

Article

Antimicrobial Activity of Oil from *Butyrospermum parkii* Seed (Shea Butter)

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Abstract: The oil of the powdered seed of *Butyrospermum parkii* was extracted sequentially using petroleum ether and hexane by soxhlet extractor. The colour of the oil reveals that the petroleum ether extracts to be light brown and hexane to be pale yellow. 80g of the seed sample of *Butyrospermum parkii* extracted by hexane yielded 38.8% of oil and petroleum ether yielded 40.25% of the crude oil. The moisture content was 8.3%. The iodine values, Saponification values, Peroxide values, free fatty acid values, of oil obtained from *Butyrospermum parkii* seed are 53.20% and 51.30%, 215.00 and 212.10 Mg KOH/Kg 8.3 and 7.5meq/Kg 9.20% and 10% for hexane and petroleum ether respectively. The thin layer chromatography of oil obtained from *Butyrospermum parkii* seed contained two components. The antipathogenic activity shows that they cannot be exploited for use in pharmaceutical, while the study shows that *Butyrospermum parkii* oil are of high yield, consumption value and due to their saponification value, iodine value, peroxide value and free fatty acid level, the oil could be exploited for use in vegetable oil and cosmetic industries.

Key words: Antimicrobial Activity, *Butyrospermum parkii*

1. Introduction

Worldwide, natural vegetable oils and fats are increasingly becoming important in nutrition and commerce because they are sources of dietary energy, antioxidants, biofuels and raw materials for the

manufacture of industrial products. They are used in food, cosmetics, pharmaceuticals and chemical industries. Vegetable oils account for 80% of the world's natural oils and fat supply (Asuquo *et al.*, 2010). The search for alternatives to antibiotics is generally a global challenge to the scientific community. Several reasons have been advanced for the need for alternations to antibiotics. This may include toxicity, emergences of resistant variants, allergic among a host of others (Etim *et al.*, 2012). Since time immemorial infectious diseases have been treated effectively with decoction or infusion consisting either mixture of plant bark, roots, leaves and oils. Most people in the rural areas of the world depend largely on herbs for treatment of several ailments because medicinal herbs constitute indispensable components of traditional medicine practice due to low cost, easy access and ancestral experience (Marini-Bettolo GB1980).

Shea butter oil botanically called *Butyrospermum parkii* is a soft paste of melted fat with a milky colour in solid form and brownish when melted. It has a characteristic odour. It contains fatty acid triglyceride and a high amount of unsaponifiable matter, which ranges from 2.5% to 15% (Eka, 1997). This exceptionally rich vegetable extract contains fatty acids, phytosterol and unsaponifiable matter which stimulate the skin's natural renewal process. The composition of the product depends on several criteria particularly the geographical occurrence, its botanical origin, handling of the seeds and processing e.g drying time, ripening (Asintoke, 1987). The shea butter fat can also be used in soap making, cosmetics and traditional medicine in many rural areas, (Maranz *et al.*, 2004, Alander, 2004). *Butyrospermum parkii* is one of the plants that is medicinally important and had been used in traditional medicine for variety of purposes in treating infectious and non-infectious diseases.

Butyrospermum parkii tree grows naturally widely in the dry Savannah Belt of West Africa. *Butyrospermum parkii* belong to the family *sepotaceae*. The tree usually grows to an average height of 15m. It produces its first fruit when it is about 20 years old and reaches its full production when it is about 45 years old. It produces nuts for up to 200 years after reaching maturity. The tree grows profuse branches and a thick waxy and deeply fissured bark and that makes it fire resistant. *Butyrospermum parkii* tree flower between January to April and develops its fruits which ripen and fall down in June to August. The mesocarp of the fruit is eaten and the kernels are extracted for oil.(Wayne Kihz 2001). Shea butter (*Butyrospermum parkii*) extracted from the nuts is one of the most affordable and widely used vegetable fats in the Sahel. Shea butter tree is an important oil producing plant, especially as it occurs where other plants are rare. It is useful in soap making but it is unique in having a high fraction oil of eight percent (8%) that does not convert into soap, this fraction has numerous medicinal qualities (Molek, O. 1999). The refined fat is sold as baking fat, margarine and other fatty spreads under trade names and finds increasing use in various foodstuffs. Unripened shea butter is sold in 'leaves' in markets,

and if properly prepared and wrapped is resistant to oxidative rancidity and will keep for many years if not exposed to air and heat.(Poheda and Soursseler 1992).

Shea butter is used as a base for medicinal ointments, and has been claimed to have anti-inflammatory properties. Shea butter has been claimed to be effective treatment for the following conditions: fading scars, eczema, burns, rashes, severely dry skin, dark spots, skin discolorations, chapped lips, stretchmarks, wrinkles, and in lessening the irritation of psoriasis. In Nigeria, shea butter is used for the management of sinusitis and relief of nasal congestion (Tella, 1979). This is due to its hydrating properties which help in relaxing the tension in the face skin thus easing respiration. Fusion of the bark has been shown to have selective antimicrobial properties as being effective against *Sarana luuha* and *Staphylococcus aureus* (Sofowora1979).

Over the past century, a number of synthetic antimicrobial agents have been discovered and developed, but drug resistance and toxicity are still the major hindrances to gaining successful therapeutic outcomes in many instances. Herbal medicines may represent a safe and useful supplement to existing chemotherapeutic therapies for the management of infectious diseases (Etim et al., 2012). Antimicrobial activities of leaves and stem bark of *Butyrospermum parkii* on microbes (micro-organism) like *Staphylococcus aureas*, *Pseudomonas aeuroginosa* *E.coli* and others have been undertaken. In fact, much work has been done on the leaves and stem bark of *Butyrospermum parkii* and to the best of our knowledge little or no work has been done on oil of this plant in this part of the world. The present work was designed to provide information that may aid further utilization of *Butyrospermum parkii* for the benefit of mankind. The specific objectives of the study were to:

- i. Extraction of oil from the crushed seed of *Butyrospermum parkii*
- ii. Determine the physical and chemical properties of the oil extract
- iii. Confirm or disprove the antipathogenic profile of *Butyrospermum parkii* of oil extract.

2. Materials and Methods

The seeds of *butyrospermum parkii* were collected from the premises of Abubakar Tafawa Balewa University Bauchi. The endocarps were subsequently removed by cracking the shell that covered the seed. The seeds were crushed in a mortar with pestle and allowed to dry for a period of one month.

2.1. Oil Extraction

Oil from the paste was extracted with n-hexane and petroleum solvents for eight hours using soxhlet apparatus.

2.2. Physico-chemical Characterization

Standard procedures of American oil Chemists society were used for indices values (AOAC, 1997) procedures were applied for moisture content, free fatty acid, iodine value, saponification value and peroxide value.

2.3. Bioassay

This is the study of antimicrobial activity of the crude or purified extracts against micro-organism. It was used as a guide to determine the active components of the stem bark of *Stereospermum kunthianum*. The crude extracts were tested for antibacterial. The test organisms were collected from Abubakar Tafawa Balewa University Teaching Hospital, Bauchi. They are as follows: *Escherichia coli*, *Staphylococcus aerus*, *Pseudomonas aeruginosa*, and *trychopyton rabrum*. The bacterial assay procedures of Water Worth (1978) and perez *et al*, (1990) were employed with small modification. The methods involved the preparation of the culture medium and inoculation. Aseptic technique was used to avoid contamination.

2.3.1. Preparation of the medium

Two media were employed for this research: NA (Nutrient agar) for bacteria culture and MEA (Malt extract agar) for fungi culture. The media was prepared by dissolving 28g of NA in 1 litre of distilled water, while 50g of MEA was dissolved in 1 litre of distilled water. They were sterilized at 121 °C for 15 minutes in an autoclave and subsequently allowed to cool to about 45 °C (temperature at which the agars remains molten) and pour in plate (petri dishes) allow to gel or solidified.

2.3.2. Standardization of innoculums

The seven test organisms were sub-cultured with nutrient broth using a wire loop (done aseptically) and incubated for 24 hours at 35 °C for bacteria and 48 hours at 25 °C for fungi.

The growth of the micro-organisms in the broth by the turbidity produced was adjusted to match 0.5 McFarland standards (10^8 cfu/ml), which was further adjusted to 10^3 cfu/ml and 10^5 for bacteria and fungi respectively.

2.3.3. Inoculation of the plates and application of the extracts

The agar plates NA (nutrient agar) and MEA (Malt extract agar) were inoculated by spreading a small volume (0.05 ml to 0.10ml) of the liquid inoculums (sub-cultured nutrient broth) by means of an L-shaped glass rod (or a “spreader”) in such a way that the surface of the agar in the plates were covered with the plates were covered with microbes. One microbe was inoculated to one plate making a total of four plates for four microbes.

Two wells for hexane and petroleum ether extracts were made. The plant extracts is diluted using dilution method and in each of the appropriately labeled well (hole) diluted plant extract were introduced. The inoculated plates were left on the bench for about an hour to allow the extracts diffuse into the agar. The NA and MEA were aerobically incubated at 37 °C for 23 hours for the bacteria and 48 hours for the fungi. The diameter of zones of inhibition was measured by means of linear instrument in millimeter (venier calliper) and recorded.

3. Results

3.1. Nature and Yield of Crude Extracts oil of *Butyrospermum parkii*

The results Nature and yield of crude oil obtained from the oil extraction from of *Butyrospermum parkii* using hexane and petroleum ether is shown in the table 1.

Table 1: Nature and yield of crude extracts oil of *Butyrospermum parkii*

Solvents	Extract colour	Extract texture	Extract yield	Percentages recovery	Odour	Boiling point °C
Hexane	Pale yellow	Solid	31.0	38.80	Pleasant	63
Petroleum ether	Light brown	Solid	32.10	40.25	Pleasant	62

3.2. Chemical Analysis of the Oil

The quality parameters of the oil extracted from *Butyrospermum parkii* which include, iodine value, moisture content, saponification value, free fatty acid, peroxide values were determined and the result are as shown in table 2.

Table 2. Quality parameters of the oil extracted from *Butyrospermum parkii*

	Iodine value (%)	Saponification value mg (KOH/Kg)	Peroxide value (meq/Kg)	Free fatty value (%)	Moisture content (%)
Hexane extract	53.20	215.00	8.30	9.20	2.6
Petroleum ether extract	51.50	212.10	7.50	10.10	8.3

3.3. Results of the Bioassay

Activity of the crude oil from *Butyrospermum parkii* seed was tested on seven clinical isolates; *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Trychophyton rubrum*. The measured zone of inhibition of the pathogens by the crude oil extracts are summarized in the table 3.

Table 3. Antimicrobial Activity of *Butyrospermum parkii* oil

Extract	Organism	Zone of inhibition by extract (mm)
Hexane	<i>Pseudomonas</i>	- -
	<i>aeruginosa</i>	
	<i>Escherichia coli</i>	- -
	<i>Trychophyton</i>	- -
	<i>rubrum</i>	
Petroleum ether	<i>Staphylococcus</i>	2.7
	<i>aeurus</i>	
	<i>Pseudomonas</i>	- -
	<i>aeruginosa</i>	
	<i>Escherichia coli</i>	- -
	<i>Trychophyton</i>	- -
	<i>rubrum</i>	
	<i>Staphylococcus</i>	3.5
	<i>aeureus</i>	

4. Discussion

Physical analysis of the oil reveals that the petroleum ether extracts to be light brown and hexane to be pale yellow. These colours are due to carotene, a pigment found in butter. Iodine value measures the degree of unstauration in fat or vegetable oil (i. e. the number of double bonds) (Daintith, 2008). It determines the stability of oils to oxidation as well as allows the overall unsaturation of the fat to be determined quantitatively. Knowledge of the iodine value enables the combustion temperature of the oil to be evaluated (Roger *et al.*, 2010). The iodine values oil obtained from *Butyrospermum parkii* seed are 53.20% and 51.30% and therefore they fall under non drying oil suggesting that they contained saturated fatty acids indicating that it is saturated and must probably stable to heat (Goh, 1994). Non-drying oils have iodine values less than 100 (Asuquo *et al.*, 2010). The iodine values of shea butter oil are lower than those of sunflower (110-143), castor oil (83.75), soybeans (120-143), *Coula edulis* (90-95) and rubber seed oil(134.51) (Abayeh *et al.*, 1999).

Saponification value helps to determine the quantity of potassium hydroxide (in mg) needed to neutralize the acids and saponify the esters contained in 1 g of the lipid. The saponification values of 215.00 and 212.10 Mg KOH/Kg were obtained for hexane and petroleum ether extracts respectively in this study are similar to those of typical seed oils such as soybean, castor, peanut, cotton seed, sunflower and avocado oils whose average saponification values range from 175 to 250 (Roger *et al.*, 2010). The higher the saponification value of the oil, the higher the lauric acid content of the oil is. The

lauric acid content and the saponification value of oil serve as important parameters in determining the stability of oil in soap making (Asuquo et al., 2012). This finding suggests that *Butyrospermum parkii* oil with high saponification value will find useful application in soap making and shampoo compared to oils with lower saponification values. Peroxide values of 8.3 and 7.5meq/Kg were obtained for hexane and petroleum ether extracts respectively. Peroxide value is an indicator of deterioration of oils (Ikwaagwu et al., 2000). The WHO/FAO (Kyari, 2008) stipulated a permitted maximum peroxide level of not more than 10 mequivalent of peroxide oxygen/kg of the oils, therefore, since the oil in this study has a peroxide value above 10, it may not be suitable for consumption.

The percentage moisture contents of 8.3% obtained in this study is similar to 10% obtained by Asuquo et al., (2010). Low moisture content is an indication of good shelf life for the oil. Low moisture content of oil might be as a result of effectiveness of the distillation apparatus used for recovering the oil. The fatty acid composition of vegetable oils is a main feature of their description and identification. It is also used as an indication of the purity and quality of the oil because the type and quality of each fatty acid vary from one vegetable oil to another. The oleic acid/linoleic acid (O/L) ratio has been used as an indicator of peanut oil stability and potentiality of the oil for deep frying fat (Asuquo et al., 2012). The free fatty acid value 9.20% and 10% for hexane and petroleum ether extract are low and support the value of edible oil. The thin layer chromatography of oil obtained from *Butyrospermum parkii* seed contained two components. A moved a distance of 0.9cm from the spotting point, with R_f value of 0.16 and B moved a distance of 1.1cm from the spotting point, with R_f value of 0.19.

The organisms (pathogen) tested are based on their implication in human diseases such as skin diseases, typhoid, pneumonia, dysentery, urinary tract, respiratory problems and others. From the result of the antibacterial assay shown in table 6 indicates that *Butyrospermum parkii* oil seed extracted by hexane show no activity on *Pseudomonas aeruginosa*, *Escherichia coli*, *Trychophyton rubrum* but it shows slight activities on *Stapylococcus auerus* with zone of inhibition of 2.7mm. The Petroleum ether extract, on the other hand, shows reasonable activity on *Stapylococcus auerus* with inhibition zone of 3.5mm but inactive on *Pseudomonas aeruginosa*, *Escherichia coli*, *Trychophyton rubrum*. This shows petroleum ether extract are more active on *Stapylococcus aeuerus* than hexane extract. Hence, the inhibition of extract (oil) is found to be reduced by solvent used in the extraction. In this case, hexane reduces the antimicrobial activity of oil much more than petroleum ether.

5. Conclusion

The percentage oil recovery from seed of *Butyrospermum parkii* hexane and petroleum ether are 38.8% and 40.25% respectively indicating that the oil can be extracted commercially using these

solvents. The iodine values show that the oil is saturated and stable to heat. Saponification values indicate that it can be used in soap making. The low free fatty acid values for hexane and petroleum ether extract reveals that it will be good for consumption. Peroxide values are low thereby indicating that the oil is a saturated ester. The result of the antibacterial assay indicates that *Butyrospermum parkii* oil seed extracted by hexane show no activity on *Pseudomonas aeruginosa*, *Escherichia coli*, *Trychophyton rubrum*, but it shows slight activities on *Stapylococcus auerus* with zone of inhibition of 2.7mm. The Petroleum ether extract on the other shows activity on *Stapylococcus auerus* with inhibition zone of 3.5mm but inactive on *Pseudomonas aeruginosa*, *Escherichia coli*, *Trychophyton rubrum*. Thus, their antipathogenic activity shows that they cannot be exploited for use in pharmaceutical. This study shows that *Butyrospermum parkii* oil are of high yield, consumption value and due to their saponification value, iodine value, peroxide value and free fatty acid level, the oil could be exploited for use in vegetable oil and cosmetic industries.

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