

## PAPER 52 – CHARACTERIZATIONS OF SHEA BUTTER LEAF (VITTELLA PARADOXA) POWDER

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### ABSTRACT

The study investigated the phytochemical analysis, proximate composition, pH, and analytical enquiries of FT-IR, BET, and SEM-EDS of shea butter leaf powder. The leave was washed thoroughly under water to remove insoluble substances, later with distilled water, sundried for 14 days, ground and, sieved into powder by 60 um mesh size. The product was stored in an airtight container for further use. The qualitative analysis of the phytochemical study indicated 111.85mg/g flavonoid, 86.54mg/g tannins, 237.82mg/g phenol, 46.05mg/g alkaloids, and 535mg/g saponin. The proximate analysis shown 12.59% moisture content, 4.10% ash content, 12.34% crude fat, 12.25% crude protein, 17.80% crude fiber, and 40.92% carbohydrate content. The pH of the extract was 6.38. BET shown 182.5 area, 10.10cc/g pore volume, and 2.13nm pore size. FT-IR results indicated the presence of N-H, O-H, C-H, C N, C C, C O, C N, C C as functional groups present. SEM-EDS revealed the surface morphology. EDS shown the percentage in weight elemental compositions of the sample powder as 37.50% O<sub>2</sub>, 29.64% Ca, 24.14% K, 6.07% Cl, and 2.65% Si. The results revealed the importance of Shea butter leave to process industries such as food processing industry, cosmetic and pharmaceutical industry, and as an adsorbent in waste water treatment.

**KEYWORDS:** Shea butter leaves, phytochemical screening, proximate analysis, and analytical studies

### 1.0 INTRODUCTION

The shea butter tree is otherwise called the Karite tree. It belongs to the family Sapotaciae, which comprises two major species. The two species are *Vitellaria paradoxa*, which was formerly called (i) *Butyrospermum paradoxa*, and (ii) *Vitellaria parkii*. It is perennial and peculiar to sub-Saharan Africa. The species of tree is found from Senegal to Uganda in Africa. This stretch can be described as a shea butter belt (Maanikuu & Peker, 2017). Solomon et al. (2017) established that *Butyrospermum paradoxa* (*V. paradoxa*) is more common in the western part of Africa, while the other species is prevalent in East Africa. Earlier in 2014, Obisesan et al. reported that the shea plant is mostly found in the wild in Nigeria. This could be found within Guinea, Sudan, and the Sahel.

### 2.0 MATERIALS AND METHODS

The fresh and health leaves of shea butter (*V. paradoxa*) was harvested in Gidan - kwano community, Minna in Bosso Local Government Area of Niger State, Nigeria. The plant part was identified at the department of Plant Biology, School of Life Science, Federal University of Technology, Minna, Niger state.

#### 2.1 Preparation of Shea Butter Leave Powders

The harvested leaves were washed three times under running tap water and lastly with distilled water to remove any solid, dissolvable, or insoluble particles that were attached to the leaves. The thoroughly washed leaves were open-dried for two weeks, milled to a powder with a mechanical device, and sieved to remove any present shaft. The powder product was kept in an airtight container for further use.

#### 2.2 Phyto – chemical Analysis

A phytochemical study was carried out to investigate the presence of some of the natural chemicals called polyphenols, which are antioxidants, in plant parts. These antioxidants are non-toxic, low-cost, helpful for traditional medicinal purposes, and, more recently, they serve as bio-reducing agents in the reduction of metallic salt to metallic ions during nanoparticle synthesis. The phytochemical study is carried out using the extract obtained from the plant powder.

#### 2.3 Determination of pH

5 grams of shea butter leave powder were measured using a weighing balance and gently poured into a beaker containing 12.50 ml of distilled water. The two substances were mixed through a mechanical shaker for 15 minutes after the pH was measured using the pH meter (Akwu et al., 2019).

## 2.4 Proximate Analysis

Proximate analysis is a scientific and physical inquiry carried out to investigate the composition of micro- and macro-elements in a feed. The scientific tests include moisture content, ash content, crude fiber, crude protein, and crude fat. The analysis was done using the standard method of AOAC, 2000. The percentage composition of carbohydrates is determined by subtracting the sum of the values of moisture content, ash content, crude fiber, crude fats, and crude protein from 100. The percentage of dried matter is also obtained by deducting the percentage of moisture content from 100.

## 2.5 Analytical studies of Shea butter leave powder

The third goal of this objective is to characterize shea butter leave powder using the analytical instruments for FT-IR, BET, and SEM-EDS. FT-IR will be carried out to reveal the functional groups present in the leaf part of the plant. SEM will show the surface morphology; EDS will be used to determine the elemental composition; and BET will be carried out to reveal specific surface areas, pore sizes, and pore volume distributions of the material.

## Phytochemical Screening

The results of the phytochemical study of shea butter leave extract presented in Table 1 indicated the presence of saponin, tannins, phenols, alkaloid and flavonoids.

**Table 1.** The qualitative and quantitative analysis of Shea butter leaf extract.

S /no	Phyto- chemical components	Test	Observation (coloration)	Inference	Mean values $\pm$ Sd (mg /g)
1	Phenol	Ferric Chloride	Brownish green / Black blue	P	233.8153 $\pm$ 1.53
2	Flavonoids	Alkaline	Yellow	P	111.8455 $\pm$ 1.48
3	Alkaloids	Mayer's	Cream/ Yellow precipitate	P	46.0512 $\pm$ 0.78
4	Tannins	Ferric Chloride	Brownish green / Black blue	P	86.5382 $\pm$ 0.61
5	Saponin	Foam	A foamy layer was observed	P	535. 8210 $\pm$ 2.35

Gopalakrishnan K. et al. (2017) reported it to be a naturally occurring polyphenol in plants with the main characteristic of binding and precipitating proteins. Edem et al. (2016) also attributed its usage in the treatment of diseases to its antimicrobial properties. Agbo et al. (2014) submitted that compounds with high phenolic contents have a very good potential to neutralize free radicals. Hence, they are good antioxidants. The major reasons for the use of shea fruit ash in the local soap-making industry to cure skin-related diseases are discussed by Akoma et al. (2018).

## 3.2 Proximate Analysis

The results obtained from proximate analysis of shea butter leave powder indicated the various percentages compositions of the macronutrients found in the plant feed is shown in Table 2.

**Table 2. Proximate Analysis of Shea Butter leaves Powder**

S/No	Component	Shea Butter Leave Powder (%)
1	Moisture Content	12.59
2	Ash Content	4.10
3	Crude Fat	12.34
4	Crude Protein	12.25
5	Crude Fibre	17.80
6	Carbohydrate	40.92
	<b>Total</b>	<b>100.00</b>

The percentage of ash content in the leave part is carried out to reveal the mineral component in the organ. Lower report of ash content in plant species may suggest a low deposit of mineral elements in the plant. The carbohydrate content is reportedly higher in the leave of plants than in any other parts. This could have been to the fact that photosynthesis takes place in the plant – part Akwu et al., (2019). The percentage of composition of moisture content in a plant determines its absorption capacity and assimilation rate. According to Ngaha et al. (2016), plants with high moisture content have low storage ability, which gives them a higher advantage for industrial use. The result obtained using a pH meter to determine the hydrogen ion concentration of the extract shows that the pH is 6.38

### 3.4 Analytical Studies of Shea Butter Leave Powder

#### 3.4.1 Fourier Transform Infrared (FT – IR)

Fourier transforms infrared spectral analysis carried out was aimed at identifying the presence of various functional groups present in shea butter leave powder. The functional groups which were revealed by the FT-IR include the O-H stretch, C-H stretch, C=O stretch, C-O stretch, C-C stretch, C=C stretch and the N-H stretch as shown in the FT -IR graph which shows the FT-IR spectra of shea butter

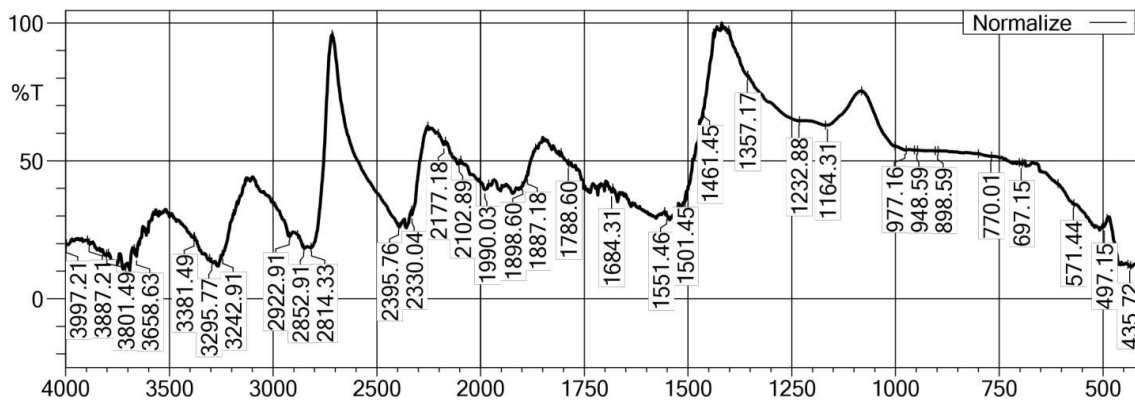


Figure 1. Fourier Transform Infrared (FT – IR)

#### 3.4.2 Branauer-Emmett-Teller analysis (BET)

Bardestani et al. (2019) listed specific surface area and pore size as basic physical and chemical parameters that can be controlled while synthesizing adsorbents for environmental challenges. The specific surface area of an adsorbent plays a very vital role in the adsorption mechanism of heavy metals from aqueous solutions and, more importantly, in nanoparticle application. Based on the IUPAC classification of pore size, shea butter leaf powder falls under the mesopore grouping, which is recommended for bio-adsorbents. Table 3 shows the Branauer-Emmett-Teller analysis (BET)

Table 3. BET analysis of Shea butter leave powder

S/No	Characteristics	BET / BJH values
1	Surface Area (m <sup>2</sup> /g)	182.5
2	Pore Volume (cm <sup>3</sup> /g)	0.101
3	Pore Size (nm)	2.133

#### 3.4.3 SEM- EDS

The results obtained for SEM revealed the surface morphology of the shea butter leaf powder. Unlike that of activated carbon or other carbonaceous materials, which reveal the presence of clogged pores and volatile organic compounds (VOC) on the surface of the raw adsorbent, Mohammad & Yahya (2021) found that the surface morphology of shea butter leaf powder has irregular shapes with different dimensions and unequal pore sizes. Alhajali et al. (2022) revealed that the irregularities in the surface structure of plant part powder may have greatly contributed to removing heavy metal contaminants in wastewater. The quantitative tabulation of analytical EDS spectra as presented in Table 3.5 revealed the percentages in weight of 37.50% O<sub>2</sub>, 29.64% Ca, 24.14% K, 6.07% Cl, and 2.65 Si. The abundance of Ca, K, and Cl may favour the removal of heavy metals during effluent treatments. The presence of silicon may not be unconnected with the challenges of dust particles during open-air drying, which is still preferable to oven drying which can cause denaturalization of the organic matter that are present in leaves. Shown in Figures 2(a) and 2(b) are the surface morphology of shea butter leaf powder and energy dispersive spectroscopy of shea butter powder, respectively.

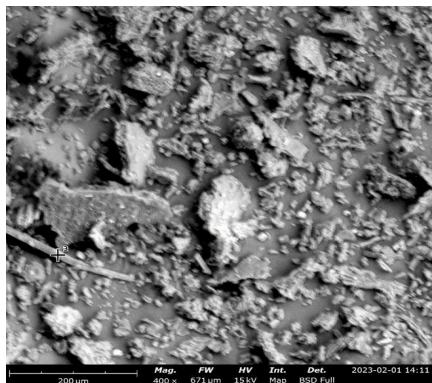


Figure 2. Surface Morphology of Shea butter leaf powder

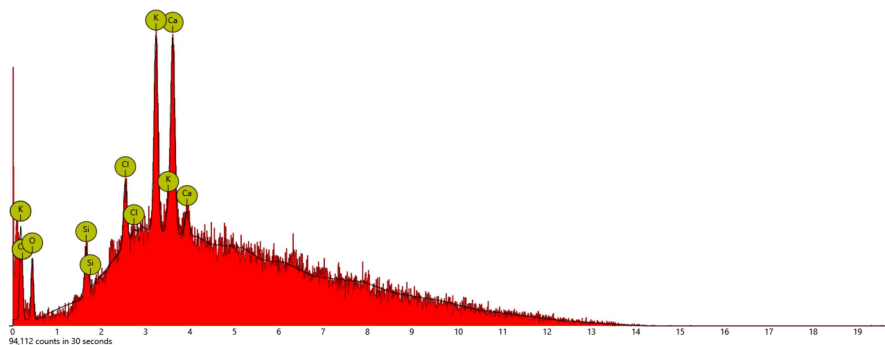


Table 5. Energy Dispersive Spectroscopy of Shea butter powder

Element Number	Element Symbol	Element Name	Atomic Conc.	Weight Conc.
8	O	Oxygen	59.09	37.50
20	Ca	Calcium	18.65	29.64
19	K	Potassium	15.57	24.14
17	Cl	Chlorine	4.32	6.07
14	Si	Silicon	2.38	2.65

#### 4. CONCLUSION

Although many research studies have been reported on shea butter, most especially on the oil and the fruit, few have been reported on the leaf. This work-study examines the phytochemical screening, pH, proximate, and analytical studies of shea butter leaf powder. The results obtained in the phytochemical screening of shea butter leaves show that the plant part contains some natural chemicals called polyphenols, which are antioxidants and can be used in process industries such as food, cosmetics, pharmaceuticals, and in the preparation of nano-adsorbents for wastewater treatment. The results of pH show the extract is a good nano adsorbent. The results obtained from proximate analysis on moisture content composition show that the leaf powder can be stored for industrial uses. The low percentage composition of ash content indicated that some elements were not present in the leaf powder. The results obtained for crude protein, crude fiber, crude fat, and carbohydrate content show that the leaf powder can be incorporated into animal feed compositions since its fruit is edible for humans and the shea butter is a natural antibiotic for humans, especially small children. The results of the analytical studies, as revealed by BET, show that both surface area and pore size of the leaf powder has physical and chemical properties that can be measured and controlled while synthesizing nano adsorbent. The results obtained from FT-IR reveal that shea butter leaf powder has an important chemical functional group that can aid adsorption techniques. The abundance of oxygen (O<sub>2</sub>) as shown by EDS confirms the presence of the hydroxy (OH) group. The presence of calcium (Ca) and potassium (K) tends to form complexes with heavy metals in water during the treatment process.

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