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Chemical Evaluation of the Proximate, Minerals, Vitamins and Phytochemical Analysis of Danielle Oliveri Stem Bark

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ABSTRACT

Daniellia oliveri stem bark (DSP) is one of potential medicinal plants loaded with several bioactive chemicals/phytochemicals, vitamins, vitamins and other nutrients. In view of these potential, it can serve as an alternative to antibiotics, thus bridging the gap between food safety and livestock production. Hence, the present study was carried out to evaluate the proximate, minerals, vitamins and phytochemical composition of DSP. Proximate analysis of DSP revealed the presence of moisture (6.25 ± 1.00 %), dry matter (93.75 ± 0.21%), crude protein (6.07 ± 0.45%), ether extract (1.03 ± 0.65%), ash (9.11 ± 0.33%), carbohydrate (21.09 ± 0.25%) and energy (488.73 ± 11.2 KJ/100g). Calcium, phosphorus, potassium, sodium, iron, zinc, magnesium, selenium and manganese were the minerals present at (71.33 mg/100g), (45.08 mg/100g), (8.17 mg/100g), (25.11 mg/100g), (3.57 mg/100g), (10.22 mg/100g), (20.93 mg/100g), (1.45 mg/100g) and (1.33 mg/100g) respectively. Vitamin analysis showed that it contained β-carotene (1.97 mg/100g), thiamine (0.74 mg/100g), riboflavin (0.42 mg/100g), niacin (0.30 mg/100g), pyridoxine (0.22 mg/100g), cyanocobalamin (0.18mg/100g), ascorbic acid (6.84 mg/100g), calciferol (0.13 mg/100g) and phytonadione (0.10 mg/100g). Phytochemical screening showed that DPS is abundant in flavonoids (9.44%) followed by alkaloids (6.83%), hydrolysable tannins (4.57 %), phenol (3.46 %), terpenoids (2.11%), saponins (2.10 %), phytates (1.88 %), condensed tannin (1.17 %), oxalates (1.03 %) and steroids (0.97 %). It was concluded DSP contain substances with numerous therapeutic potentials capable of treating various ailments and ensuring normal physiological functions of the body.

1. Introduction

Medicinal plant components remain an untapped reservoir for active compounds (phytochemicals) with properties that can potentially perform multiple biological activities such as anti-inflammatory, antimicrobial, antihelminthic, antifungal, antiviral, antioxidant etc. (Makhosazana, 2015; Alagbe et al., 2020). There are over 250,000 species of medicinal plants of therapeutic value which contains different bioactive chemicals (tannins, alkaloids, flavonoids, terpenoids, saponins, phenols etc.) in varying concentrations and also loaded with minerals, vitamins, amino acids and other nutrients (Olafadehan et al., 2020). These plants are cheap, effective, safe and produce several physiological action on the human body (Edeoga et al., 2005).

Daniellia oliveri (Rolfe) belongs to the family Fabaceae and sub-family Caesalpinioideae. It is commonly known as African copoiba balsam in English, while in Nigeria it is traditionally known by the three major languages in the country as 'Maje' in Hausa, 'iya/ozabwa/agba' in Igbo, and 'Emi iya' in Yoruba, and as 'Oda' in Igala, 'Ukpilla' in Igede and Ubakwa in Idoma (Aguoru and Anjira, 2013; Atolani and Olatunji, 2014) and some parts of India, China and Pakistan.

Daniellia oliveri tree is tall and can reach about 30 meters in height. The leaves are green, apex, ovate and peripinnate (Hassan et al., 2008). Flowers possess stigma surrounded by ten stamens with white to pale green petals and green sepals (de la Estrella *et al.,* 2010). The seed been reported to contain carbohydrates (57.84%), crude protein (27.74 %), lipid (9.67%), ash (4.17%) and crude fibre (0.60%) (Hassan *et al.*, 2008). Phytochemical analysis of the stem bark revealed the presence of phenolic compounds (e.g. gallic acid, protocatechuic acid, caffeic acid, p-coumaric, coumarinsand chlorogenic acid), anthocyanidins, polyphenolic, terpenoids, steroids, saponins, flavonoids, flavonols, tannins and phlobatannins (Boye *et al.,* 2013) and its traditionally used for the treatment of gastrointestinal disturbances, bacterial infections, breast cancer, fever, sexually transmitted diseases, ring worm, typhoid fever, headache, backache, yellow fever, are also used as aphrodisiac, diuretic and mouthwash for toothache and tooth diseases (Ahmadu and Agunu, 2012; Yaya *et al.,* 2016).

Daniellia oliveri leaves serve as source of protein and energy to animal body; therefore, it is used as a fodder to livestock during dry season (Okunade *et al.,* 2014). Its seeds are used as part of the ingredients for poultry feeds (Obun and Adeyemi, 2012). Leaves stem and trunk of the plant produces a liquid exudes in form of oleoresin which has been used in folk medicine for more than four hundred years (Gilbert, 2000). This chemical (oleoresin) is a complex mixture of large amount of essential oil, non-volatile resinous substances and small amount of acidic substances.

In view of these potential, an experiment was carried out to ascertain the proximate, minerals, vitamins and phytochemical composition of *Daniellia oliveri* stem bark.

2. Methodology

2.1 Plant collection and authentication

Fresh parts of *Daniellia oliveri* stem bark were collected from different trees within Sumitra Teaching and Research Farm, Gujarat, India. It was authenticated by a taxonomist (Dr. Sharma Ram) before the commencement of the experiment.

2.2 Processing of the plant material

The collected stem bark of *Daniellia oliveri* were cut into pieces and washed with running tap water to remove dirt's, dried under a shade for 15 days to retain the bioactive chemicals in the plant, grinded into meal (DSP) using a pulverizer and stored in a well labeled air tight container and kept for further analysis.

2.3 Chemical analysis of *Daniellia oliveri* stems bark

Proximate compositions of DSP were determined by using official method of analysis by AOAC (2000). All analysis was done in triplicates.

Energy value (KJ/100g) was calculated using the equation below:

Energy = (37× Ether extract) + (17 × carbohydrate) + (17 × crude protein)

Dry matter (DM) = 100 – moisture content

Phytochemical composition of tannins, alkaloids, saponins, flavonoids, phenols, oxalate, glycosides, steroids and terpenoids were estimated using methods described by Atamgba *et al*. (2015), Harbone (1973), Shabbir et al. (2013), Odebiyi and Sofowora (1978), Boham and Kocipai (1974). Vitamin compositions were evaluated according to the methods outlined by (Ngozi *et al*., 2017). Mineral analyses were carried out using Atomic Absorption Spectrophotometer (AAS) model 12-0TA.

2.4 Statistical analysis

All data obtained were analyzed using descriptive statistical tools and were expressed as mean ± standard error of mean (SEM) of three replicates.

3. Results

3.1 Proximate compositions of *Daniellia oliveri* stem bark

The chemical composition of *Daniellia oliveri* stem bark is presented in Table 1. The proximate components of *Daniellia oliveri*leaf stem bark used for this experiment were 92.75 %, 7.25 %, 6.07 %, 56.71 %, 1.03 %, 9.11 %, 21.09 % and 488.73 (KJ/100g) for dry matter (DM), moisture, crude protein (CP), crude fibre (CF), ether extract (EE), ash, total carbohydrate (TC) and energy respectively.

Table 1: Proximate composition of *Daniellia oliveri* stems bark

Parameters	% composition
Dry matter	93.75 ± 0.21
Moisture	6.25 ± 1.00
Crude protein	6.07 ± 0.45

Crude fibre	56.71 ± 0.81
Ether extract	1.03 ± 0.65
Ash	9.11 ± 0.33
Total carbohydrate	21.09 ± 0.25
Energy (KJ/100g)	488.73 ± 11.2

Values expressed as mean ± SEM (n=3)

3.2 Mineral analysis of *Daniellia oliveri* stems bark

Table 2 reveals the mineral composition of *Daniellia oliveri* stem bark. The sample contained calcium, potassium, phosphorus, sodium, zinc, iron, magnesium, selenium and manganese at (71.33 ± 0.01mg/100g), (8.17 ± 0.03 mg/100g), (45.08 ± 0.02 mg/100g), (25.11± 0.17 mg/100g), (10.22 ± 0.10), (20.93 ± 0.55 mg/100g), (1.45 ± 0.55 mg/100g) and (1.33 ± 0.01 mg/100g).

Table 2: Mineral analysis of *Daniellia oliveri* stems bark

Parameters	% composition (mg/100g)
Calcium	71.33 ± 0.01
Phosphorus	45.08 ± 0.02
Potassium	8.17 ± 0.03
Sodium	25.11 ± 0.17
Iron	3.57 ± 0.00
Zinc	10.22 ± 0.10
Magnesium	20.93 ± 0.55
Selenium	1.45 ± 0.02
Manganese	1.33 ± 0.01

3.3 Vitamin compositions of *Daniellia oliveri* stem bark

Table 3 revealed the vitamin analysis of *Daniellia oliveri* stem bark. β-carotene (1.97 ± 0.001 mg/100g), vitamin B1 (0.74 ± 0.003 mg/100g), vitamin B2 (0.74 ± 0.003 mg/100g), vitamin B3 (0.42 ± 0.002 mg/100g), vitamin B6 (0.22 ± 0.005 mg/100g), vitamin B12 (0.18 ± 0.007 mg/100g), vitamin C (6.84 ± 0.005 mg/100g), vitamin D (0.13 ± 0.001 mg/100g) and vitamin K (0.10 ± 0.001 mg/100g).

Table 3: Vitamin composition of *Daniellia oliveri* stems bark

Parameters	Composition (mg/100g)
β-carotene	1.97 ± 0.001
Vitamin B1 (Thiamine)	0.74 ± 0.003
Vitamin B2 (Riboflavin)	0.42 ± 0.002
Vitamin B3 (Niacin)	0.30 ± 0.004
Vitamin B6 (Pyridoxine)	0.22 ± 0.005
Vitamin B12 (Cyanocobalamin)	0.18 ± 0.007
Vitamin C (Ascorbic acid)	6.84 ± 0.005
Vitamin D (Calciferol)	0.13 ± 0.001
Vitamin K (Phytonadione)	0.10 ± 0.001

Values expressed as mean ± SEM (n=3)

3.4 Phytochemical constituents of *Daniellia oliveri* stem bark

The phytochemical constituents of *Daniellia oliveri* stem bark is presented in Table 4. The sample contained; alkaloids (6.83 ± 0.01%), flavonoids (9.44 ± 0.00 %), terpenoids (2.11 ± 0.07), condensed tannins (1.17 ± 0.02 %), hydrolysable tannins (4.54±0.05 %), saponins (2.10 ± 0.00 %), phenols (3.46 ± 0.03 %), oxalates (1.03 ± 0.01 %), phytates (1.88 ± 0.00 %) and steroids (0.97 ± 0.01 %).

Table 4 Phytochemical composition of *Daniellia oliveri* stems bark

Constituents	% composition
Flavonoids	9.44 ± 0.01
Terpenoids	2.11 ± 0.07
Condensed tannin	1.17 ± 0.02
Hydrolysable tannin	4.57 ± 0.05
Alkaloids	6.83 ± 0.01
Saponin	2.10 ± 0.00
Phenols	3.46 ± 0.03
Oxalates	1.03 ± 0.01
Phytates	1.88 ± 0.00
Steroids	0.97 ± 0.01

Values expressed as mean ± SEM (n=3)

4. Discussion

Moisture content of a sample gives an estimate of the amount of water present in a sample. It is also used as an index to determine the shelf life of a sample (Awogbemi and Ogunleye, 2009). The Moisture content value (6.25 %) recorded in this experiment is similar to the findings of Atamgba et al. (2018) who reported a value of 6.00 % in Jatropha curcas stem bark. Olanipekun et al. (2016) reported a higher moisture content of 9.00 % in Morinda lucida stem bark. CP level in Daniellia oliveri stem bark (6.07 %) is low; this is a clear indication that it cannot be used as a protein supplement for animals. According to NRC (1994) protein supplement must exceed 20 % for optimal livestock production. The value in this study is contrary to the reports of Ezekiel et al. (2019) who observed that Maerua angolensis stem bark contains 21.79 % CP. The result indicates that Daniellia oliveri stem bark is abundant in fibre (56.71 %), the report is in agreement with findings of Olanipekun et al. (2016) but contrary to Audu et al. (2018); Ogundele et al. (2017) who recorded 34.80 % and 4.87 % for Balanites aegyptiaca and Moringa olifera stem bark respectively. According to Fasola et al. (2011), feeding animal's adequate quantity of fibre aids to lower serum cholesterol level, reduce the risk of coronary heart disease and improves feed digestion. Ash content is an indication of the amount of minerals in a sample, which are important in many biochemical reactions functioning as co-enzyme and help physiological functioning of major metabolic process in the body (Ojewuyi et al., 2014). The ash content obtained is similar to values Enantia chlorantha (9.20 %) and Albizia lebbeck stem bark (9.71 %) reported by Alagbe et al. (2020). However, lower values were obtained for Moringa olifera stem bark (2.41 %), M. olifera seed husk (2.39 %) and M. olifera fruit pod reported by Ezekiel et al. (2017). The ether extract of DSP (1.03 %) is lower than the values reported for Carpolobia lutea root (1.86 %). According to Aiyesanmi and Oguntokun (1999) fat are pivotal to the functioning of cells, increase palatability of foods and contributing energy to the body. The energy composition of DSP was higher than values obtained for Maerua angolensis stem bark (169.71 KJ/100g) but lower than values recorded for Jatropha curcas stem bark (907.0 KJ/100g). Carbohydrates are responsible for providing energy for metabolism of living organisms (Onyeka, 2008). The lower energy in DSP is an indication that it cannot serve as a good energy source to animals.

The mineral composition of DSP showed that calcium had the highest concentration followed by phosphorus, sodium, magnesium, zinc, potassium, iron, selenium and manganese respectively (Ca> P > Na > Mg > Zn >K >Fe >Se >Mn). Calcium plays a key role in rigidity, support and transmission of nerve impulses (Alagbe, 2020; Gupta *et al*., 2005; Olafadehan *et al*., 2020). Phosphorus has been reported to be good for bones and teeth formation and also needed for growth, repair of tissues and cells for the production of DNA and RNA (Ajibade and Fagbohun, 2010). Sodium is responsible for the regulation of plasma volume and muscle contraction (Ekpo, 2007; Alagbe, 2020). Magnesium works in synergy with phosphorus by enhancing protein synthesis and improving glucose tolerance in animals (Huheey et al., 1993; Vasudevan and Sreekumari, 2007). Zinc is active in the formation of chrorophyll in plants and enzyme activation (Arinola, 2008; Abdennour et al., 2000). Potassium plays a key role in regulation of nerves, muscles and activation of intracellular enzymes (Bonde et al., 2002; Chai et al., 1992). Iron is essential element for haemoglobin formation, normal functioning of the central nervous system and in the oxidation of protein, carbohydrates and fats (Adeyeye and Otokiti, 1999; Enin et al., 2014; Beard, 2001). Selenium is an essential trace element in animal nutrition and exerts multiple actions related to animal production, fertility and disease prevention (Abd El Ghany et al., 2010). Manganese helps to protect against free radicals, thus giving total protection to the body (Agbo, 2004; Alagbe 2020).

Vitamin analysis of DPS showed that vitamin C had the highest concentration followed by β-carotene, vitamin B, vitamin D and vitamin K respectively (Vitamin C > β-carotene > vitamin B > vitamin D > vitamin K). The values reported were higher than those reported for Ficus capensis by Ngozi et al. (2017). β-carotene are precursors of vitamin A, which plays a key role in visual pigments of the retina which regulates gene expression and cell differentiation (Bakare *et al*., 2010). According to Adesina (2006), vitamin B complexes are for oxidative phosphorylation and co-enzyme formation. Vitamin C and D are necessary for immune defense (antioxidant) and calcium absorption respectively (NHWC, 2002; Button, 2004). Vitamin E and K are essential in absorption of iron, fertility, maintenance of cell membrane and clothing of blood respectively (NHWC, 2002).

Phytochemicals/bioactive chemicals or secondary metabolites are important chemicals in plants which confers them ability to perform multiple biological activity such as antimicrobial, antifungal, antiviral, antihelminthic, antioxidant etc. (Oluwafemi et al., 2020; Hyun et al., 2018). DSP contains higher concentration of flavonoids than the values reported for Delonix regia seed meal (2.11 %), Daniellia oliver leaf (0.61 %), Centella asiatica leaf meal (6.11 %), Morinda citrifolia leaf (2.11 %) by (Alagbe, 2008; Alagbe, 2009; Alagbe and Oluwafemi, 2019). The presence of flavonoids in significant amounts in DPS is an indication that it possesses antibacterial, antifungal and antioxidant properties (Chen et al., 2000). Alkaloids have been suggested to be involved in antimicrobial, analgelsics, antiplasmodic and antimalarial activity (Faizi et al., 2003). Tannins are a very complex group of plant secondary metabolites, which are soluble in polar solution and are distinguished from other polyphenolic compounds by their ability to precipitate proteins (Silanikove *et al*., 2001). There are two types of soluble tannins present in a large number of plant species. These are the hydrolysable tannins (HTs) and condensed tannins (CTs). Condensed tannins are more widely distributed in higher plant species than the hydrolysable variety and are thought to be more active in precipitating proteins (Dykes *et al.,* 2005). Hydrolysable tannins are esters of a sugar, usually glucose and a phenolic acid such as gallic acid in gallotannins (Hartzfeld *et al.,* 2002). Adisa et al. (2010) reported that tannins are known to possess antibacterial and antiviral activity. Phytic acid and/or phytates compete with essential dietary minerals such as calcium, zinc, iron and magnesium to make them biologically unavailable for absorption (Alagbe, 2019; Edeoga et al., 2005). Phenols are strong antioxidants which prevent oxidative damage to biomolecules such as DNA, lipids and proteins that play a role in chronic disease (Ojewuyi et al., 2014). Phenols are strong antioxidants which prevents the entry of diseases (Ezeokeke et al., 2015; Alagbe, 2019). Terpenoids has high therapeutic value and function as antimicrobial, anticarcinogenic and anti-diuretic (Ismaila et al., 2012). Steroids play a major role in fertility of animals (Atamgba et al., 2015).

5. Conclusion

Medicinal plants are abundant in phytochemicals or bioactive chemicals. These constituents vary among plants species, geographical location, extract methods, level of plant maturity, soil type etc. Herbal plants are natural alternative to antibiotics because they are relatively safe, effective and cheap, they also fall within the European Union recommendation (generally regarded as safe). Tannins, flavonoids, alkaloids, glycosides, terpenoids, phenols, saponins etc. which have a wide range of activity such as antioxidant, anti-inflammatory, antihelminthic, antiviral, antifungal, antimicrobial etc.

References

[1] [1] Abd El Ghany, H., Tortora-Perez, J.L., Gonzalez Mendez, A.S and Ceron, T. L (2010). The importance of selenium and the effects of its deficiency in Animal health. *Small Ruminant Research*, 89 (2&3): 185-192.

[2] [2] Adisa, R.M., Choudhary, E.A., Adenoye, G.A. and Olorunsogo, O.O. (2010). Hypoglycaemic and biochemical properties of Cnestis ferruginea. *African Journal of Traditional Complementary and Alternative Medicine*, 7: 185-194.

[3] [3] Hyun, L., Yanhong, L., Sergio, C., Mariano, E.O., Fang, C., Ron, L.C., Sungtaek, O and Cyril, G.G. (2018). Phytochemical as antibiotic alternatives to promote growth and enhance host health. *Journal of Biomedical Sciences* 10 (18): 49-76.

[4] [4] A.O.A.C. (2000). Association of Official Analytical Chemists. Official Methods of Analysis 19th Edition Washington, D.C Pages 69-77.

[5] [5] Atamgba, A.A., Margret, A.A., Kayode, D and Amonor, J.W. (2015). The biomedical significance of the phytochemical, proximate and mineral composition of the leaf, stem bark and roots of *Jatropha curcas*. *Asian Pacific Journal of Tropical Biomedicine*. 5(8):650-657.

[6] [6] Alagbe, J.O. (2019). Effect of different levels of dried *Delonix regia* seed meal on the performance, haematology and serum biochemistry of growing Grass cutters. *Agricultural Research and Technology Open Access Journal*. 18(4):001-006.

[7] [7] Bonde, J. P., Joffe, M, Apostoli, P., Dale, A and Spano, M (2002). Sperm count and chromatin structure in men exposed to inorganic lead: lowest adverse effect levels. *Occupational Environmental Medicine*, 59(4):234-242.

[8] [8] Alagbe, J.O. (2019). Effects of dried *Centella asiatica* leaf meal as a herbal feed additive on the growth performance, haematology and serum biochemistry of broiler chicken. *International Journal of Animal Research*. 3(23): 1-12.

[9] [9] Beard, J.L (1999). Iron biology in immune function, muscle metabolism and neuronal functioning. *Journal of Nutrition*, 131: 5685-5695.

[10] [10] Ngozi, K.A., Chimaraoke, O., Chima, A.E.E and Jennifer, C.O (2017). Phytochemical, proximate analysis, vitamin and mineral composition of Aqueous extract of Ficus capensis leaves in South Eastern Nigeria. *Journal of Applied Pharmaceutical Science*, 7(3):117-122.

[11] [11] Alagbe, J.O and Oluwafemi, R.A. (2019). Growth performance of weaner rabbits fed Noni (*Morinda citrifolia*) and *Moringa olifera* leaf mixture as partial replacement of soya bean meal. *International Journal of Advanced Biological and Biomedical Research*. 7(2): 185-195.

[12] [12] Oluwafemi, R.A., Isiaka Olawale and Alagbe, J.O. (2020). Recent trends in the utilization of medicinal plants as growth promoters in poultry nutrition- A review. *Research in: Agricultural and Veterinary Sciences*. 4(1): 5-11.

[13] [13] Olafadehan, O.A., Oluwafemi, R.A and Alagbe, J.O. (2020). Performance, haemato-biochemical parameters of broiler chicks administered Rolfe (*Daniellia oliveri*) leaf extract as an antibiotic alternative. *Advances in Research and Reviews*, 2020, 1:4.

[14] [14] Olafadehan, O.A., Oluwafemi, R.A and Alagbe, J.O (2020). Carcass quality, nutrient retention and caeca microbial population of broiler chicks administered Rolfe (*Daniellia oliveri*) leaf extract as an antibiotic alternative. *Journal of Drug Discovery*. 14(33):146-154.

[15] [15] Alagbe, J.O. (2020). Performance, hematology and serum biochemical parameters of weaner rabbits fed different levels of fermented *Lagenaria brevifora* whole fruit extract. *Advances in Research and Reviews*, 2020, 1:5.

[16] [16] Ogundele Damilola Tope, Oludele Olusanya Emmanuel,Oladejo Afees Adebayo and Olayemi Victoria Tosin (2017). Phytochemical Constituents, Proximate Composition and Mineral Analysis of Aqueous and

[17] Ethanolic Stem Bark, Seed Extracts and Plant Parts of Moringa oleifera. *Journal of Applied Life Sciences International*, 10(4): 1-7.

[18] [17] Chia, S.E., Ong, C.N., Lee, S.T and Tsakok, F.H (1992). Blood concentrations of lead, mercury, zinc and mecury in human semen parameters. Arch. Androl. 29:177-183.

[19] [18] Alagbe, J.O and Oluwafemi, R.A. (2019). Hematology and serum biochemical indices of growing rabbits fed diet supplemented with different levels of *Indigofera zollingeriana* leaf meal. *Progress in Chemical and Biochemical Research*. 2(4): 170-177.

[20] [19] Chen, C.Y., Chang, F.R, Shih, Y.C, Hsieh, T.J and Tseng, H.Y (2000). Cytotoxic constituents of Polyalthia longifolia. *Journal of Animal Production*, 63:1475-1478.

[21] [20] Edeoga, H.O., Okwu, D.E and Mbaebie, B.O (2005). Phytochemical constituents of some Nigerian medicinal plants. *African Journal of Biotechnology*, 4(7):658-688.

[22] [21] Faizi, S., Mughal, N.R., Khan, R.A, Ahmad, A and Bibi, N (2003). Evaluation of the antimicrobial property of Polyalthia longifolia: isolation of a lactone as the active antibacterial agent from the ethanol extract of the stem. Phytotheraphy Research, 17:1177-1181.

[23] [22] Huheey, J.E., Keiter, E.A and Keiter, R.I (1993). Inorganic chemistry: Principles of structure and reactivity. Harpers Collins College Publishers, New York. 934-949.

[24] [23] Gupta, M., Mazumber, U., Kumar, T, Gomathi, P and Kumar, R. (2005). Antioxidant and hepato-protective effects of Bulhiniaracemosa against paracetamol and carbon tetrachloride induced liver damage in rats. Iran Journal of Pharmacological Therapy, 3:12-20.

[25] [24] Ojewuyi, O.B., Ajiboye, T.O., Adebanjo, E.O., Balogun, A and Mohammed, A.O. (2014). Proximate composition, phytochemical and mineral contents of young and mature *Polyalthia longifolia* Sonn. Leaves. *Fountain Journal of Natural and Applied Sciences*, 3(1):10-19.

[26] [25] Arinola, O.G (2008).Essential trace elements and metal binding proteins in Nigerian consumers of alcoholic beverages. Pakistan *Journal of Nutrition*, 7(6): 763-765.

[27] [26] National Health and Wellness Club (2002). Smart Nutrition: the essential mineral, vitamin and supplement reference guide. NHWC, Minnetonka, Pp 13-76. www.healthandwellnessclub.com

[28] [27] Enin, G.N., Antia, B.S and Enin, F.G (2014). Chemical assessment of the proximate, mineral and antinutrients composition of Sida acuta leaves. *Organic Chemistry*, 71(2014):24654-24660.

[29] [28] Boham, B. A. and Kocipai, A. C. (1974). Flavonoids and condensed tannins from leaves of Hawaiian vaccinium vaticulatum and V. calycinium. Pacific Sci. 48: 458-463.

[30] [29] Harborne, J. D. (1973). Phytochemical methods: A guide to modern techniques of plant analysis. Chapman and Hall, London. 279.

[31] [30] Odebiyi, A. and Sofowora, A. E. (1978). Phytochemical Screening of Nigerian Medicinal Plant. Part III, Lloydia, 41, 234- 246.

[32] [31] Adeyeye, E and Otokili, M.K (1999). Proximate composition and some nutritionally valuable minerals of two varieties of Capsicum annum. *Discovery Innovations*. 75-81.

[33] [32] Agbo, J.T (2004). Proximate nutrient composition of sickle pod (Cassia obtusfolia) leaves and seeds. *Plant Products Research Journal*, 8:13-17.

[34] [33] Akubugwo, I.E., Obasi, N.A and Ugbogu, A. E. (2007). Nutritional and chemical value of Amaranthus hybridus leaves from Afriko Nigeria. African Journal of Biotechnology, 6(24):2833-2839.

[35] [34] Ekpo, A.S (2007). Determination of the chemical composition of Gbetum Africana seeds. *African Journal of Nutrition*, 6(1): 40-43.

[36] [35] Audu, I.W., Audu, B.S and Suleiman, Y (2018). Phytochemistry and proximate composition of root, stem bark, leaf and fruit of Balanites aegyptiaca. *The Journal of Phytopharmacology*, 7(6): 464-470.

[37] [36] Ezekiel, T.W., Nachana, T and Attama, C (2019). Phytochemical screening, elemental and proximate analysis of Maerua angolensis stem bark. *International Journal of Biochemistry Research and Review*, 27(4): 1-10.

[38] [37] Bakare, D.H and Hale, O. M. (2010).Liver iron depletion without copper loss in swine for excess zinc. Journal of Nutrition 77:225-228.

[39] [38] Vasudevan, M.D and Sreekumari, S (2007). Textbook of biochemistry for medical students 5th edn, Jaypee Brothers Medical Publishers Ltd. New Delhi, India pp: 283-287.

[40] [39] Alagbe, J.O (2020). Caecal Microbial Population of Growing Grass Cutters (*Thyronoyms Swinderianus*) Fed *Phyllantus Amarus* and *Pilogstigma Thonngii* Leaf Meal Mixture as Partial Replacement for Soya Bean Meal. *Concept of Dairy and Veterinary Sciences*. 3(5): 350 – 355.

[41] [40] Olanipekun, M.K., Adewuyi, D and Adedeji, D.E (2016). Ethnobotanical importance and phytochemical analyses of some selected medicinal plants in Ado-Ekiti Local Govt. Area. *Journal of Herbal Medicine Research*, 1(3):0007-0016.
[42] [41] Ezeokeke, S.D., Prenzier, M and Robards, K. (2015). Phenolic content and antioxidant activity of Olive extracts. Food Chemistry, 73:73-84.
[43] [42] Dykes, S., Zadeh, Z.T., Torshizi, M.A.K and Rokni, H. (2005). Effect of three herbal extracts on growth performance, immune response, blood factor and intestinal selected bacteria population in broiler chickens. *Journal of Agricultural Science and Technology*, 13:527-539.
[44] [43] Sitanikove, J.A., Morel, P.C., Wilkinson, B.H and Purchas, R.W. (2001). Preliminary investigation of the effects of low level dietary inclusions of fragrant essential oil and oleoresins on pig performance and pork quality. *Journal of Meat Science*, 75:350-355.
[45] [44] Hartzfeld Y, Song M, Che TM, Lee JJ, Bravo D, Maddox CW, Pettigrew JE .(2002). Dietary plant extracts modulate gene expression profiles in ileal mucosa of weaned pigs after an infection. *Journal of Animal Science*, 92:2050–2062.
[46] [45] Alagbe, J.O., Shittu, M.D and Eunice Abidemi Ojo (2020). Prospect of leaf extracts on the performance and blood profile of monogastric – A review. *International Journal of Integrated Education*. 3(7): 122-127.
[47] [46] Aguoru, C. U., and Anjira, S. (2011).Evaluating extracts of Daniella oliveri for antimicrobial activities in Benue state, North Central Nigeria. Ind J Sci Res Tech, 1, 12-17.
[48] [47] Atoni, C. U and Olatuji, S. (2014).Phytochemical and biological investigation of *Daniellia oliveri* leaves (Fabaceae). Planta Medica, 78(11), 149-158.
[49] [48] de la Estrella, M., Aedo, C., Mackinder, B and Velayos, M. (2010).Taxonomic Revision of *Daniellia* (Leguminosae: Caesalpinioideae). *Systematic Botany*, 35(2), 296-324.
[50] [49] Boye, A., Amoateng, P., Koffuor, G. A., Barku, V. Y. A., Bawa, E. M and Anto, O. E. (2013).Anti-nociceptive and antioxidant activity of an aqueous root bark of Daniellia oliveri *oliveri* (Rolfe) Hutch and Dalziel (Fam: Leguminosae [Fabaceae]) in ICR mice. *Journal of Applied Pharmaceutical* Science, 3(12), 36-45
[51] [50] Ahmadu, A. A., Haruna, A. K., Garba, M., Sule, M. I., Pateh, U. U., Ebeshi, B. U and Sarker, S. D. (2012).Flavonoid glycosides from the leaves of *Daniellia oliveri*. Nigerian Journal of Natural Products and Medicine, 8(1), 67-68.
[52] [51] Gilbert, M. (2000).Medicinal importance of Copaiba oil.J.Pharmacol, 4, 1159-1164.
[53] [52] Hassan, L. G., Dangoggo, S. M., Umar, K. J., Saidu, I and Folorunsho, F. A. (2008). Proximate minerals and anti-nutritional factors of *Daniellia oliveri* seed kernel. Chem Class J, 5, 31-36.
[54] [53] Obun, C. O and Adeyemi, O. A. (2012). Effects of raw and toasted *Daniellia oliveri* Rolfe seed meal as replacement for groundnut meal on the performance of broiler chickens. *Revista Científica UDO Agrícola*, 12(4), 947-954
[55] [54] Okunade, S. A., Olafadehan, O. A and Isah, O. A. (2015).Fodder potential and acceptability of selected tree leaves by goats. Animal Nutrition and Feed Technology, 14(3), 489-498.