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The biomedical significance of the phytochemical, proximate and mineral compositions of the leaf, stem bark and root of *Jatropha curcas*

Atamgba Agbor Asuk[1*], Margaret Akpana Agiang[2], Kayode Dasofunjo[1], Amonor James Willie[1]

[1]*Department of Medical Biochemistry, Cross River University of Technology, Okuku Campus, P.M.B 1123, Calabar, Cross River State, Nigeria*

[2]*Department of Biochemistry, University of Calabar, P.M.B 1115, Calabar, Cross River State, Nigeria*

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ABSTRACT

Objective: To analyse the phytochemical contents of leaf, stem bark and root of *Jatropha curcas* (*J. curcas*) in four solvent extracts and their proximate and mineral compositions.

Methods: Standard analytical procedures were used for the determination of phytochemicals, proximate and mineral compositions of the leaf, stem bark and root extracts of *J. curcas*.

Results: Results of the analysis showed the presence of polyphenols, flavonoids, alkaloids, cardiac glycosides, coumarins, saponins, terpenoids, steroids, triterpenoid saponins, carotenoids, phlobatannins and tannins in the leaf, stem bark and root of all the solvent extracts. Flavonoids were present in the highest amount in the ethyl acetate extracts of the leaf (7.35% ± 0.02%), stem bark (4.12% ± 0.01%) and root (3.35% ± 0.02%) followed by polyphenols in the methanol extracts of leaf (4.62% ± 0.02%), stem bark (2.77% ± 0.05%) and root (2.49% ± 0.02%). Poly-acetylated compounds were absent in all the solvent extracts of the leaf, stem bark and root. However, some anti-nutritional agents such as oxalates, phytates and cyanates were present in all the solvent extracts of the leaf, stem bark and root except the ethyl acetate. Phytates were high in the aqueous solvent of the leaf (6.12% ± 0.00%) but low in the stem bark (1.00% ± 0.05%) and root (0.89% ± 0.03%). Proximate composition showed appreciable amounts of total carbohydrate (36.33% ± 0.72%), crude protein (26.00% ± 0.47%) and reducing sugars (5.87% ± 0.14%) in the leaf, while crude fat was more in the stem bark (16.70% ± 0.30%). There was corresponding substantial energy in the leaf [(1514.77 ± 20.87) kJ/100 g] and stem bark [(907.00 ± 8.52) kJ/100 g]. Moisture and ash contents of the leaf, stem bark and root were within acceptable limits for the use in drugs formulation. The mineral composition showed substantial amounts of important elements such as Fe, Ca, Na, Mg and Zn. Others were P, K and Se.

Conclusions: The outcome of this study suggests that the leaf, stem bark and root of *J. curcas* have very good medicinal potentials, meet the standard requirements for drug formulation and serve as good sources of energy and nutrients except for the presence of some anti-nutritional elements predominant in the leaf.

1. Introduction

Jatropha curcas (*J. curcas*) or physic nut is a non-edible multipurpose shrub [1]. It is a medicinal herb that is a member of the plant family Euphorbiaceae, and an uncultivated non-food wild species with branched and erect parts growing up to 6 m in height and predominantly found in tropical and sub-tropical regions of the world [2,3].

The Greek root (jatros) from which the genus name *Jatropha* was derived means "doctor" implying ancient medical uses of the plant in its centre of origin in Latin America [4]. Different parts of the plant have been used as ethno-medicine in different countries for centuries [5].

*Corresponding author: Atamgba Agbor Asuk, Department of Medical Biochemistry, Cross River University of Technology, Okuku Campus, P.M.B 1123, Calabar, Cross River State, Nigeria.
Tel: +234 8035853000, +256 776312811
E-mail: raphaelasuk@gmail.com
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Many studies have been done to demonstrate the efficacy of *J. curcas* against a wide array of bacteria and fungi [3]. Results of several studies also revealed that *J. curcas* had anticancer and antitumour properties [6,7]. Other medicinal plants have been studied using modern scientific approaches. However, only few drugs of plant origin could reach clinical uses; for this reason, a special effort is needed for the development of herbal drugs having therapeutic ability [8]. Medicinal plants have a long tradition of use outside of conventional medicine. It is becoming more main stream as improvement in clinical research shows the value of herbal medicine in the treatment and prevention of disease [9].

Medicinal plants have continued to play important roles in the development of new drugs and effective health care systems in many countries, developed and less-developed countries alike. In a review of plant contribution to drug development, Newman *et al.* observed that at least 119 chemical substances of plant origin can be considered as important drugs that are used in one or more countries [10]. Of the 119 drugs, 74% were discovered as a result of chemical studies directed at the isolation of the active substances from plants used in traditional medicine. Numerous plant products in the form of decoction, tincture, tablets and capsules have been clinically used for the treatment of different ailments and diseases including cancer. Synthetic analogues in some cases have also been prepared to improve the efficacy and decrease the side effects of parent compounds. Traditional medicine using plant extracts continues to provide health coverage for over 80% of the world's population, especially in the developing world [11].

Indeed, traditional medicine is a potential source of new drugs and a source of cheap starting products for the synthesis of known drugs. Some examples include reserpine from *Rauvolfia* species, vinblastine from *Catharanthus roseus* or the discovery of a contraceptive in the zoapatle (*Montanoa tomentosa*) [12].

Plant chemicals from carbohydrates, fats, protein, vitamins and minerals, are parts of our body composition and chemistry. Plant medicine remains indispensible to modern pharmacology and clinical practice. Many of the current drug discovery and development process are plant-based and new medicines derived from plants are inevitable.

The increasing population of the world (especially the third world countries) requires that the search to accommodate this increase be broadened in the use of various plants so as to ensure easy reach and minimization of certain health care problems through meeting up with the nutritional and medicinal needs. Paucity therefore demands the evaluation of the medicinal and nutritional values of the leaf, stem bark and root of *J. curcas* through determination of phytochemical, proximate and mineral constituents of *J. curcas*.

2. Materials and methods

2.1. Equipment, chemicals and reagents

Materials used in laboratory included beaker, measuring cylinder, porcelain dish, test tubes, spatula, conical flasks and retort stands. Filter paper (Whatman No. 1), mortar and pestle, analytical and mechanical weighing balance were also used.

All chemicals and reagents used in this work were of analytical grade and they included ferric chloride solution, Fehling's solution A and B, hydrochloric acid (concentrated and dilute), sodium bicarbonate, sodium hydroxide and dilute ammonia solution. Tetraoxosulphate (VI) acid, glacial acetic acid, lead acetate, 10% alcoholic solution of naphthol, Mayer's reagent, Dragendorff's reagent, picric acid solution (Hager's reagent), Wagner's reagent, ethanol, methanol, ethyl acetate and distilled water were also included among others.

2.2. Collection and preparation of the plant materials

The leaf, stem bark and root of *J. curcas* were collected from Bedia farm in Obudu, Obudu Local Government Area, Cross River of Nigeria. Identification and authentication (identification no: 67) was done by Frank I. Apejoye of Botany Department, University of Calabar.

2.2.1. Processing of the plant materials

The leaf, stem bark and root of *J. curcas* were collected and air dried at room temperature in Medical Biochemistry Laboratory, Cross River University of Technology Okuku Campus, Nigeria for 14 days for use in the determination of phytochemicals, anti-nutrients investigation, proximate composition and mineral elements. The samples were ground into powder using a pulverizer and stored in an air tight bottle prior to use for analysis. The ground samples were used for the analysis of proximate composition and minerals content. After weighing 200 g, each of the ground sample of the leaf, stem bark and root was dissolved in 1000 mL each of deionised water, ethanol, methanol and ethyl acetate and was kept in the refrigerator for 72 h. The extract was filtered using a chess cloth and Whatman filter paper No. 1 (24 cm), to obtain filtrates of the respective solvents of water, ethanol, methanol and ethyl acetate which were then used for phytochemicals estimation spectrophotometrically.

2.3. Proximate analysis

The analysis of the proximate composition of *J. curcas* leaf, stem bark and root was carried out using the official methods of analysis of the Association of Official Analytical Chemists [13,14].

2.3.1. Energy value

This was calculated (kJ/100 g) using the equation:

$$\text{Energy value} = (37 \times \text{fat}) + (17 \times \text{carbohydrate}) + (17 \times \text{protein})$$

2.4. Phytochemical analysis

Phytochemical analysis for tannins, phenolics, flavonoids, saponins, carotenoids, sesquiterpenoids, cardiac glycosides and alkaloids were carried out according to known and standard methods. Tannins and phlobatannins were estimated using the Folin-Denis spectrophotometric method [15]. Saponin and triterpenoid saponin content were determined using the method of Liener [16], and modified by Hudson and El-Difrawi [17]. Flavonoids, alkaloids and sesquiterpene lactones were determined by ethyl acetate extraction and gravimetric measurement, the alkaline precipitation and gravimetric method and the double extraction and gravimetric measurement, respectively as described by Harborne [18]. Total oxalate was determined according to the procedure of Day and Underwood [19]. Phytate content was determined using the method