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Assessment of the nutritional qualities of ten botanicals used in pregnancy and child delivery in Ibadan, Nigeria

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Abstract

Ten botanicals used in pregnancy and child delivery by traditional maternity experts in Ibadan were analysed for their nutrient and phytochemical constituents to provide scientific insight into their therapeutic uses. The nutrient and phytochemical analyses of powdered plant samples were done using standard methods. The plants contained phosphorus, calcium, iron, manganese, magnesium and zinc in varied quantity. *Eleusine indica* (165.0mg/100g) was highest in calcium content and *Croton zambesicus* (40.0mg/100g) had the least. Iron content was 9.7mg/100g in *E. indica* and *Uraria picta* had 2.7mg/100g. The protein content of plant samples varied between 13.95% and 18.30%, the highest (18.30%) being in *Phyllantus niruri* and *Clerodendrum volubile* (13.95%) the least. The carbohydrate value ranged between 45.75% (*U. picta*) and 52.60% (*C. volubile*). Crude fibre was 17.80% in *Xylopia aethiopica* and C*. volubile* contained 13.50%. All plants contained alkaloids, cerotenoids, flavonoids, saponins and steroids. The plants have significant nutritional properties in addition to phytochemical constituents. The nutrients could support the increased energy and nutritional requirements in pregnancy, prevent malnutrition and supplement the phytochemicals in therapeutic activities. Toxicological studies of the plants would confirm their safety in administration.

Keywords: Ethnobotanicals, traditional maternity, pregnancy, child delivery, phytochemical screening, nutritional components.

Introduction

The use of herbs during pregnancy to stabilize pregnancy and facilitate child birth is a common practice in Nigeria. The knowledge of use of herbs in pregnancy is acquired from relations, traditional medical practitioners and herb sellers. Pregnant women use herbs for some reasons: to prevent spontaneous abortion and miscarriage, to ensure good development of the feotus, to prevent sickness such as anaemia, malaria, constipation, nausea and hypertension, to facilitate labour and to have a beautiful, weighty and healthy baby.

The demand for both energy and nutrients is increased during pregnancy. Pregnancy is associated with physiological changes that result in increased plasma volume and red blood cells and decreased concentrations of circulating nutrient-binding proteins and micronutrients. In many developing countries, these physiological changes can be aggravated by under-nutrition, leading to micronutrient deficiency states, such as anaemia, that can have disastrous consequences for both mothers and newborn infants. The recommended daily dietary allowances or intakes of micronutrients for pregnant women in their third trimester include calcium (1000 – 1200 mg), Iron (179 – 299 mg), zinc (2.0 mg), iodine (200 µg), selenium (27 µg) and copper (1.15 mg)[1]. Calcium deficiency is rare in pregnancy but appears in cases of hypoparathyroidism (diminished concentration of parathyroid hormone in the blood) and severe dietary inadequacy and in individuals who are unable to eat a diet rich in dairy products. Low calcium and magnesium concentrations have been associated with hypertensive disorders of pregnancy, although a causal effect has not been shown. Iron deficiency resulting mainly from poor dietary iron bioavailability causes anaemia and has been associated with maternal mortality. Iron deficiency is known to affect immune status by reducing the delayed-type hypersensitivity reaction, graft rejection, and cytotoxic activity of phagocytes. A low plasma iron concentration also selectively inhibits proliferation of TH1 and not TH2 cells; thus, iron may be important for maintaining maternal health and reducing the risk of infection. Zinc deficiency in pregnant women has been associated with congenital abnormalities, abortions, intrauterine growth retardation, premature birth, and preeclampsia. Zinc deficiency can also affect the immune response [1].

There is inadequate data on the use of medicinal plants by pregnant women worldwide. There are on-going efforts on documentation of such plants with the hope of conducting pharmacological, toxicological, and clinical studies on them, as well as validating their safety in administration. A study by Lamxay *et al.* reported the use of 49 different plant species in women's health care in Khammouane province of Lao PDR, Southeast Asia [2].

Table 1: Therapeutic values of the ten botanicals used in pregnancy in Ibadan

S/N	Botanical	Traditional method of preparation	Therapeutic effect
1.	*Clerodendrum volubile*	Leaves or fruits are powdered and cooked with either rat or bat. Little palm oil, African pepper (*Piper guineense*) and salt are added to the preparation. The pregnant woman consumes the traditional soup.	To prevent or correct breech presentation (a baby who is lying bottom or feet down in the uterus) and ensure cephalic (the position of a baby who is lying head down in the uterus).
2.	*Croton zambesicus*	Leaves (200g) powdered and added to native soap (1 Kg), the mixture is pounded with mortar and pestle to ensure that the prepared soap is not gritty. The pregnant woman baths with the soap daily. A decoction of its leaves is also taken as antimalaria and antihypertensive in pregnancy.	The preparation is for protection against diseases and evil spirit. To ensure that the feotus is carried to its term (40 weeks) in good health.
3.	*Diodia scandens*	Stems or leaves are charred. The powder (one tablespoonful) is then dissolved in water (250 ml). Some of the preparation is drunk by the pregnant woman and the remaining is rubbed on the vagina.	To prevent excessive bleeding during labour and after birth or delivery. To ensure safe delivery.
4.	*Eleusine indica*	Roots are cut into smaller pieces and ground into fine powder. The powder is cooked with catfish, pepper (*Piper guineense*), palm oil, salt and a local ring (straightened). After cooking the soup is eaten by the pregnant woman and the ring is worn on her finger till child birth.	To prevent sickness during pregnancy and stabilize the pregnancy. To support the health of the woman and the feotus, and ensure safe child birth. The leaf juice is also used to expel the after birth.
5.	*Hybanthus enneaspermus*	Fresh leaves are ground into paste and cooked with catfish, pepper, palm oil and salt. The soup is taken towards expected delivery date (EDD).	To facilitate an easy labour thereby ensuring safe delivery at term (40 weeks).
6.	*Launaea taraxacifolia*	Leaves are eaten as vegetable soup regularly during pregnancy.	To boost the immunity of the expectant mother and the feotus. To make-up for the high nutrient requirement in pregnancy. To prevent Pregnancy-induced hypertension and anaemia.
7.	*Phyllanthus niruri*	Leaves paste ground and cooked with catfish, pepper, palm oil and salt as soup. The soup is taken towards delivery.	The soup is taken to ease labour and easily expel the placenta (oxytocic).
8.	*Synsepalum dulcificum*	Fruits or leaves extracted in water. Extract taken weekly.	To prevent miscarriage or spontaneous abortion.
9.	*Uraria picta*	Powdered leaves cooked with catfish as soup. The soup is eaten twice daily towards delivery	It is used to prevent placenta praevia (also known as low lying placenta) is a complication of pregnancy, when the placenta is in the lower area of the uterus and covers part or all of the cervix.
10.	*Xylopia aethiopica*	Fruits, *Piper guineense* and small quantity of potash (potassium carbonate) are ground together into powder or charred. The powder is then soaked in alcohol. One tot is taken daily after meal.	To suppress fibroids in the uterus and facilitate conception. Fibroids are tumors of the muscle wall in the uterus. They may cause miscarriages, impede growth of the baby, and make delivery difficult.

A survey of medicinal plants used for contraception and pregnancy related cases in Malawi, reported the use of 21 plant species for pregnancy related cases [3]. In a study of traditional practices and medicinal plants used during pregnancy by Anyi-Ndenye Women (Eastern Côte d'Ivoire), Dhaj and Danho documented the therapeutic uses of 75 plants by pregnant women [4]. Tamuno *et al.* studied the use of herbs in pregnancy among 500 pregnant women attending the antenatal clinic of the Aminu Kano Teaching Hospital, Kano, Nigeria. He reported that 31.4% of pregnant women used herbal medicines in the subsisting pregnancy [5].

The use of herbs in pregnant related cases is also known in developed countries. *Mitchella repens* (Squaw Vine), *Trillium erectum* (Beth Root), *Hydrastis canadensis* (Golden Seal) and *Caulophyllum thalictroides* (Blue Cohosh) are used to induce stronger contractions in case of weak and prolonged duration of labour to prevent exhaustion of the mother and the baby's life from being endangered due to lack of oxygen [6]. Also, tea made from *Capsella bursa-pastoris* (Shepherd's Purse) and *Alchemilla vulgaris* (Ladies Mantle) are used to stop excessive bleeding after delivery. *Trillium erectum* (Beth Root), *Achillea millefolium* (Yarrow) and *Quercus robur* (Oak bark), taken as a tea help to astringe the dilated womb and return it to its normal size and shape. *Melissa officinalis* (Lemon Balm), *Cnicus benedictus* (Blessed Thistle), *Hypericum perforata* (St. Johnswort), *Leonurus cardiaca* (Motherwort), *Galium aperine* (Cleavers), and *Rosa canina* (Rosehips) are used as tonic herbs and anti-depressants to strengthen the mother after child birth [6]. Black cohosh (*Cimicifuga racemosa*), alone or in combination with other medicinal herbs as "mother's cordial", has a long traditional use and is frequently used by midwives as a uterine stimulant and labour-inducing aid [7].

Ethnobotanical investigation revealed the use of *Clerodendrum volubile* P. Beauv., *Croton zambesicus* Muell. Arg., *Diodia scandens* Sw., *Eleusine indica* (L.) Gaertn., *Hybanthus enneaspermus* (L.) F. Muell., *Launaea teraxacifola* (Willd.) Amin ex C. Jefferry, *Phyllantus niruri* (L.), *Synsepalum dulcificum*

(Schumach. and Thonn.) Baill., *Uraria picta* (Jacq.) DC., and *Xylopia aethiopica* (Dunal) A. Rich, in pregnancy and child delivery in traditional maternity clinics in Ibadan (Table 1). Based on the information that the ten plants are used during pregnancy and child birth in two traditional maternity clinics in Ibadan, this study examined their mineral and chemical components to provide a scientific insight into their indigenous therapeutic uses.

Materials and methods

Plant materials

The selection of botanicals for this study was based on information collected from two traditional maternity clinics in Ibadan, Nigeria. Fresh and healthy *Clerodendrum volubile* (leaves), *Croton zambesicus* (leaves), *Diodia scandens* (leaves), *Eleusine indica* (roots), *Hybanthus enneaspermus* (leaves), *Launaea taraxacifola* (leaves), *Phyllantus niruri* (leaves), *Synsepalum dulcificum* (leaves), *Uraria picta* (leaves), and *Xylopia aethiopica* (fruits) were collected from University of Ibadan campus. The test plants were identified at species level in the University of Ibadan Herbarium (UIH) (Table 2). The voucher specimens were deposited in UIH. The test plants were washed, cut into small pieces and dried at room temperature (28 - 30^{o}C) for two weeks until completely dried. The dry plant materials were ground into powder and stored in air-tight glass bottles at room temperature (30^{o}C) prior to experiments.

Table 2: Profile of the ten botanicals used in this study

S/N	Botanical	Family	Local name (Yoruba)	Habit	Part used
1.	*Clerodendrum volubile*	Verbenaceae	Dagba	Climber	Leaves
2.	*Croton zambesicus*	Euphorbiaceae	Ajekobale	Shrub	Leaves
3.	*Diodia scandens*	Rubiaceae	Dasa	Herb	Leaves
4.	*Eleusine indica*	Poaceae	Gbegi	Herb	Roots
5.	*Hybanthus enneaspermus*	Violaceae	Abiwere	Shrubs	Leaves
6.	*Launaea taraxacifolia*	Asteraceae	Yanrin	Herb	Leaves
7.	*Phyllanthus niruri*	Euphorbiaceae	Ehinbisowo/ Eyin-olobe	Herb	Leaves
8.	*Synsepalum dulcificum*	Sapotaceae	Agbayun	Tree	Leaves
9.	*Uraria picta*	Fabaceae	Alupaida	Shrub	Leaves
10.	*Xylopia aethiopica*	Annonaceae	Eru Alamo	Tree	Fruits

Micronutrient/proximate analysis

Micronutrient analysis was carried out after wet digestion [8]. The digested samples were analysed for Calcium (Ca), Iron (Fe), Manganese (Mn), Magnesium (Mg), and Zinc (Zn) using Atomic Absorption Spectrophotometer (FC 210/211 VGP Bausch scientific AAS). Phosphorus (P) was determined using Vanadomolybdate (Yellow method) [9]. Percent transmittance was determined at 400 nm using Spectronic 20 (Bausch and Lomb) Colorimeter. The plant samples were analysed for proximate compositions: moisture content, crude protein, crude fat, ash, crude fibre, and carbohydrate using standard technique [9].

Phytochemical screening

Phytochemical tests were carried out using standard procedure described by Soforowa and Evans [11, 12].

Alkaloids: The powdered plant sample (500 mg) was weighed and extracted with 10 ml of 2 % hydrochloric acid (HCl). The HCl extract was then filtered with Whatman filter paper (No.1) so as to have a clear solution and also to prevent false results. The filtrate of about 2.5 ml was treated with few drops of Dragendoff's reagent. A precipitate indicated the presence of alkaloids.

Anthraquinones: The powdered plant sample (500 mg) was shaken with 10 ml of benzene. The solution was filtered and 5 ml of 10% ammonium hydroxide (NH4OH) solution was added to the filtrate. A violet colour was observed in the lower phase. It indicated presence of anthraquinones.

Carotenoids: The extract (10ml) was added to a test tube and evaporated to dryness on a water bath. 2-3 drops of saturated $SbCl_3$ in $CHCl_3$ was added to the residue. A blue-green colour eventually changing to red indicates the presence of carotenoids.

Flavonoids: A few drops of concentrated hydrochloric acid (HCl) were added to a small amount of an alcoholic extract of the plant material. Immediate development of a red colour was taken as an indication of the presence of flavonoids.

Saponins: The sample (200 mg) was shaken with 5 ml of distilled water and then heated to boil. Persistent frothing showed the presence of saponins.

Steroids: The extract (0.5 g) was dissolved in 2 ml of chloroform. Sulphuric acid was carefully added to form a lower layer. A reddish-brown colour at the interphase indicated the deoxysugar characteristic of cardenolides. A violet ring formed just above the

ring and gradually spread throughout the layer indicated presence of steroids.

Tannins: The sample (500 mg) was mixed with 10 ml of distilled water and heated on water bath. The mixture was filtered and ferric chloride ($FeCl_3$) was added to the filtrate. Appearance of blue black colouration showed the presence of tannins [11, 12].

Data analysis

Micronutrient and proximate data were expressed as mean ± standard deviation, and were subjected to One-way Analysis of Variance (ANOVA). The differences between means were separated by Duncan Multiple Range Test (DMRT) at $P<0.05$ level of significance.

Results

The plant samples contained varied quantity of micronutrients (Table 3). *L. taraxacifolia* had the highest phosphorus (150.0 mg/100g), followed by *E. indica* (142.5 mg/100g) and the least (40.0 mg/100g) was observed in *P. niruri.* Calcium content was in the order: *E. indica* (165.0 mg/100g) > *H. enneaspermus* (150.0 mg/100g) > *C. zambesicus* (40.0 mg/100g). The maximum iron content was for *E. indicia* (9.7 mg/100g), *X. aethiopica* had 7.6 mg/100g and *U. picta* (2.7 mg/100g) the least. *X. aethiopica* had 0.025 mg/100g of manganese and *S. dulcificum* contained none. The peak value of magnesium was observed in *S. dulcificum* (4.0 mg/100g), followed by *E. indica* and *U. picta* (3.5 mg/100g) and *L. taraxacifolia* (0.5 mg/100g) had the least. Zinc content of *E. indica* was 0.085 mg/100g, *H. enneaspermus* had 0.060 mg/100g, *S. dulcificum* and *X. aethiopica* (0.010 mg/100g) had the least.

Table 3: Micronutrient components of the ten botanicals used in pregnancy and child delivery in Ibadan

S/N	Botanical	Phosphorus (P) (mg/100g)	Calcium (Ca) (mg/100g)	Iron (Fe) (mg/100g)	Manganese (Mn) (mg/100g)	Magnesium (Mg) (mg/100g)	Zinc (Zn) (mg/100g)
1.	*Clerodendrum volubile*	120.0^{bc}± 14.14	105.0^{b}± 0.07	4.15^{de}± 7.07	0.005^{ab}± 0.00	3.0^{abc}± 1.41	0.050^{abc}± 0.42
2.	*Croton zambesicus*	75.0^{d}± 7.07	40.0^{e}± 7.07	5.35^{cd}± 0.21	0.005^{ab}± 0.00	2.0^{cd}± 0.28	0.020^{bc}± 0.01
3.	*Diodia scandens*	80.0^{d}± 14.14	75.0^{cd}± 7.07	6.4^{bc}± 0.14	0.005^{ab}± 0.00	1.5^{de}± 0.28	0.020^{abc}± 0.01
4.	*Eleusine indica*	142.5^{ba}± 3.53	165^{a}± 14.41	9.7^{a}± 0.14	0.020^{ab}± 0.01	3.5^{ab}± 0.42	0.085^{a}± 0.01
5.	*Hybanthus enneaspermus*	120.0^{bc}± 14.14	150^{a}± 7.07	4.25^{cde}± 0.21	0.02^{ab}± 0.01	2.5^{bcd}± 0.42	0.060^{ab}± 0.03
6.	*Launaea taraxacifolia*	150.0^{a}± 7.07	120^{b}± 14.14	6.0^{bcd}± 2.82	0.020^{ab}± 0.01	0.50^{e}± 0.42	0.020^{bc}± 0.01
7.	*Phyllanthus niruri*	40.0^{e}± 7.07	55.0^{de}± 7.07	5.3^{cd}± 0.14	0.005^{ab}± 0.00	2.0^{cd}± 0.28	0.045^{abc}± 0.01
8.	*Synsepalum dulcificum*	125.0^{bc}± 7.07	147.5^{a}± 3.53	3.0^{e}± 0.14	0.00^{b}± 0.00	4.0^{a}± 0.28	0.010^{c}± 0.01
9.	*Uraria picta*	75.0^{d}± 7.07	60.0^{cde}± 7.07	2.7^{e}± 0.14	0.005^{ab}± 0.00	3.50^{ab}± 0.42	0.020^{bc}± 0.01
10.	*Xylopia aethiopica*	105.0^{c}± 7.07	80.0^{c}± 14.14	7.6^{b}± 0.28	0.025^{a}± 0.01	2.00^{cd}± 0.28	0.010^{c}± 0.01

Legend: Mean of two readings ± standard deviation; Values of means in the same column having same letter are not significantly different ($P < 0.05$); Mean values with different letters and in the same column differ significantly ($P < 0.05$).

The proximate components of plant samples are presented in Table 4. The highest (8.90 %) moisture content was observed for *E. indica* and *H. enneaspermus*, followed by *S. dulcificum* (8.75 %) and *C. zambesicus* (8.25 %) had the least. *P. niruri* had 18.30 % protein and *C. volubile* contained 13.95 %. Crude fat was 2.40 % in *D. scandens*, 2.30 % in *H. enneaspermus* and 1.50 % in *U. picta. E. indica* (10.05 %) had the highest ash content, followed by *U. picta* (9.90 %), *X. aethiopica* and *D. scandens* had the least (8.75 %). *X. aethiopica* contained 17.80 % crude fibre, *E. indica* had 16.45 % and *C. volubile* (13.50 %) the least. *C. volubile* (52.60 %) was the richest in carbohydrate; *L. taraxacifolia* contained 50.20 % and *U. picta* (45.75 %) had the smallest amount. Alkaloids, cartenoids, flavonoids, saponins and steroids were found in all plants. In addition, anthraquinones were also present in all the plants except *C. volubile*, *D. scandens* and *L. taraxacifolia* while tannins were absent in *C. zambesicus*.

Table 4: Proximate constituents of the ten botanicals used in pregnancy and child delivery in Ibadan

S/N	Botanical	Moisture Contents (%)	Protein (%)	Ether Extract (Fat) (%)	Ash (%)	Crude Fibre (%)	Carbohydrate (%)
1.	*Clerodendrum volubile*	$8.65^{abcd}\pm0.07$	$13.95^{h}\pm0.07$	$1.75^{cde}\pm0.07$	$9.55^{c}\pm0.07$	$13.50^{f}\pm0.42$	$52.60^{a}\pm0.14$
2.	*Croton zambesicus*	$8.25^{d}\pm0.07$	$15.85^{e}\pm0.07$	$1.70^{cde}\pm0.14$	$9.60^{c}\pm0.14$	$15.50^{c}\pm0.42$	$49.10^{c}\pm0.28$
3.	*Diodia scandens*	$8.60^{abcd}\pm0.14$	$17.50^{bc}\pm0.42$	$2.40^{a}\pm0.14$	$8.75^{d}\pm0.07$	$14.55^{de}\pm0.07$	$48.20^{d}\pm0.14$
4.	*Eleusine indica*	$8.90^{a}\pm0.14$	$15.55^{ef}\pm0.07$	$1.90^{bcd}\pm0.14$	$10.05^{b}\pm0.07$	$16.45^{b}\pm0.07$	$48.15^{d}\pm0.21$
5.	*Hybanthus enneaspermus*	$8.90^{a}\pm0.14$	$16.45^{d}\pm0.07$	$2.30^{a}\pm0.14$	$8.90^{d}\pm0.14$	$14.05^{e}\pm0.21$	$49.40^{c}\pm0.28$
6.	*Launaea taraxacifolia*	$8.50^{abcd}\pm0.42$	$14.50^{g}\pm0.14$	$2.20^{a}\pm0.14$	$9.45^{c}\pm0.07$	$15.10^{cd}\pm0.14$	$50.20^{b}\pm0.21$
7.	*Phyllanthus niruri*	$8.30^{cd}\pm0.00$	$18.30^{a}\pm0.14$	$2.05^{abc}\pm0.07$	$8.85^{d}\pm0.07$	$14.95^{cd}\pm0.07$	$47.50^{e}\pm0.42$
8.	*Synsepalum dulcificum*	$8.75^{ab}\pm0.07$	$17.20^{c}\pm0.14$	$1.60^{de}\pm0.28$	$10.30^{a}\pm0.14$	$15.20^{c}\pm0.14$	$46.95^{e}\pm0.21$
9.	*Uraria picta*	$8.70^{abc}\pm0.14$	$17.75^{b}\pm0.07$	$1.50^{e}\pm0.14$	$9.90^{b}\pm0.14$	$16.25^{b}\pm0.21$	$45.75^{f}\pm0.49$
10.	*Xylopia aethiopica*	$8.40^{bcd}\pm0.14$	$15.35^{f}\pm0.07$	$1.80^{cde}\pm0.14$	$8.75^{d}\pm0.07$	$17.80^{a}\pm0.28$	$46.90^{e}\pm0.14$

Legend: Mean of two readings ± standard deviation; Values of means in the same column having same letter are not significantly different ($P < 0.05$); Mean values with different letters and in the same column differ significantly ($P < 0.05$).

Discussion

Some of the traditional recipes are enriched with palm oil, catfish, African pepper (*Piper guineense*) and salt (Table 1). The well nourishing nutrients enriched recipes could help in alleviating malnutrition peculiar to pregnant women in developing country such as Nigeria, as well as preventing pregnancy induced hypertension [1]. As an example, virgin palm oil provides carotenes apart from tocotrienols and tocopherols that have been shown to be powerful antioxidants and potential mediators of cellular functions [12]. Oil palm fruits are significant source of lipids, carotenoids and vitamin A, which have a physiological role in cellular differentiation and could provide oligonutrients essential to fetal development [4]. Although catfish is high in cholesterol, it is low in sodium, high in phosphorus and selenium, very high in vitamins B_1 and B_{12}. Sodium (from salt) maintains the body's fluid and electrolyte balance, acid-base balance, muscle contractions, and nerve transmission. Phosphorous is a critical component of every cell. It works with the B vitamins to generate energy and is necessary for growth of bones and teeth; which are 85% phosphorous. It works with sodium and potassium to maintain acid-base balance, and assist in muscle contraction, kidney function, heartbeat regulation, and in nerve conduction [13]. Selenium as an antioxidant protects cells from damage from substances called free radicals. It also helps regulate the thyroid function and is necessary for proper immune system function. Vitamin B_1 helps to produce energy from carbohydrate on a cellular level, and is very important for nerve conduction and muscle function. Vitamin B_{12} is involved in many body functions, including metabolic reactions, making red blood cells, and maintaining health nerve tissue [13]. *Piper guineense* contains micro- and macro-nutrients, as well as vitamins A, C and E which are antioxidants [14]. One of the phytomedicinal therapies involves the wearing of ring cooked in *E. indica* based soup (Table 1). This could serve as a psychological therapy to reassure the expectant mother of her safety, good health and normal delivery as long as the ring is worn. Also of importance is the acclaimed efficacy of traditional recipe prepared with *C. volubile* to correct breech presentation. This therapy could be a good alternative to surgical operation (cesarean).

Although the botanicals are therapeutically used for specific reasons, they could help in the prevention and treatment of pregnancy associated diseases: anaemia, malaria, constipation, hypertension and sexually transmitted infections. This is based on their phytochemical constituents and reported pharmacological studies. *E. indica*, *L. taraxacifolia* and *D. scandens* could help in the prevention of anaemia due to their high iron content (Table 3), Iron in form of haemoglobin carries oxygen from the lungs to the body's tissues; and plays a role in enzymatic reactions. Iron deficiency is the most widespread health problem in the world, impairing normal mental development in 40-60% of infants in the developing world, debilitating the health and energies of 500 million women, and leading to more than 115,000 deaths during childbirth a year [15]. *C. zambesicus, E. indica* and *L. taraxacifolia* could be useful in the management and treatment of malaria during pregnancy. Okokon *et al.* reported that the ethanol leaf extract of *C. zambesicus* (50-200 mg/kg) demonstrated antiplasmodial activity against *Plasmodium berghei* infection in mice. Hence could be useful in treating malaria [16]. The ethanolic leaf extract of *E. indica* (320-960mg/kg) demonstrated significant ($P<0.01$ - 0.001) antiplasmodial and antidiabetic activities in rats [17]. *L. taraxacifolia* is used traditionally for the treatment of malaria [18]. *C. zambesicus* and *P. niruri* might be useful in the treatment of pregnancy related constipation [18]. *X. aethiopica* and *P. niruri* could be useful in the management and treatment of sexually transmitted infections [19, 20]. *C. zambesicus* and *H. enneaspermus* may have therapeutic effect in the management of pregnancy induced hypertension. Roberta *et al.* reported the anticoagulant effect of leaf extracts of *C. zambesicus*, this activity,

associated with the vasorelaxant properties of some of its diterpenes might be useful for the prevention of cardiovascular diseases [21]. *H. enneaspermus* had cardioprotective effect on isoproterenol induced rats [22].

The mineral and nutritional constituents of the ten botanicals (Tables 3 and 4) are likely to supply the increased energy and nutrient requirements in pregnancy. *C. volubile*, *L. taraxacifolia*, *C. zambesicus* and *H. enneaspermus* are high in carbohydrate and carbohydrates are macronutrients that provide the body with the energy it needs to function. A carbohydrate deficiency can result in reduced energy levels, leaving the body unable to heal itself or function well. Prolonged carbohydrate deficiency can result to loss of muscle and weakness of the immune system [23]. *P. niruri* is rich in protein, in addition to its hepato-protective property [24]. Protein deficiency and malnutrition can occur at any age due to illness or poor diet and may have devastating consequences on health. Protein-deficiency malnutrition could lead to muscle wasting, poor wound healing, frequent infection, swelling, hair breakage and loss of sexual interest. Among women of childbearing age, protein deficiency may lead to irregular menstrual cycles or temporary loss of fertility. The risk of pregnancy-related complications increases if the mother is malnourished; as the baby is at high risk of not developing normally [25]. *X. aethiopica*, *Eleusine indica* and *Uraria picta* are rich in fibre and might help in the solving the problem of constipation associated with pregnancy. While no disease is caused solely by a lack of fibre in the diet, it plays a role in the development of several medical conditions. Constipation, hemorrhoids and high cholesterol levels are some of the complications of not eating enough fibre [26].

Of all the ten plants used in this study, *E. indica* relatively had the best components of mineral nutrients, especially calcium, iron and zinc (Table 3). Calcium is essential for the health of bones and teeth, and a normal heart rhythm. This mineral is also required for muscle contractions and relaxation, nerve and hormone function, and blood pressure regulation [27]. Zinc stabilizes the structure of proteins and cell membranes, and regulates gene expression and DNA function. Consequently, a deficiency in zinc can contribute to a number of health problems as it is required for healthy immune function [28].

Conclusions

The ten botanicals contained nutrients and phytochemicals that are beneficial to the pregnant woman and the feotus. The nutrients could support the increased energy and nutritional requirements in pregnancy. Also, the nutrients might be useful in alleviating malnutrition problem commonly associated with pregnancy in developing countries such as Nigeria. Furthermore, the phytonutrients could supplement the active compounds of the plants in therapeutic activities. However, pharmacological and toxicological studies on the plants will provide more information on their therapeutic value and safety. There is need for the integration of phytomedicines into antenatal care in developing countries because the inadequate distribution of health care centres, poverty and low literacy status of women encourage the continuous use of herbs in pregnancy.

Author's contributions

Gbadamosi, IT conceived and designed the experiment. She was involved in the screening of the plant samples in the Laboratory and she drafted the manuscript and revised it critically for important intellectual content. Otobo ER contributed to the screening of the plant samples in the Laboratory and was also involved in the analysis of data. The two authors gave final approval of the version to be published.

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