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Full Length Research

Comparative Study of the Phytochemical Properties of *Jatropha curcas* and Azadirachta *indica* Plant Extracts

Harry-Asobara, Joy Linda* and Samson, Eno-Obong Okon

Forestry Research Institute of Nigeria, Eastern Research Station, Umuahia, Abia State, Nigeria.

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Phytochemical studies were carried out on the plant parts of *Jatropha curcas* (L.) and *Azadirachta indica* (A. Juss) found in the South Eastern parts of Nigeria with a view to highlighting their pre-existing secondary metabolites which have varieties of biological activities attributed to them. Qualitative and quantitative analysis of seven secondary metabolites (alkaloids, tannins, saponins, flavonoids, phenols, HCN and phytate) were undertaken. The result showed that all secondary metabolites analyzed were present in all tissues of the two plant species studied but at different concentrations. The concentration of Alkaloid (1.38), Flavonid (0.44) and Saponin (0.72) contents of Neem leaf was observed to be more than in other parts of the neem plant and also more than as found in other plant parts of *J. curcas*. Phenolic contents of Neem leaf and bark were observed to be the same (0.18). However, Jatropha seed contained the highest percentage of HCN (60.07) and Phytate (0.54) than any other part of the two species while *Jatropha* bark and *Jatropha* leaf had highest percentages of phenol (0.24) and tannin (0.46) respectively. Generally aside HCN contents, alkaloids were the most abundant in neem plant parts followed by saponins, flavonoids, phytates, tannins and then phenols. Jatropha plant parts however contained less alkaloids and phenols than the other phytochemicals. Results obtained therefore spotlight these important phytochemicals in the tree species. However, variations observed in their concentrations confer value and individuality on the species.

Key words: *Jatropha curcas*, *Azadirachta indica*, Plant parts, Extracts, phytochemical

INTRODUCTION

Plants are composed of chemical substances of which some are not directly beneficial for the growth and development of the organism. These secondary compounds have usually been regarded as a part of the plants' defense against plant-feeding insects and other herbivores (Rosenthal and Janzen, 1979). The chemical properties of many plants have been known for a long time and natural products based on plant extracts such as rotenone, nicotine and pyrethrum have been commonly used in pest control during the earlier half of this century.

However, after the Second World War, they lost their importance with the introduction of the synthetic organic chemicals. The organic chemicals were concentrated products with a high knock-down effect on target organisms. The chemicals could be produced in large quantities relatively cheaply and they rapidly substituted most other products in the 1950s. To the disadvantages of synthetic chemicals' contamination of the environment and human health risks, misuse of non-selective chemicals can wipe out the natural enemies and induce problems with development of resistance.

Today there is considerable interest among biochemists and botanists to screen plants for secondary chemical compounds, which could be used for developing medicals and pesticides, particularly in the tropical rain forests where plant species are numerous but threatened with extinction (Downum et al., 1993). However, it is an expensive and difficult process to isolate and identify the active ingredients and further

*Corresponding author. E-mail: jlhasob@gmail.com

produce them in formulations which can be commercialized. Furthermore, natural pesticides are not uniform products but rather consist of different active ingredients which often vary in concentration from sample to sample. This makes toxicological tests difficult and costly to run (Latum and Gerrits, 1991), that although the active ingredients in most plants are known, it has not been possible to synthesize these complex compounds.

Examples of plant species that have been noted to yield various synthetic alternatives include *Jatropha curcas* (L.) and *Azadirachta indica* (A. Juss). The neem tree, *A. indica* (A. Juss) , is so far the most promising example of plants currently used for pest control. This holy tree in India, from where it originates, now has a global distribution throughout the tropics. It is used for many purposes such as shade tree, poles for construction, medicine, tooth sticks and as a source of insecticide (National Research Council, 1992). *A. indica* contains several active ingredients which act in different ways under different circumstances. According to Feng *et al.* (1995), at least nine neem limonoids have demonstrated an ability to block insect growth, affecting a range of species that includes some of the most deadly pests of agriculture and human health.

J. curcas (L.) is an ornamental plant naturalised in many tropical areas. The roots, stems, leaves seeds and fruits of the plant have been widely used in traditional folk medicine in many parts of West Africa (Scott *et al.*, 2003). The seeds of *J. curcas* have been used as a purgative, antihelminthic and abortifacient as well as for treating ascites, gout, paralysis and skin diseases. The seed oil of the plant has been used as an ingredient in the treatment of rheumatic conditions, itch and parasitic skin diseases, and in the treatment of fever, jaundice and gonorrhoea, as a diuretic agent, and a mouth-wash. The leaf has been used as a haemostatic agent and the bark as a fish poison. In certain African countries people are accustomed to chewing these seeds when in need of a laxative. *Jatropha curcas* seeds have been found to be highly effective against Strongyloides papillosus infection in goats. It has also been suggested that *J. curcas* seeds could be a useful chemotherapeutic agent provided that it is active at a non-lethal dose (Grainage and Ahmed, 1988). This may be because of its reported antihelminthic activity (Mok, 1991).

J. curcas contains purgative oil and a phytotoxin or toxalbumin (curcin) similar to ricin in Ricinis. Curcin - a phytotoxin (toxalbumin), is found mainly in the seeds and also in the fruit and sap; while Purgative oil - the seed yields 40% oil, known as hell oil, pinheon oil, oleum infernale or oleum ricini majoris, contains small amounts of an irritant curcanoleic acid, which is related to ricinoleic acid and crotonoleic acid, the principle active ingredients of castor oil and croton oil respectively(Scott *et al.*, 2003).

This study therefore aims at contributing to the exploitation of plant-derived compounds by highlighting the pre-existing secondary metabolites of *J. curcas* and *A. indica* which have varieties of biological activities attributed to them.

METHODOLOGY

The plant parts (Root, Bark, Leaves and Seeds) of both *Jatropha curcas* and *Azadirachta indica* used for this study were all gathered within the Umudike area of Abia State, situated in the South-East region of Nigeria (5° 29´N and 7°24´E) within the lowland rainforest, on an altitude of 122m above the sea level (Keay, 1959). Each test sample (leaves, seeds, bark and roots) was washed, dried in the oven at 65°C and then ground into powdered form. The ground samples were sieved to obtain powdered materials used for the physico- chemical analysis which at the Central Laboratory of the National Root Crops Research Institute, Umudike, Nigeria.

Similarly, a measured weight of the oven dried samples (3kg) of both *J. curcas* and *A. indica* was burnt to ashes (as in ash determination) thereby removing all the organic materials leaving the inorganic ash. Seeds of *J. curcas* could not burn to ashes, therefore ashes of seeds of both *Jatropha* and Neem were not included in the experiment. Mineral content of the ashes was determined following the Dry Ash Extraction Methods (James, 1995, Kirk and Sawyer, 1989).

RESULTS AND DISCUSSION

As shown in Table 1, *Jatropha* Seed contained greater percentage of alkaloid (0.32), flavonoid (0.42), hydrogen cyanide (HCN)(60.07) and phytate (0.54) while greater percentage phenol was observed in *Jatropha* Bark (0.24) , followed closely by *Jatropha* Root (0.22). However greater percentage of Tanin (0.46) and Saponin were contained in *Jatropha* Leaves (0.48)

Neem leaf in comparism with the other parts of the plant gave greater percentage of alkaloid (1.38), flavonoid (0.44), and saponin (0.72) (Table 2). Neem Seed contained greater percentage of HCN (13.04) and phytate (0.32) than other parts of the plants while greater percentage of tannin was observed in Neem Bark (0.26) followed very closely by Neem Seed (0.24). Neem Leaf and Neem Bark contained same phenolic percentage (0.18).

Ashes of *Jatropha* Root contained more calcium Ca (184.37) than those of leaf and bark while magnesium Mg (19.2), potassium K (368.4), sodium Na (16.8) and Phosphorous P(420.82) were observed more in ashes of Jatropha Leaf. Jatropha leaf also had more level of ash (6.04) followed closely by Jatropha Bark (5.88) (Table 3). Similarly, Neem Leaf was observed to contain higher amount of calcium Ca (192.38), potassium K (258.0), sodium Na (21.32) and phosphorous P (233.06) and also

Table 1. Physico-chemical analysis of *Jatropha curcas* plant parts.

Sample	Alkaloid (%)	Flavonoid (%)	Saponin (%)	Phenols (%)	HCN (Mg/kg)	Phytate (%)	Tanin (%)
Root	0.18	0.20	0.16	0.22	14.34	0.16	0.24
Bark	0.16	0.36	0.24	0.24	43.54	0.32	0.36
Leaves	0.16	0.18	0.48	0.16	31.42	0.38	0.46
Seed	0.32	0.42	0.22	0.18	60.07	0.54	0.34

Table 2. Physico-chemical analysis of *Azadirachta indica* plant parts.

Sample	Alkaloid (%)	Flavonoid (%)	Saponin (%)	Phenols (%)	HCN (Mg/kg)	Phytate (%)	Tanin (%)
Root	0.84	0.14	0.18	0.08	6.40	0.10	0.12
Bark	1.22	0.36	0.32	0.18	11.33	0.15	0.26
Leaves	1.38	0.44	0.72	0.18	6.13	0.18	0.24
Seed	0.68	0.28	0.50	0.12	13.04	0.32	0.14

Table 3. Mineral (macro) composition of ashes of *Jatropha curcas* (L.) and *Azadirachta indica* (A. Juss) Samples (mg/100g).

Sample	%Ash	Ca	Mg	K	Na	P
Jatropha						
Leaf	6.04	60.12	19.2	368.4	16.8	420.82
Bark	5.88	44.09	12.0	134.8	13.2	368.57
Root	5.62	184.37	16.8	126.4	7.9	346.53
Neem						
Leaf	6.84	192.38	7.2	258.0	21.32	233.06
Bark	5.60	112.22	7.2	102.0	18.1	162.45
Root	4.36	24.05	4.8	88.40	10.92	153.06

had higher level of ash (6.84) compared to Neem bark and root, although closely followed by bark (Table 3).

RESULT DISCUSSION

Toxicity of *J. curcas* plant is attributed to several components, including saponins, lectin (curcin), phytates, protease inhibitors, and curcalonic acid and phorbol esters (Adolf *et al*., 1984; Makkar and Becker, 1997), as well as secondary metabolites alkaloids, tannins, flavonoids, phenols and saponins (Martinez-Herrera *et al*., 2006). Although many parts of *J. curcas* plants are used in various tropical countries for treatment of a variety of ailments, the high HCN (60.07) contents of the seeds in this study suggest their high toxicity level. Duke (1985); Henning (1994); and Sherchan *et al.* (1989) reported the rodenticidal and pesticidal properties of *J. curcas* seeds to a variety of insect pests. This study reveals that the seeds are equally high in Alkaloid (0.32%) and Flavonoid (0.42%). Burkill (1994) reported the presence of tannins and saponins in the leaf of *J. gossypifolia* and *J. multifida* respectively which is confirmed by this study. Oskoueian *et al.* reported that extract of root and latex of plants which contained phenolics, flavonoid and saponins showed notable antioxidant, anticancer and anti-inflammatory activities. The high phenolic contents of *Jatropha* bark (0.24) and root (0.22) in this study signify their involvement in different biological activities.

Anti-microbial and pesticidal properties of Neem are attributed to a general class of Nine natural products called "triterpenes", more specifically, "limonoids." The most significant of the limonoids are Azadirachtin, Salannin, Meliantriol, and Nimbin and each and every part of the tree contains the bioactive compounds (lakshhi, 2009). Singh *et al.* (2005) noted that apart from the Limonoids, fresh and dry bark of stem, mature and tender leaves, roots, flower and different parts of fruit, i.e., raw and ripe fruit epicarp, mesocarp and seed) of Neem (*A. indica*) are equally rich in pre-existing secondary metabolites. The high secondary metabolites

contained in Neem leaf (Alkaloid(1.38); Flavonoid (0.44); Saponin(0.72); Phenol(0.18) in this study over the other Neem plant parts and even over plant parts of *J. curcas* strongly highlights their use in agriculture, industrial and various anti-microbial activities. The Neem plant parts studied showed considerably low HCN values signifying that Neem products could be very eco-friendly.

The qualitative screening from the present study revealed the presence of alkaloids, tannins, saponins, flavonoids phenols phytate and HCN in all plant parts of *J. curcas* and *A. indica* investigated but to varying intensities/quantities as shown in Tables 1 and 2. Preliminary qualitative test according to Mallikharjunah *et al*. (2007) is useful in the detection of bioactive principles and subsequently may lead to drug discovery and development. Olawale-Abulude (2007) undertook phyto-chemical screening of leaves of twenty-eight woody species from different plant families in Nigeria and discovered the presence of tannins, alkaloids and flavonoid in all samples. Thus these secondary metabolites seem cosmopolitan in plants but to varying degrees, their different degrees of occurrence in plant parts conferring taxonomic usefulness on them. This study also brings to bare the fact that *J. curcas* and *A. indica* are potential sources of these important phytochemicals. For instance, flavonoids are one of the most popular secondary metabolites possessing a variety of biological activities at nontoxic concentrations (Irshad *et al*., 2010).

Dietary flavonoids are noted to play effective roles in cancer prevention (Ren *et al*., 2003; Aggarwal and Shishodia, 2006). Flavonoids together with the other secondary metabolites identified in the *Jatropha* species and Azadirachta indica studied have been severally reported in other plants to show curative activity against diverse pathogens, used traditionally as analgesic, antimicrobial and soothing herbs (Hassan *et al*., 2004; Faruq *et al*., 2004; Olafimihan, 2004; Singh *et al*., 2009; Thirunavukkarasu *et al*., 2010; Ganesh and Vennila, 2011).

On the other hand, ashes of parts of Neem and Jatropha used in this study also contained considerable high chemical compositions. Calcium content was more in Neem, while Jatropha contained higher potassium. Phosphorous content of the two plant species was equally high. According to Risse and Harris (2008), wood ash contains *Calcium carbonate* as its major component, representing 25 or even 45 percent. Less than 10 percent potash, and less than one percent phosphate; there are trace elements of iron, manganese, zinc, copper and some heavy metals. However these numbers vary as combustion temperature is an important variable in determining wood ash composition and all of these are, primarily, in the form of oxides (Misra *et al*., 1993). Etiegni and Campbell, (1991) noted that ashes with high chemical compositions and char contents have proven to be effective in insect control and as an odor control agent, especially in composting operations.

Conclusion

The possibility for small-scale farmers to buy agricultural inputs is limited. This together with the problems of health risks and environmental pollution, owing to misuse of chemicals, provide good arguments for carrying out studies on natural products. Some plants are more frequently occurring in the studies than others, such as neem and neem related plants, tephrosia and species of the Euphorbiaceae family. However, there is a lack of a systematic approach to the problems related with the utilization of plant-derived products. Many studies are carried out in isolation with little back-ground information about the plants and what has been done elsewhere. For example the National Research Council, Washington, USA considers Neem one of the most promising of all plants. Probably no other plant yields as many strange and varied products or has as many exploitable by-products. However, most of these findings on neem and its products are not patented, despite being potentially valuable, cost effective, reduces incidence of pests and parasite resistance with increase in agricultural production, environmental protection and health care services for humans and livestock. In line with these adequate benefits, researches on neem and other promising plant species must be directed at identification and quantification of the active principles and patenting of findings thereby making these findings readily accessible to mankind for adoption.

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