVEST HANDLING OF THE EDIBLE PARTS (LEAVES AND FRUITS) OF THE DESERT DATE( *Balanites aegyptiaca)*

A CASE STUDY IN THE JIRAPA AND NADOWLI DISTRICTS OF THE UPPER WEST REGION OF GHANA.

**(A QUESTIONNAIRE FOR USERS OF THE DESERT DATE)**



BACKGROUND OF RESPONDENTS

1) District……

2) Community ……

3) Age (tick) 1) 18-30 { } 2) 31-50 { } 3) 51 above { }

4) Occupation ……

5) Sex (tick) 1) Male { } 2) Female { }

6) Marital status 1) Married { } 2) Single { } 3) Divorced { }

7) Level of education (tick)

1) Non { } 2) Primary { } 3) Middle school { } 4) SHS { } 5) Tertiary { }

8) Do you harvest Balanites leaves?

1) Yes { } 2) No { }

9) If yes, how do you do it?

1) Climb to pluck 2) Use of go to hell3) Others specify ……..

10) What special equipment do you use for harvesting?

1) cutlass 2) sticks 3) others, specify ……

11) Do you have production of leaves all year round

1) Yes ☐ 2) No ☐

12) If no, what time of the year do you harvest the leaves?

1) January to march 2) April to June 3) July to September

4) October to December

13) What do you use the leaves for

1) Vegetable 2) For soup 3) Fodde r 4)Others specify ……

14) At what stage of development do you harvest the leaves?

1) When the leaves are young 2) When the leaves are old

3) Others, specify……

15) Why do you harvest leaves at that stage

……

……

16) What do you do with the leaves after harvesting (tick)

i) Use fresh { } ii) Store { } iii) Process { }

17) If you process it, how do you process it?

……..

18) What method do you use to preserve the product?

i) Boiling ii) Drying iii) Boiling and drying

iv) Others, specify ……..

19) Do you have any special treatment before processing them?

1) Yes { } 2) No { }

20) If yes, specify ……



21) Do you harvest Balanites fruits?

1) Yes { } 2) No { }

22) If yes, how do you harvest them?

i) Stoning ii) Climbing to pluck iii) Others, specify……

23) What equipment do you use to harvest the fruit?

i) Stones ii) Others specify ……

24) What period of the year do you harvest the fruit (tick)

i) January – June { } ii) July – December { }

25) Do you have the production of fruits all year round?

a) Yes { } b) No { }

26) If No, what period of the year do you harvest fruits

a) January – March b) April – June c) July – September

d) October – December

27) What do you use the fruit for?

a) Soak in water and drink b) lick Pulp c) Others specify……

28) How do you process the fruit? ……

29) How do you preserve them?

i) Drying ii) Boiling iii) Others specify……..

30) If drying, how long does it take before going bad?

i) 1 – 2 months ii) 2 – 3 months iv) above three months

31) If boiling, how long does it take before going bad?

i) 1 – 2 months ii) 2 – 3 months iii) Above three months

32) Do you eat *Belanites* fruits?

i) Yes { } ii) No { }

33) If yes, do you eat it when it is

i) Fresh { } ii) dry { }

34) Do you process the fruits to preserve?

i) Yes { } ii) No { }

35) What period of the year do you process the leaves?

a) January – March b) April – June c) July – September

d) October – December

36) Do you have any problems with processing the leaves

a) Yes { } b) No { }

37) If Yes, mention them ……..

38) Do you have any tool/equipment for processing the leaves

i)Yes { } ii) No { }

39) If yes, mention them ……

40) What do you use the plant for?

i)Fire wood ii) Fencing gardens iii) Roofing houses

iv) Others, specify ……..

41) What problems does the plant pose to you?

i) Destroy our crops ii)Occupy a lot of space

iii) Others Specify ……

42) Do you cultivate the plant?

i) Yes { } ii) No { }

43) If yes, which part of it do you use to cultivate it?

i) Seed ii) Stem iii) Root iv) Others specify ……

44) If yes, which period of the year do you cultivate it?

i) Dry season ii) Rainy season

45) How long does take to mature

i) Less than a year ii) Three years

iii) Others specify ……

46) If No, why don't you cultivate it

i) Don't see the need to cultivate it ii) Needs more attention to cultivate

iii) Others specify …….

47) If No, have you ever made an attempt to cultivate it

i) Yes { } ii) No { }

**Appendix (2)**

**POSTHARVEST HANDLING OF THE EDIBLE PARTS (LEAVES AND FRUITS) OF THE DESERT DATE ( *Balanites aegyptiaca)***

A CASE STUDY IN THE JIRAPA AND NADOWLI DISTRICTS OF THE UPPER WEST REGION OF GHANA.

**(A QUESTIONNAIRE FOR HERBALISTS)**



1) Age ……

2) Community……

3) Sex ……..

4) No. of children ……

5) Educational level ……...

6) Marital status …….....

7) No. of wives ……

8) How long have you been a herbalist?

i) 1 – 10 years ii)10 years and above

10) Have you ever used *Balanites* in treating any sickness?

i) Yes ☐ ii) No ☐

11) If yes, what part of the plant have you ever used

i) Fruit ii) Stem iii) Root iv) Back

v) Others specify ……

12) Can you mention any disease you use the plant to cure?

i) …….

ii) ……...

iii) ……..

iv) ……

13) Which part do you use to treat a specific disease?

| Plant part | Diseases treated |
|---|---|
| i) Stem | |
| ii)Fruit | |
| iii)Root | |
| iv)Back | |
| v)others | |



14) Do you process the part of plant before using it?

i) Yes ☐ ii) No ☐

15) If yes, how do you process each part?

i) Drying ii) Boiling iii) Drying and grinding

iv) Others, specify ……

16) Do you add any substance or plant to *Balanites* for the treatment of diseases/

i) Yes ☐ ii) No ☐

17) If yes, what substance or plant do you add for treatment

……

18) Do you use the leaves for preparing food?

i) Yes ☐ ii) No ☐

19) If yes, what food do you use to prepare

i) Mix with groundnut for soup ii) Mix with okro for soup

iii) Others specify……..

## Appendix 3

**Desert date tree**

**Dry fruits of the desert date**

**Fresh fruits of the desert date**

**Plate 1 cutdown and detach leaves method demonstrated**

**Plate 2 stand and detach method demonstrated**

**Cutdown and detach and stand and detach methods of harvesting the leaves shown in plate 1 and 2**