Extraction of saponine from *danfaraa* plant roots from Gurhengwal town, Askira/Uba local government of Borno state Nigeria

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Abstract: **Danfaraa plant roots shows higher sorption behavior property as well as foamcapacity far better than some commercial surfactants eg, good mama that was used in the study. This saponin-based surfactant is significantly environmentally friendly and shows better biodegradability than the commercial surfactants. The natural surfactant from dafaraa. Cissus populnea plants roots will contribute to efforts in diversify the Nigerians economy, a way to solve the problem of non-biodegradable, high price and non-environmentally friendly phenomenon that exists in the production of comercial surfactant such as good mama and can add value to green chemistry and sustainable development and exploitation of the cleansing properties of saponin present in dafaraa plants.**

I. INTRODUCTION

Surfactants are routinely deposited in numerous ways on land and into water systems, whether as part of an intended process or as industrial and house hold waste. Some of them are known to be toxic to animals, ecosystems, and humans and can increase the diffusion of other environmental contaminants (Azab, 2001).

The through and search for natural surfactant have limit the environmental hazard of soap and synthetic detergents on one hand and reduce drastically their toxic effects to plants and animals. Presently, we have several surfactants and the demand for the commodity has been in the increase. However, the raw materials for their production are scarce and continuously costly. As a solution to these problems, surfactant technologies resorted to the use of some plants as natural, cheaper raw materials for surfactant development (Agu, 2001) adopted by (Kime, 2016).

Petroleum and coal, the conventional surfactant base are natural resources and will eventually be depleted, it is a step in the right direction to make surfactants based on other sources especially plant origin. Many plants produce significant quantities of saponins which have surfactant properties. Saponins are groups of secondary plant metabolites that are found in abundance in various plant species particularly in Sapindaceae family and Sapindus genus (Foerster, 2009). Saponins are any of various plant glycosides that form soapy lathers when mixed and agitated with water, used in detergents, foaming agents, and emulsifiers or any of various steroids glycosides found in plant tissues that dissolve in water to give a soapy froth (Foerster, 2009). Hence, it is summarised that a study on evaluation of some surfactant properties in *Cissus populnea* root, stem bark and leaves is another way to advance the technology to expand the use of mostly neglected plants in our area.

Nigerian Raw Minerals

Nigeria is blessed with a number of mineral deposits which, if well harnessed, could be diversified in our economy (Ishaya, 2014). Colonialism is a major feature of the economic history of Nigeria. Britain eventually gained control of Nigeria administration. After independence, the Nigeria economy seemed very promising and is playing an important economic role in the world, especially as a producer of fossil fuels.

Nigerians economy is struggling to leverage the country’s vast wealth in fossil fuels in order to displace poverty that affects about 45% of its population. Economists refer to the co-existence of vast wealth in natural resources and extreme personal poverty in developing countries like Nigeria as the ‘‘resources curse’’ (Anonymous, 2013). Although resource curse is more widely understood to mean an abundance of natural resources that fuels official corruption resulting in a violent (Ishaya, 2014). Nigeria’s exports of oil and natural gas-at a time of peak prices have enable the country to account surpulus in recent years.

Nigeria is a vast country with considerable wealth in natural resources and with the type of local raw materials available, it can provide high quality products that can even be exported to developed part of the world. Unfortunately, the discovery of oil in 1956 hurt the mineral mining industries and some other local raw materials as government and industries both began to focus on this new resource. At present, mining of minerals in Nigeria accounts for only 0.3% of its Gross Domestic product (GDP), due to the influence of the vast oil resources. The domestic mining industries are still underdeveloped, leading to Nigerian having to import mineral that could be produced domestically. Our agricultural sector suffered the same fate as the mining sector (Anonymous, 2013) adopted by (Kime, 2015).

The Roots

According to (Belmain *et al*., 2000) the plant is used as diuretic and as a post-harvest ethnobotanical protectant in Ghana .previous studies on the plant has also shown that the root extract from the plant have been use for treatment of skin diseases, boils, infected wounds and for treating urinary tract infection, thus suggesting antibacterial potency of the plant (Kone *et al*., 2004). The root is also used in southern part of Nigeria as an arrow poison antidote (Gill, 1992). In Niger, Kogi, Plateau, Kwara and Benue States of Nigeria the plant is used for making vegetable soup for post natal stoppage of blood flow (Soladoye and Chukwuma, 2012). The gum obtained from the plant has been evaluated its potential uses as a dispersant in pharmaceutical liquid system (Iwe *et al*., 1993). However, further studies have conducted on the plant shown it is poisonous plant used as pesticides and fish poison, therefore suggesting it ichtyotoxic properties (Bosch, 2002). The roots are used by Yoruba to cure sore breast of women at childbirth and male coital adjunct disease (Burkill, 2000). Studies from herbaria collections indicates that the plant is confined to the savannah zone of the country and is more abundant in the northern region where it is used by Fulani to feet cattle, ostensibly to increase milk production (Brotherton, 1969). The fibres are also used for binding material and for making papers and baskets.

Physiochemical components

Physiochemical analysis was carried out on the root and the presence of alkaloid, flavonoids, tannins, saponins and anthraquinone were tested and investigated. The investigation was followed by quantitative analysis of each bioactive ingredient in each part of the plant to generate sample size. The procedures followed earlier works on plant root analysis as used by Sofowora (1993) and Trease and Evans (2005). A detailed method of extraction, as well as purification techniques for active plant ingredient described by Harborne (1973) was also employed for extraction of plant materials**.**

Structure and basic properties of saponins

Saponin is a class of chemical compound found in particular abundance in various plant species. More specifically, they are amphipathic glycosides grouped phenomenological by the soap-like foaming they produce when shaken in aqueous solutions and structurally by having one or more hydrophilic glycoside moieties combined with a lipophilic triterpene derivative. Saponins are naturally occurring in a variety of higher plants and a few marine species. These *amphiphilic* compounds consist of a hydrophobic aglycone linked to a hydrophilic sugar moiety. According to Chapagain, (2006), Saponins are basically classified as triterpenoids, steroids, or steroid alkaloids. According to the structure of the aglycone (non sugarpart) and *monodesmosidic, bidesmosidic,* or*tridesmosidic* (Greek desmos=chain) is according to the number of the sugar moieties attached to the aglycone. The steroid saponins comprise two categories, based on the structure of the aglycone ring. They are said to be *furostan*e when the E ring of the aglycone is opened and spirostane when it is closed. All classes of aglycones may have a number of functional groups causing big natural diversity. This diversity can be further expanded by the composition of sugar chain, sugar numbers, branching patterns, and type of substitution. Hexoses (glucose, galactose), 6-dehydroxyhexoses *(rhamnose, furanose), pentoses* (xylose, arabinose), and uronic acids *(glucuronic, galacturonic*) are the most common sugar residues in the saponin molecules that are attached at the C-3 position 9 *monodesmosidic*), and C-26 or C-28 (*bidesmosidic*). Tri-*desmosidic*saponin (saponins having three sugar chains) are seldom found in nature. The sugar moiety linked to the glycine through an ether or ester glycosidic linkage at one or two site. The configuration of inter-glycosidic is either α or β and the monosaccharide and can be in the *pyranose*or*furanose* forms (Chapagain, 2006).

Since the *agylcone* is very hydrophobic and the sugar chains are very hydrophilic, these characteristics provide saponin molecules with very excellent foaming and emulsifying properties. The presence of both polar (sugar) and non-polar (steroid or triterpene) groups provide saponins with strong surface-active properties that possess a strong foaming capacity in aqueous solutions. In aqueous solution they form small micelles individually, and these hydrophobic micelles of triterpene or steroid groups stack together like small piles of coins. Saponinmolucules also form micelles with sterols, such as cholesterol and biles acids. The hydrophobic portion of the saponin (*aglycone*or*sapogenin*) associates (*lipophilic*bonding) with the hydrophobic sterol molecules, in stacked micelle aggregation. Indeed, it should be no surprise that the name ‘saponin’comes from latin word sapo meaning soap (Chapagain, 2006). Figure 1 below shows the aglycone skeletons of the saponins.

Biological properties

In plant roots, saponins are secondary metabolites which use compounds that are not required for plant growth and development but presumed to function in communication or defence. Although little is known about the influence of the biological activities of saponin on the growth of the plant both inhibitory and stimulatory effects of saponins have been reported in the literature. One of the earliest works on steroidal saponins reported that an optimal concentration of saponins doubled the growth of wheat embryo. It has been reported that the saponins exhibit *phytohormone*-like activities and that pea saponin exerts a stimulatory effect on lettuce root growth but not on seed germination. It is reported that saponin molecules that occur constitutively in healthy plants acts as a barrier to infection and protect the plants attack by wide range of potential pathogens For example, the well- known saponins avenacin A-1 from oat roots, α-tomatine from tomato, and α-chalonine from potato, are to exhibit antifungal activities . The nature of the particular aglycone moieties and sugar constituents of a saponin dictates the way in which it will react with different living organisms, such as microbes, plants and animals. Saponins are, for example, very toxic to cold-blooded organisms, but apparently not to mammals.

Earlier studies have revealed that many saponins or saponin – rich extracts (SRE) from various plants showed antifungal activities have reported growth inhibition of *epidermaphyton, flooccosum, micro idesinterdigitalis,* and *trichophytonruburum* fungi by a saponin-rich extract of *maesalanceolata*. Many saponins have also been found to have an inhibitory effect against candida *albicans, crytococusneoformans*, and *Aspergillusfumigatus*. Similarly, saponin from *chenopodiumquinoa*, *Capsiumannum, phytolaccatetramera*, and *panaxnotoginseng* were also reported to have anti fugal activities. A study of the literature also revealed that saponins reduce larval growth and cause mortality in the flower beetle, *TenebriOMOlitor*, European grape moth, *Lobesiabotrana* and European corn borer*, Ostrimianubialis*. Studies have also reported that the high saponin content cultivar of alfalfa is correlated with resistance to the pea aphid (Chapagain, 2006).

Nutritive properties

In the past, saponins were recognized as anti-nutritional constituents due to their adverse effects, such as toxicity to fish and cold blooded animals and haemolytic effects; however, recent studies have shown that saponins are beneficial to humans. In recent studies have shown that saponins possess hypocholesterolemic, immune stimulatory, and anticarcinogenic properties (Chapagain, 2006). Saponins are also considered natural antioxidants since they bind to cholesterol and prevent cholesterol oxidation in the colon. Extracts of the saponin-containing plants like yucca schidigera and Quillajasaponaria have been reported being used for various food applications since time immemorial. The beneficial effects on human and animal health of supplementation with saponin–rich extracts have also been documented (Anthony *et al*., 1994). It has been suggested that the prime reason for the beneficial effects of saponin-rich extracts was the influence of antimicrobial activities of the saponin compound present in the extracts.

Application of saponin

Saponins are a diverse group of compounds widely distributed in the plant kingdom, which are characterized by their structures containing a triterpene or steroid aglycone and one natural sugar chains. Saponins belong to a complex and chemically diverse group of compounds which derive their name from their ability to form stable, soap-like foam in aqeous solutions. In plants, saponins play a role as secondary metabolites and assigned for defence mechanism. Consumer demand for natural products coupled with their physiochernical (surfactants) properties and mounting evidence on their biological activity such as anticancer and anti-cholesterol activity has led to the emergence of saponins as commercially significant compounds with expanding applications in food, cosmetics, and Pharmaceutical sectors. The realization of their full commercial potential requires development of new Processes/processing strategies to address the processing challenges posed by their complex nature. Their adverse effects are mainly reflected in depressed feed intake that causes growth inhibition to animals, monogastrics in particular, and reduced animal reproduction (Chapagain, 2006).

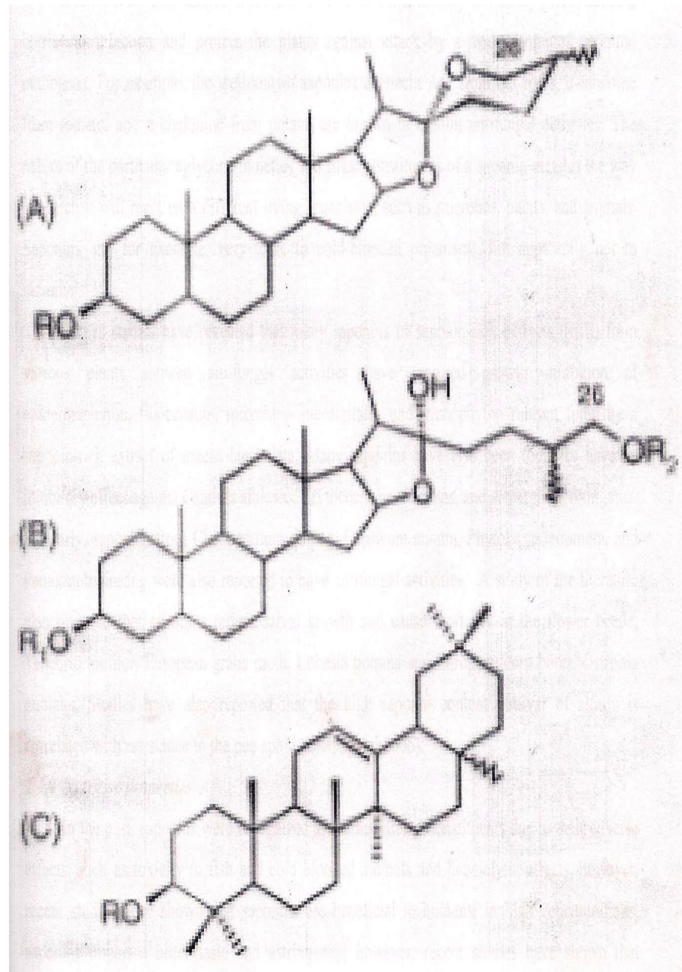

Figure 1: Aglycone Skeletons of (A) Steroidal Spirostane, (B) Steroidal Furostane, and (C) Triterpenoid saponins. R = Sugar moiety (According to Chapagain, *et al*., 2006).

Surfactants

A surfactant is a type of raw material that possesses both water-soluble and oil-soluble characteristics. It mainly functions as a water/oil stabilizer, and exists in our body too because it possesses an invaluable trait- It is capable of maintaining oil/water mixtures in its mixed state- surfactants are included in almost every cosmetic product. Like many other scientific breakthroughs, the history of surfactant started like an accidental discovery-that were developed in response to the shortage of the animal and vegetable fats used to make soap during world war I and world war II. Thus, surfactants indeed perform an excellent function. However, there is one setback people need to be careful about type of surfactants used. Although some surfactants derive from natural causes, many others are people produced from petroleum oil. The latter types of surfactants are what people need to avoid using. Petroleum surfactants are as its name suggests surfactants made from petroleum oil. They have a longer stabilization span surfactants derived naturally. Petroleum surfactants are also known for their ability to act as a foaming agent (Richard, 2006, Earth care north America Trading Corp, 2003-2013).

Generally, surfactants are a large group of surface active substances with a great number of applications. Most surfactants have degreasing or wash active abilities. They reduce the surface tension of the water so it can wet the fibbers and surfaces, they loosen and encapsulate the dirt and in that way ensure that the soiling will not re-deposit on the surfaces. Surfactant have a hydrophobic (water repellent) part and a hydrophilic (water loving). The hydrophobic part consists of an uncharged carbohydrate group that can be straight, branched, cyclic or aromatic. Surfactants are compounds that lower the surface tension (or interfacial tension) between two liquids or between a liquid and a solid. Surfactants may act as detergents, wetting agents, emulsifiers, foaming agents, and dispersants (Richard, 2006). Richard, 2014 describes that the lipohilic tails of the surfactant ions remain inside the oil because they interact more strongly with oil then with water. The polar "heads" of the surfactant molecules coating the micelle interact more strongly with water, so they form a hydrophilic outer layer that forms a barrier between micelles, from merging into fewer, larger droplets ("emulsion breaking") of the micelle.

The compounds that coat a micelle are typically amphiphilic in nature, meaning that micelles may be stable either as droplet of aprotic solvent such as oil in water, or asprotic solvents such as water in oil. When the droplet is aprotic it sometimes is known as a reverse micelle. Two phenomena result from these opposing forces within the same molecule: adsorption and aggregation. For example, in aqueous media, surfactant molecules will migrate to air /water and solid/water interfaces and orientate in such a fashion as to minimize, as much as possible, the contact between their hydrophobic groups and the water. This process is referred to as 'adsorption' and results in a change in the properties at the interface. Likewise, an Alternative way of limiting the contact between the hydrophobic groups and the water is for the surfactant molecules to aggregates in the bulk solution with the hydrophilic 'head groups' Orientated towards the aqueous phase. These aggregates of surfactant molecules vary in shape depending on concentration and range in shape from spherical to cylindrical to lamellar (Sheets/layers).

The aggregation process is called 'micellisation' and the aggregates are known as 'micelles'. Micelles begin to form at a distinct and frequently very low concentration known as the 'critical micelle concentration' or 'CMC'. In simple terms, in aqueous media, micelles result in hydrophobic domains within the solution whereby the surfactant may solubilise or emulsify particular solutes. Hence, surfactants will modify solution properties both within the bulk of the solution and at interfaces. The hydrophilic portion of a surfactant may carry a negative or positive charge, both positive and negative charges or no charge at all. These are classified respectively as anionic, cationic, amphoteric or non-ionic surfactant (Richard, 2006). The balance between the two parts is decisive for the properties of surfactant. Some Compounds, like short-chain fatty acids, are amphiphilic or amphipathic, i.e., they have one Part that has an affinity for non-polar media and one part that has an affinity for polar media. These molecules form oriented mono-layers at interfaces and show surface activity. In ‘’standard" surfactant terminology the "head" refers to the solubilizing group-the lyophilic or hydrophilic group, in aqueous systems-and the "tail" refers to the lyophobic or hydrophobic group in water:

Figure 1; Shows the Structure of Surfactants.

$CH_3 (CH_2) n CH_2$-S

↑ ↑

‘Tail’ ‘head’.

Soaps (fatty acid salts containing at least eight carbon atoms) are surfactants. Detergents are surfactants, or surfactant mixtures, whose solutions have cleaning properties? That is, Detergent salter interfacial properties so as to promote removal of a phase from solid surfaces. The polar or ionic head group usually interacts strongly with an aqueous environment, in which case it is solvated via dipole-dipole or ion-dipole interactions. In fact, it is the nature of the polar head group which is used to divide surfactants into different categories (Richard, 2006). A surfactant (surface active agent) is a compound with a water-soluble oil-insoluble (hydrophilic) portion on one side and an on the opposites sides. Generally, the hydrophobic portion is a long alkyl chain while the hydrophilic portion is a solubility enhancing portion. The surfactant exhibits surface activity by lowering the surface tension of liquids (Muthuprasanna *et al.,* 2009) Listed that for a surfactant suited for detergent manufacture should have the following characteristics: Specific adsorption, soil removal, low sensitivity to water hardness, dispersion properties, soil anti-redeposition capability, high solubility, wetting power, neutral odour, desirable foam characteristics, storage stability, low intrinsic colour, favourable handling characteristics, minimal toxicity to humans, no adverse environmental impacts, good raw material.

Water: Hydophobic part Hydrophilic part

Oil: Liphophilic Lipophobic

Figure 2: Structure of Surfactant (Richard, 2006).

II. MATERIALS AND METHODS

Instruments used for the research

Pestle and mortar, sieve, test tube, oven, precision weighing balance, Fourier Transform Infrared Spectrometer (FTIR), with an attenuated total reflectance (ATR) attachment, measuring cylinder (10 cm^3), distillation apparatus, pH meter, leaves of *Cissus populnea* plant and general cleaning agents (Good Mama). Heating mantle, desiccators, glass funnel, Soxhlet extractor apparatus, round bottom flasks, burette (100 cm^3), beakers (100 cm^3), stop watch, glass syringe (100 ml), graduated cylinder (25 ml),

Reagents

Acetone, distilled water, Methanol, acetic acid, OMO-good Mama and paraffin oil.

Collection of Plant roots

Danfaraa plant roots was obtain by digging down the ground of the plant which was found at a farmland area in Gurhengwal town of Askira/Uba Local Government Area of Borno State, North East Nigeria.The general available cleansing agents, synthetic/commercial detergents (a detergent manufactured by lever brothers Nigeria with trade name (OMO-GOOD MAMA) were purchased from the market in Maiduguri Borno State.

Pre-treatment

The random sampling method used by (Ponarulselvam, *et al.* 2012), Nagati (2012) and (Ninfaa, *et al.,* 2014) was adopted. The fresh plant roots samples were collected and the roots specimen was kept in Chemistry Research Laboratory of the University of Maiduguri, Borno state for some time. This is to ensure its dryness at a room temperature in the laboratory.

The plant sample collected was freed from twigs and extraneous matter by sifting the Soil, grit, sand and dirt was removed. The sample was rapidly and thoroughly washed under tap water, rinsed with distilled water.

Preparation of Sample

The method of Agu (2010) was adopted; the sample (leave) were crushed to powder form using iron pestle and mortar. The Powdered samples were sieved by using sieve to obtain powdered samples to be used as raw surfactant.

Extraction of Crude Saponins from the roots

The procedure outlined by Agu, (2010) which described the extraction of saponins by the gravimetric method of AOAC (1984) was followed in this work, using Soxhlet extractor and two different organic solvents. 2.5 g of the sample dried grounded powder was weighed into a thimble and transferred into a Soxhlet extractor chamber fitted with a condenser and a round bottom flask containing 100 cm^3 of acetone. Heat was applied using a heating mantle and exhaustively extract lipid and interfering pigments for 1.5 hrs and thereafter, distiled off the solvent. The defatted sample was further transferred into another Soxhlet extractor fitted to both a condenser and a dried weighed round bottom flask containing 100 cm^3 of methanol with applied heat using a heating mantle and exhaustively extract for another 1.5 h. The methanol was recovered by distillation at the end of the extraction.

The flask with its extracts was transferred to the oven when evaporation to dryness occurred before cooling in desiccators. The flask with its contents was reweighed and the percentage of saponin-based surfactants was calculated as shown below:

$$\%\ of\ saponin = \frac{weight\ of\ saponin}{weight\ of\ sample} \times \frac{100}{1}$$

Determination of the presence of saponins in crude and extracts of the sample (leaves)

The method described by Odebiyi and Sofowora (1978) and Abulude, *et al.* (2009) was used to test for the presence of saponins in the test samples. 2.5 g of each of the crude surfactants and the saponin extracts was shaken vigorously with 5 cm^3 of water in the test tube, frothing which persisted was taken as an evidence for the presence of saponins.

III. RESULT AND DISCUSSION

Tests for Saponins

Abulude *et al.,* (2009) and Odebiyi and Sofowora (1978) methods were used to test the presence of saponon in crude surfactants and extracted saponin of leaves of *Cissus populnea*. The entire sample shows abundant and persistent foam on addition of distil water to the samples with vigorous shaking. The foam formed by root appear to have more bubbles, confirming the presence of saponin with the clear formation of foam at different concentrations of root. The capacity to provide lather is one of the first measures of performance of surfactant and based on Kime *et al.,* (2016) reports that, most widely appreciated properties of surface active substance when in aqueous solution is their ability to promote the formation of foam and persistence bubble.

Extraction and determination of crude and pure saponin

The result obtained (saponin) were clearly different from the crude surfactants which were dried powdered samples. The saponins obtained become dried solid crystalline form after the solvent were recovered by distillation. The crude surfactant has residue that cannot be dissolved completely. The extract was filtered and the solvent materials were re-extracted at the same conditions for 18 hrs. The filtration was brought to gather (total extracts) and evaporated to dryness at low-pressure.

Characterization of surfactants

The characterization of extracted saponin and crude surfactant of *Cissus populnea* plant root, FT-IR Bruker optics Alpha T Fourier Transform infrared spectrometer was used. Table 1 present FT-IR of crude surfactant and extracted saponin from the leave. The spectra absorption bands from 3355.43cm^{-1} to

3840.19cm^{-1}suggested OH stretching with broad peak intensity. The position of absorption band at 2364.04cm^{-1} to 2922.49cm^{-1}wave number before and after extraction can be attributes to C-H stretching with distinct peak intensity. The other prominent peaks considered to be methylene bending absorption of 1449.10cm^{-1} and methyle bending absorption of 1369.67cm^{-1}. The absorption spectra at 1020.48 cm^{-1}- 1271.58cm^{-1} are most likely due to C-N stretching with a sharp peak. The N-H bending absorption of primary amine was observed in the 1613.68cm^{-1} – 1507.70cm^{-1} region of the spectrum with medium band intensity. The C=0 stretching absorption band of saturated aliphatic esters was suggested between the region of 1702.97cm^{-1} – 1732.14cm^{-1} before and after extraction with strong peak intensity.

Table 2 Present FT-IR spectra of crude surfactant and extracted saponin from roots which shows important absorption band at 3734.74cm^{-1} wave number for extracted saponin was attributed to strong characteristics absorption properties of alcohols assign both with broad peaks intensity. Also absorption of 2364.50cm^{-1} – 2316.86cm^{-1} before and after extraction was considered to be C=C stretching these absorption band is often very week or completely absent in the IR spectrum. The absorption band between 1008.89cm^{-1} – 1045.77cm^{-1}displayed strong C-O stretching peak intensity of the crude surfactants and saponin from root, which suggested the presence of an ester group. The spectrum was adequate to detected carboxylic acid and derivatives in the region.

Table 1; FT – IR Spectra of Crude and Extracted Saponin from the sample (Root)

Functional group	Bond	Wave number range (cm^{-1})	Mode of vibration	Intensity
Alcohol	O – H	3734.20 3743.74	Stretching H – Bonded	Broad peak
Alkynes	C ≡ C	2316.86 2364.50	Stretching varbration	Weak
Alkanes	C – H	2857.64 3000.00	Stretching	Distinct peak
Esthers	C – O	1008.69 1045.77	Stretching	Strong peak
Carboxylic acid & Derivative	C – O	1113.88 1367.18	Stretching	Strong peak
Alkanes	C – H	1430.55 1448.79	Bending	Medium
Amines	N – H	1522.97 1596.84	Bending	Medium
Amines	N – H	1596.84	Stretching	Medium
Aldehydes	C = O	1613.93	Stretching	Strong peak
Esthers saturated aliphatic	C = O	1737.45	Stretching	Strong peak

Foam Study

Foam production and stability against time (h) for 2g of extracted saponin and OMO at 30^{0}C. It is on this figure that the foam property was observed, the result obtained for extracted saponins has a high quality foam production which clearly compete with the commercial/synthetic surfactant. Kime *et al.,* (2016) reported on foam study that, most widely appreciated properties of surface active substance when in aqueous solution is their ability to promote the formation of foam and persistence bubble. Also the presence of foam on the surface of a washing solution has long been regarded as indication that the solution contains enough quality, it also enhances the colloidal stability by inhibiting the coalescence of bubble. Similarly, the foam behavior of crude surfactants and the extracted saponis from the leave, stem bark, root of *Cissus populnea* Plant clearly shows that the plant has a high quality saponin present. The leave and roots extract produces more foam and bubbles than stem bark. The higher the concentration of the extract the more foam production and stability obtained. The gas will therefore, tend to diffuse through the walls from the smaller to the larger bubbles and subsequently reduced to zero with time this was reported by Agu *et al*., (2013) the major reasons may be attributed to its crude nature that is, the absence of formulation ingredients like builders, stabilizer etc.

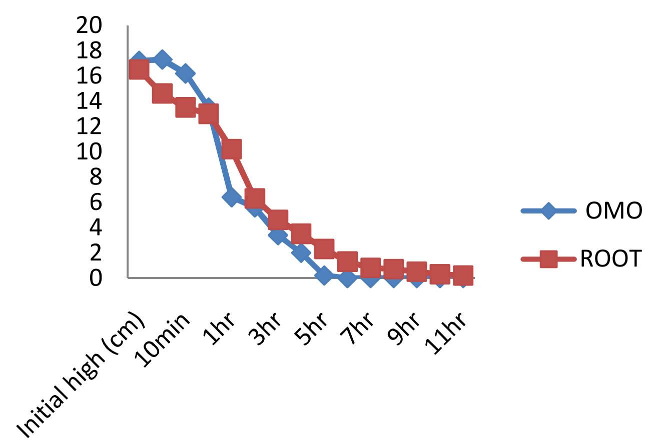

Figure 3. Foam Production and Stability of 2 g for Crude Surfactant Saponin and OMO-good Mama in 100 ml Dilution.

Figure 3 shows the emulsion capacity % verse time (hr) for 4 g of saponin-base surfactants extract and OMO-good Mama solution. From the first hour to three hours the emulsion capacity of the extracted saponins of leave and roots are higher than OMO-good Mama. At 4 g concentration the result obtain shows that saponin extract from the leave exhibited higher emulsion capacity and stability which may shows a better emulsify agent than the other surfactant under study with a result obtained ranging from 98.0 % to 75.9 %, 91.3 % to 66.7 %, 90.0 % to 70 % and 87.5 % to 64.1 % for leave; roots, OMO-good Mama and steam bark respectively. This shows that at higher or lower concentration, the emulsion capacities of the saponin-base surfactant are higher than the commercial/synthetic detergent (OMO-good Mama).

From the bellow results, it is evident that the bio-base surfactants from the *Cissus populnea* plants have emulsion capacity and stability, when used along have an emulsifying power. The compatibility has showed the stability achievement at different concentrations of the surfactant solution is as a result of the extracted saponin from the leave, root steam bark and OMO that acts as emulsying agents. In all cases, the quality of emulsion stability increases by increasing the concentration of saponin extracted. Ahmed *et al.,* 2006 state that, two liquids can form different types of emulsion. An example, oil and water can form first, an oil-in-water emulsion, where in the oil is the dispersed phase, and water is the dispersion medium. Second, they can form a water-in-oil emulsion, wherein water is the dispersed phase and oil is the external phase. Multiple emulsions are also possible, including a water-in-oil-water emulsion and an oil-in-water-in-oil emulsion. To achieve this stability in emulsion, an emulsifying agent must be present.

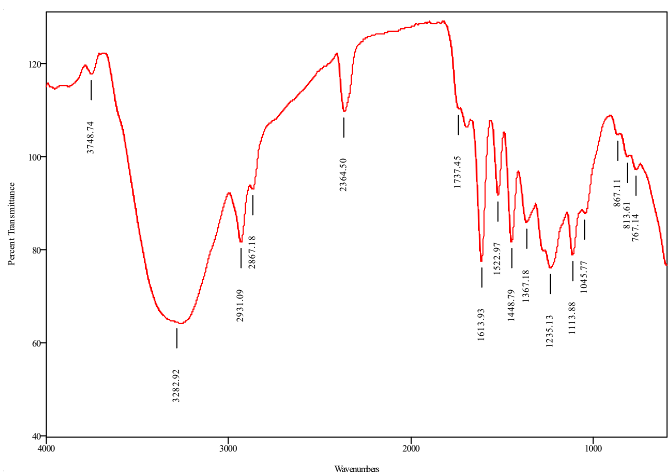

Figure 4; FT – IR Spectra of Crude and Extracted Saponin from the sample (Root)

IV. CONCLUSION

This study has showed that *Cissus populnea* plants can serve as bio-base surfactant and saponin as its surface active agents. It is however satisfactory to observe that all saponin extracted from *Cissus populnea* exhibit similar surfactant properties compared to *Balanite aegyptica* plant surfactant. Its good emulsion capacity and stability implied the usefulness of the plant as natural surfactants. It is also as a better emulsion as a result of its high stabilization of oil-in-water (o/w) emulsion. *Cissus populnea* plant shows higher surface tension and sorption behaviour property as well as foam formation/capacity far better especially leaves and roots than some commercial/synthetic surfactants (OMO-good Mama) that were used in the study. This saponin- based surfactant is significantly be as an eco-friendly and may show better biodegradability than the commercial surfactants. The natural surfactant from *Cissus populnea* plants leave and roots will contribute to efforts in diversify the Nigerians economy, a way to solve the problem of non-biodegradable, high price and non-eco-friendly phenomenon that exists in the production of commercial/synthetic surfactant and add value to green chemistry and sustainable development and exploitation of the cleansing properties of saponin present in *Cissus populnea* plants.

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