

## Effects of Different Process- Drying Methods on the Nutritional Potential of *Balanites aegyptiaca* leaves

Ogori AF<sup>1\*</sup>, Wakawa LD<sup>2</sup>, Makinde OJ<sup>3</sup> and Vivien OO<sup>1</sup>

<sup>1</sup>Department of Home Science, Faculty of Agriculture, Federal University, Gashua, Nigeria

<sup>2</sup>Departments of Forestry and Wildlife Management, Faculty of Agriculture, Federal University, Gashua, Nigeria

<sup>3</sup>Department of Animal Science, Faculty of Agriculture, Federal University, Gashua, Nigeria

\*Corresponding Author: Ogori AF, Department of Home Science, Faculty of Agriculture, Federal University, Gashua, Nigeria.

Received: April 27, 2017; Published: May 30, 2017

### Abstract

The nutritional potential of process dried *Balanites aegyptiaca* leaves collected from Gashua and its environment was evaluated for their proximate values, mineral composition and vitamin A contents. The result indicated that pretreated sample of shade dried sample C, had high content of dry matter, protein and crude fiber. The blanched sample A have better fat, ash and NFE values than the control sample. Boiled sample Zn, Cu leave minerals; Sundried Fe, and Blanched Mg and Ca leaves minerals have high mineral values competing favorably with the control sample. The fresh leave as a control sample and shade dried leave sample had a high content of vitamin A. The results revealed that shade dried and blanched dried leaves of *Balanites aegyptiaca* tree have high nutritional potentials. The results also showed a clear relationship between heats effect on nutrient retention in balanites leaves. From the obtained results, matured leaves of *Balanites aegyptiaca* are good alternative source of nutrients and essential minerals which are required for human health and active life.

**Keywords:** Proximate; Mineral Composition; Nutritional Potential Vitamin A; Balanites Leave; Processing; Drying Methods

### Introduction

Balanites leaves, flower, fruits and oil have been a popular utilize plants for foods across dry lands Africa [1]. Utilization of balanites plants parts is popular with Uganda people [2]. According to NRC [3], balanites produce certain necessities of life in arid difficult zones and its potential yet untapped. In Nigeria, especially the North regions, balanites leaves have been generally underutilize except as seen, browsing plant by animals. Many developing countries suffer from insufficient and high cost of cultivatable green leafy vegetable which might lead to phyto –nutrient bioavailability issues. Leaves from plants are good sources of mineral, vitamins as well as protein supplements [4]. Diet rich in vegetables can lower blood pressure and the risk of eye and digestive problems as well as reduce the risk of heart and cancer diseases because of good amount of vitamins and minerals [5]. It can also protect the human body from free radical stress and increase the immunity of our bodies due to antioxidant properties [6]. Requirements of man for vitamin A are not less than a milligram per day however majority of this quantity come from green and yellow vegetables such as lettuce, spinach, sweet potatoes, pumpkins and carrots which are rich in Beta-carotene [7]. The nutritional component of balanites laves could improve its wide utilization in food [8], however balanites falls into such recipes [9]. A lot of work on nutritional profiles on balanites plants parts have been done [10], but limited information is available on nutritional potentials of pretreated balanites leaves. Understanding the nutrient composition of pretreated balanites leaves would contributes to unlocking its hidden nutritional potentials. It's also contributes to its food utilization and diversification among other leafy vegetable foods., hence renew effort for wide plant consumption [10]. The proximate, mineral and vitamin contents of pretreated leave of *Balanites aegyptiaca* would ascertain its edibility qualities for humans and could also create awareness of its food and feed potentials in the arid region of Nigeria. This research work seeks to establish balanites leave meal utilizability and applications for Nigeria people of North east arid zones as well as advocates it's nutritional and economic value chains.

## Material and Methods

### Source of Raw Material

Mature leaves from *Balanites aegyptiaca* were harvested from its wild trees at Gashua bush lands, fallow land and from the Federal University environments, into sacks and conveyed to the laboratories of the Department of Home sciences, Federal University Gashua in yobe state, Nigeria.

### Methodology

One hundredth (100g) of the harvested leaves sample were Rinsed and drained. About (20g) each of the leave portions was given Blanching, boiled dried, Shade Drying, Sun Drying and Solar Cabinet drying pretreatments. Raw *Balanites aegyptiaca* leave sample was use as a control. The raw leave sample as well as the pretreated samples was pestle to powder and proximate, mineral and vitamin analysis were carried out on each sample using standard methods [11].

### Proximate Analysis

Proximate analysis of each samples leave were carried out for moisture, crude fat, protein, ash, fibers contents were carried out using standard methods as outlined by Association of Official Analytical Chemists (AOAC,2000). For determination of the percentage carbohydrates the following formula was used:

$$\% \text{ Carbohydrates} = 100 - (\% \text{ moisture} + \% \text{ proteins} + \% \text{ fats} + \% \text{ ash} + \% \text{ fibers}) \text{ [11].}$$

### Beta Carotene

β- carotene (Vitamin A) of fresh leaves and process- pretreated leaves were determined using Standard Official Methods of Analysis [11].

### Mineral Composition

The mineral composition of zinc (Zn), copper (Cu), magnesium (Mg) iron (Fe) and calcium (Ca,) of each leave process- treated samples were estimated using emission flame photometer [11].

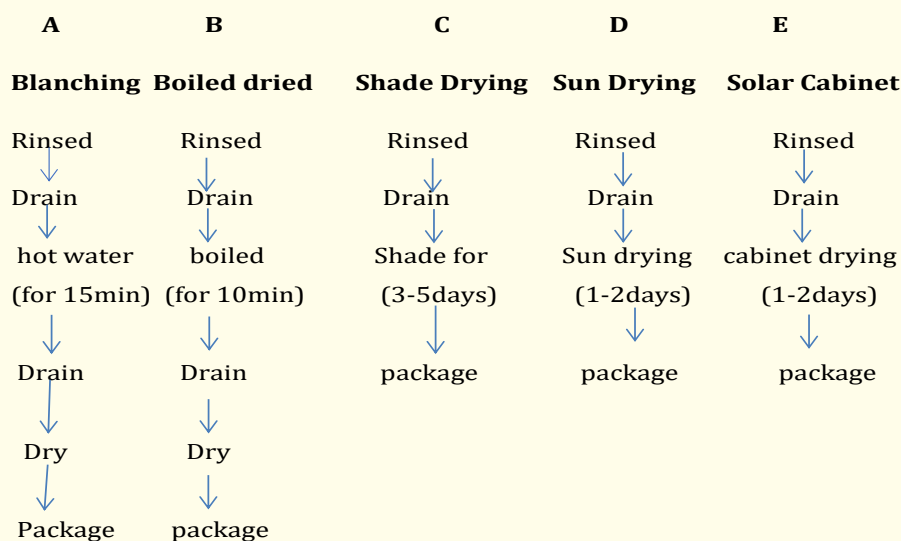


Figure 1: Flow chart showing various process drying methods on *Balanites aegyptiaca* matured leaves.



**Plate 1:** Showing pretreated dried *balanites aegyptiaca* leaf samples.

## Result and Discussion

Table 1 shows the proximate values of dried balanites leaves at various process drying methods. The dry matter of balanites fresh Leaf was observed to be higher than the pretreated leaves samples. The boiled, shade dried and solar cabinet pretreated dried samples were compared with the control sample. The crude protein of the leaf revealed that shade dried and solar cabinet dried leaf had high amount of crude protein. This trend in percentage values was followed by boiled sample, sun dried sample and the control sample respectively. The high crude protein value seen on shade dried and solar cabinet dried leaves samples may be due to mild dry heating system of shade and solar cabinet drying.

Sample	Dry Matter%	Crude Protein%	Crude Fibre %	Fat%	Ash%	NFE%
Control (fresh leave)	98.24 <sup>a</sup>	14.84 <sup>b</sup>	18.98 <sup>d</sup>	2.02 <sup>c</sup>	8.69 <sup>a</sup>	56.30 <sup>b</sup>
A	89.66 <sup>d</sup>	13.86 <sup>c</sup>	18.18 <sup>d</sup>	2.78 <sup>a</sup>	7.78 <sup>b</sup>	57.40 <sup>a</sup>
B	90.48 <sup>c</sup>	15.05 <sup>a</sup>	19.56 <sup>c</sup>	2.13 <sup>b</sup>	7.45 <sup>b</sup>	55.81 <sup>c</sup>
C	91.23 <sup>b</sup>	15.28 <sup>a</sup>	19.89 <sup>c</sup>	1.96 <sup>d</sup>	6.58 <sup>c</sup>	56.31 <sup>b</sup>
D	89.79 <sup>d</sup>	14.99 <sup>b</sup>	20.44 <sup>b</sup>	1.99 <sup>d</sup>	7.13 <sup>b</sup>	55.45 <sup>c</sup>
E	90.88 <sup>c</sup>	15.11 <sup>a</sup>	21.01 <sup>a</sup>	1.78 <sup>e</sup>	6.94 <sup>c</sup>	55.16 <sup>c</sup>

**Table 1:** Proximate analysis of *balanites aegyptiaca* pretreated leaf samples.

Results are mean of duplicates samples. Superscript with same values on same column is not significantly different

Key: A: Blanched leaves; B: Boiled dried leaves; C: Shade Dried leaves; D: Sun Dried leaves; E: Solar Cabinet leaves

The crude fibre values of fresh leaf were (18.98)%, blanched (18.18)%, shade dried (19.89)%, sundried (20.44)% and solar cabinet (21.01)% revealed that solar, sun drying, shade and boiled approaches may have cause the retention and modification of fiber macronutrients. This tells that this approach of drying generally remodels balanites leaves nutrients.

The fat value from fresh leaf or control sample (2.02)%, blanched (2.78)%, boiled (2.14)%, shade (1.96)%, sundried (1.99)% and solar cabinet (1.78)% reveals that boiled and blanched treatments had higher values comparably, inferring that heating rupture *Balanites aegyptiaca* leaves fatty acid molecule, may be making nutrients bioavailable. The shade, sundried and solar cabinet dryings of these leaves may have stabilized its fat molecule for human consumption.

The ash value of fresh leaves (8.69)%, blanched (7.78)%, boiled, shade (6.58 )%, sundried (7.13)% and solar (6.94)% confers that blanched, boiled, sun dried, solar cabinet process- drying of balanites leaves may have resulted in re-mineralization of the products. The mineral value observable from these pretreatments except for shade drying methods may depict an analytic approach to mineral extraction.

Table 2 shows some mineral contents of balanites leaves from blanched, boiled, shade, sun and solar cabinet process dried systems. Blanched sample A had (0.0074 mg/g) Zn, (0.0068 mg/g) Cu, (0.1873 mg/g) Fe, (0.8250 mg/g) Mg and (2.5825 mg/g) Ca value contents. Boiled dried leaves sample B have (0.0206 mg/g) Zn, (0.0104 mg/g) Cu, (0.01105 mg/g) Fe, (0.8126 mg/g) Mg and (2.2671 mg/g) Ca. The shade dried leaves sample C had (0.0083 mg/g) Zn, (0.0081 mg/g) Cu, (0.1017 mg/g) Fe, (0.8126 mg/g) Mg and (2.3080 mg/g) Ca. Sundried sample had (0.0070 mg/g) Zn, Cu (0.0199 mg/g), Fe( 0.2962 mg/g), (0.7203 mg/g) Mg and (1.6727 mg/g) Ca. Solar cabinet dried sample E had (0.0094 mg/g) Zn, Cu (0.0102 mg/g), Fe (0.0942 mg/g), Mg (0.0942 mg/g) and Ca (2.7834 mg/g).The boiled leaves sample have higher Zn content than the rest pretreated leaves samples. It is however lower than the fresh balanites leaves sample. The zinc value obtained agreed with boiled balanites leaves value of (0.0042 mg/g) reported by (Okia et al 2016). This observation in Zinc content may be due to rupturing that might have released more zinc for it bioavailability. Copper mineral contents were observed to be higher in boiled, sundried and solar cabinet dried treated samples compare with the rest samples. Balanites boiled values of (0.0042 mg/g) Cu reported by (Okia et al 2013) agree with the obtained value of (0.0104mg/g) Cu from the boiled sample treatments. Iron mineral content value were observe to be higher in sundried samples followed by blanched and shade dried samples when compare with fresh leaves control sample. However, boiled values (0.1105mg/g) agreed with (0.043 mg/g) boiled value reported by [10]. Magnesium contents were higher in all samples except in solar cabinet leaves sample but could not be compare with the control sample. Pretreatment given did not influence calcium level in all sample but solar, blanched, boiled and sundried samples were high compare with the control. It is observed that heat interferes with mineral content in balanites leaves, hence modifiers mineral release and bioavailability. It is observed that sun drying retains mineral Fe and Ca while solar cabinets drying retain Ca and Zn minerals.

Sample	Zn (mg/g)	Cu (mg/g)	Fe (mg/g)	Mg (mg/g)	Ca (mg/g)
Control (fresh)	0.03973 <sup>a</sup>	0.02482 <sup>a</sup>	0.03973 <sup>d</sup>	1.350 <sup>a</sup>	23.260 <sup>a</sup>
A	0.0074 <sup>d</sup>	0.0068 <sup>e</sup>	0.1873 <sup>b</sup>	0.8250 <sup>b</sup>	2.5825 <sup>c</sup>
B	0.0206 <sup>b</sup>	0.0104 <sup>c</sup>	0.1105 <sup>c</sup>	0.8126 <sup>c</sup>	2.2671 <sup>d</sup>
C	0.0083 <sup>c</sup>	0.0081 <sup>d</sup>	0.1017 <sup>c</sup>	0.8126 <sup>c</sup>	2.3080 <sup>d</sup>
D	0.0070 <sup>d</sup>	0.0199 <sup>b</sup>	0.2962 <sup>a</sup>	0.7203 <sup>d</sup>	1.6727 <sup>e</sup>
E	0.0094 <sup>b</sup>	0.0102 <sup>c</sup>	0.0942 <sup>d</sup>	0.0942 <sup>e</sup>	2.7834 <sup>b</sup>

**Table 2:** Some mineral contents of *balanites aegyptiaca* pretreated leaves samples.

Results are mean of duplicates samples. Superscript with same values on same column is not significantly different

Key: A: Blanched leaves; B: Boiled dried leaves; C: Shade Dried leaves; D: Sun Dried leaves; E: Solar Cabinet leaves

The vitamin A content through pretreatment given in table 3 shows that shade dried *balanites* leaves (15.06)%ug, solar cabinet dried leaves (14.37)%ug and sundried leaves sample had higher vitamin A retention compare with the rest except the control sample with (21.08)%ug vitamin A .This observation maybe because vitamin A is a heat labile vitamin and could not be retain in boiled and blanched treated dried samples , but with lesser content in sundried leave samples.

Sample	Vitamin A (%µg)
Control	21.08 <sup>a</sup>
A	11.56 <sup>e</sup>
B	13.01 <sup>d</sup>
C	15.06 <sup>b</sup>
D	13.88 <sup>d</sup>
E	14.37 <sup>c</sup>

**Table 3:** Vitamin A content of *balanites aegyptiaca* pretreated leave samples.

Results are mean of duplicates samples. Superscript with same values on same column is not significantly different

Key: A: Blanched leaves; B: Boiled dried leaves; C: Shade Dried leaves; D: Sun Dried leaves; E: Solar Cabinet leaves

## Conclusion

The present study revealed that the fresh and process dried balanites leaves, which are rarely consumed in North east of Nigeria as diet have a major amount of dry mass, protein, fat, total ash, crude fiber which are optimal at boiled, shade dried and solar cabinet dried leaves treated approaches. The high levels of essential minerals; Zn, Cu, Fe, Mg and Ca which are optimally present at solar, boiled and blanch treatments, are very important to human biochemical metabolism. Vitamin A have beneficial nutritional potential. The vitamin A of shade dried and solar cabinets balanities leaves may be useful as functional ingredients, fortifier or for vitamin A supplementation in cereal flour, confectionaries and bulky carbohydrates staple foods.

## Acknowledgement

The authors acknowledged the grant received from The Tertiary Education Trust Fund (TETFund) through the Federal University, Gashua, Nigeria that made it possible to carry out this work.

## Bibliography

- Hall JB and Walker HD. "Balanites aegyptiaca: A monograph". School of Agriculture and Forest Sciences 3 University of Wales, Bangor (1991).
- Katende AB., *et al.* "Wild food plants and mushrooms of Uganda". RELMA Technical Handbook Series No. 19 RELMA/SIDA, Nairobi, Kenya (1999): 490.
- NRC. "Nutrient requirements of Poultry". 9<sup>th</sup> Revised Edition, National Academy Press, Washington, D.C. 1994.
- Rolls BJ., *et al.* "What can intervention studies tell us about the relationship between fruits and vegetable consumption to weight management?" *Nutrition Reviews* 62.1 (2004): 1-17.
- Maher MH., *et al.* "Nutritional potential, mineral composition and antioxidant activity squash (cucurbita pepo l.) fruits grown in Egypt". *European Journal of Biomedical and Pharmaceutical Sciences* 4.3 (2017): 5-12.
- Murkovic M., *et al.* "Carotenoid content in different varieties of pumpkins". *Journal of Food Composition* 15 (2002): 633-638.
- Achu MB., *et al.* "Nutritive value of some cucurbitaceae oilseeds from different regions in Cameroon". *African Journal of Biotechnology* 4.11 (2005): 1329-1334.
- Baumer M. "Food producing trees and shrubs of West Africa Series". *Etudes- et-Recherches Senegal* 15: (1995): 168-206.

9. Kubmarawa D., *et al.* "Amino acid profile of two non-conventional leafy vegetables, *Sesamum indicum* and *Balanites aegyptiaca*". *African Journal of Biotechnology* 7.19 (2008): 3502-3504.
10. Okia CA., *et al.* "Nutritional Value of Commonly Consumed Desert Date Tree Products". *African Crop Science Journal* 21 (2013): 657-667.
11. AOAC. "Official methods of analysis of the association of the analytical chemists". 17<sup>th</sup> Edition. Inc. Irginia, Washington DC, USA (2000).

**Volume 9 Issue 2 May 2017**

**© All rights reserved by Ogori AF, *et al.***