

Teratogenic Effects of Some Nigerian Medicinal Plants: A Review

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Abstract

Currently, there is an increase in the use of herbal medicines among pregnant women globally. This is due to the fact that most pregnant women assume that medicinal plants are natural and safer than conventional drugs. Some medicinal plants patronized by the Nigerian populace have been scientifically explored and found to exhibit teratogenic effects. This review provided an update on the teratogenic effects of some medicinal plants used in Nigeria. Empirical data on Nigerian medicinal plants with teratogenic and abortion-inducing effects were assessed using Pubmed, google scholars and google data bases. Outcome of various studies were summarized. Various teratogenic effects were observed in the following plants: *Aspilia africana* (distortion of the frontal cortex layer), *Garcinia kola* (blockage of ovulation, limb malformation), *Citrus aurantifolia* (reduction in the number of fetuses), *Rauwolfia vomitoria* (bone malformation), *Vernonia amygdalina* (neurological disorders), *Carica papaya* (reduction in fetal weight, crown-rump, tail, head and number of viable fetuses), *Bambusa vulgaris* (decrease in survival rate) and *Dryopteris filix-mas* (poor mineralization in femur). Plant constituents such as Phytoestrogens, flavonoids, saponins, tannins, papain, and cyanogenic glycosides, alkaloids and anthraquinones were postulated to be responsible for most observed teratogenic effects. From these findings, caution should be exercised by pregnant women patronizing herbal remedies. They should also adhere strictly to doctor's advice on the safe and effective herbal medicine to be used.

Keywords: Safety; Medicinal Plants; Teratogens; Nigeria; Pregnancy

Introduction

From genesis, active ingredients from plants have served as sources of drugs for diagnosis, prevention, treatment and management of various ailments [1,2]. Reports from various parts of the world, including United States, United Kingdom, Europe and Africa revealed that roughly 80% of the populace patronized herbal remedies more than other forms of alternative medicines. This high patronage is due to their accessibility, availability, affordability and acceptability [2].

Categories of patients, including the aged, young and gestational mothers use herbs for various purposes, with mindsets that they are without side effects because they are natural [3-5]. It is well documented that various cultures employ medicinal plants before, during

and after pregnancies [6]. Also, it has been proven that pregnant women from high, medium and Low-income countries give more preference to herbal natural products than pharmaceutical drugs [7]. Evidences from health care providers have revealed that several herbal products pose danger to patients [8]. Also, misidentification of botanicals, inappropriate preparation and dosage misapplication could pose adverse effects to developing fetus [9].

Globally, there is high patronage of herbal products among pregnant women. Just as several conventional drugs are contraindicated during pregnancy, medicinal plants are not exempted [10], because pregnancy is considered as a period of contraindication to herbal medicines [11]. Einarson, *et al.* [12] revealed that physicians rarely prescribe herbal remedies for pregnant and breastfeeding mothers [13]. Medicinal plants posed significant roles as teratogen [14]. Relevant authorities have also cautioned against the use of herbal medicine during pregnancy, yet women with pregnancy also attempt to use medicinal plants [15].

Currently, there is an increase in the use of herbal medicine by pregnant women as an alternative to conventional drugs in Nigeria [14]. In the bid to validate the safety of medicinal plants during pregnancy, quite a lot of animal studies have shown that some herbal products could be teratogenic. Scientific reviews on teratogenic effects of medicinal plants in Brazil [16], Iran [9] and other countries have been evaluated, but there is presently no review update on teratogenic potentials of Nigerian medicinal plants, prompting this present study. This evaluation would be of relevance in policy formation concerning herbal products to be used during pregnancy in Nigeria. It would also provide empirical evidences and the basis for future investigations of other medicinal plants. Also, maternal and infant mortality resulting from misuse of herbs would be minimized.

Methods

A literature search was carried out using electronic databases including Pubmed, google scholars and google Search terms used include Teratogenic medicinal plants, Herbs uses in pregnancy in Nigeria, Nigerian medicinal plants with teratogenic effects. Additional details that could not be assessed through electronic data bases were sourced manually through the reference lists of downloaded articles. The review was organized into sections including a brief description of teratogens, utilization of herbal medicine during pregnancy, some models of screening medicinal plants with teratogenic potentials, as well as a summary of past studies on teratogenic medicinal plants. Key findings from various articles were summarized and tabulated. The exploration was limited to English full-length research and review articles published in peer reviewed journals.

Teratogens

These are agents that act on the developing embryo or fetus to produce congenital disorders after birth [17]. According to the world health organization, birth defects or congenital malformations are functional or structural disorders occurring during intrauterine life [18]. Such agents include chemicals and drugs, nutrient deficiency, maternal diseases, physical, biological agents and phytochemicals [19]. It has been reported that 65 to 75% cases of congenital malformation is from unknown causes, 15 to 25% are due to inherited genetic disorders while 10% is due to exposure of mothers to infections, mechanical injury, radiation, chemicals and drugs [20].

Apart from some known causes of genetic or non-genetic origins and intertwine with each other - gene-gene, gene-environment and gene- nutrient interactions, the etiology of birth defects is largely unknown [21]. Teratogenic agents usually posed dangers during the period of fertilization and post-implantation (embryogenesis), because the embryos are more susceptible to death arising from xenobiotic insults at this stage. In human, organogenesis occurs between day 18th and day 40th after conception, the period when most anatomical deformities occur [22].

Globally, it is estimated that 9 million infants are born yearly with severe birth defects, of which about 94% occur in developing countries [21]. From the estimated statistics of 7.9 million yearly global birth anomalies, over 1 million infants are born with serious birth

defects of post-conception origin which teratogens contributes to [21]. A study conducted at the University of Port Harcourt Teaching Hospital, South Southern Nigeria revealed the prevalence of birth defect to be 20.73 cases per 1,000 live births in [21].

Three stages are associated with the development and susceptibility to teratogens. The pre-implantation stage occurs from fertilization to implantation, where embryos are not susceptible to teratogens. This occurs between days 1 to 6 in rodents. The embryogenesis stage is the actual stage of organogenesis which takes place where the embryo produces major morphological changes (especially facial development). At this stage, the embryo is highly susceptible to teratogens. The fetogenesis stage, also known as histogenesis is the period where growth and functional maturation occur. Here, morphological changes are minimal, except structural changes. At this period, teratogens affect growth and functional aspect, such as intelligence and reproduction [20].

Herbal medicine utilization in pregnancy

In the course of pregnancy, hormonal alteration triggers some signs and symptoms, including nausea, vomiting, headaches, lower abdominal cramps, which results to discomfort [23]. Under normal circumstances, drugs are not required to treat such symptoms, because they are physiological changes [14].

However, reports have shown that some pregnant women still rely on herbal preparations for the control of pregnancy associated signs and symptoms due to doctors' refusal to prescribe conventional drugs. This is spurred by the misconception that herbal medicines are natural, without harmful effects [24]. Herbal medicines are utilized during pregnancy for induction and facilitation of labor, induction of abortion, treatment of low back ache, cold, respiratory illness, skin disorder, and protection of the unborn child against evil [25]. A local concoction popularly known as "Agbo" is used by some pregnant women more than single herbal therapy. Some select their choice of herbal remedies from the wild. As reported by users, diarrhea, rashes, dizziness, headache, and malaise are the major side effects accompanying the use herbal remedies during pregnancy. Most of these side effects are pregnancy related [14].

According to a survey carried out by Fakeya and co-workers, pregnant women procure herbal products from herbal venders in the market (119, 9.8%), wild (100, 16.7%), herbalists (56, 9.3%), road side venders (31, 5.2%), herb shops (27, 4.5%) and the Pharmacies (5, 0.83%). Apart from the use of potable water as the most preferred vehicle, some women use non-alcoholic carbonated drinks, while a minority of them use alcoholic beverages and lime fruit juice [26].

Surveys on the use of herbal remedies by pregnant women in Nigeria

A study of the pattern of herbal and spiritual remedies utilization during pregnancy among mothers of children under five years in Kano, North-Western Nigeria revealed that three-quarters (76.2%) of the mothers used herbal remedies [25].

According to Lisha and Nisha [27], utilization of herbal medicines by pregnant women occurs between 22.3% and 82.3% in the middle East of Nigeria. Similarly, a study that was carried out at the Aminu Kano Teaching Hospital revealed that 31.4% of pregnant women use herbal medicines [28]. Moreover, a socio-demographic study conducted in South-East Nigeria with Imo State University Teaching Hospital revealed that 36.8% of pregnant women used herbal medicines [29]. A study by Fakeye and co-workers [26] on the opinion of 595 pregnant women in three geopolitical zones in Nigeria toward the use of herbal medicines revealed that about 67.5% (greater than two third of respondents) used herbal remedies in various formulations. Also, a survey of 1200 pregnant women in Benin City, Nigeria revealed that 12% used local medicinal plants for various purposes [30]. Preference for using herbal medicines to conventional drugs include more efficacy than conventional medicine, cultural acceptability, easy accessibility, non-toxicity (natural state) and affordability when compared to the high cost of conventional medicines [26].

In 2013, Olowokere and Olajide carried out a descriptive cross-sectional to explore the perception of women in seven rural communities in Ife North Local Government Area of Osun State in Southwestern Nigeria on the safety and utilization of herbal remedies during

pregnancy. The study revealed that more than 60% (188) of participants had a positive perception of the use of herbal remedies during pregnancy. Most of them (72.7%, 218) derived satisfaction from using herbal remedies [14]. Surprisingly, the use of self-prepared or purchased formulated concoction (Agbo) was still reported [14,26,31]. Table 1 highlighted the list of some herbal plants used by pregnant women in Nigeria.

Plant family/common name	Preparation	Indication	Reference
<i>Ocimum gratissimum</i> (Lamiaceae), scent leaf	The leaf is squeezed with salt and sieve to extract the water for drinking.	Abdominal pain, appetite stimulant, fever, cold and catarrh.	[14]
<i>Telfairia occidentalis</i> (Cucurbitaceae), ugwu vegetable	The leave is squeezed in water and mixed with milk.	Nutritional supplements during pregnancy.	[14]
<i>Vernonia amygdalina</i> Bitter leaf water	The leave is squeezed in water and extracted for drinking or for soup preparation.	Antiemetic, fever, relief constipation, loss of appetite.	[14]
<i>Zingiber officinale</i> (Zingiberaceae), ginger	It is either eaten raw or ground and mixed with a local palm wine or soup.	Antiemetic.	[14]
<i>Cannabis sativa</i> (Cannabaceae), marijuana, Igbo.	It is prepared using local palm wine.	Analgesic.	[14]
<i>Bambusa vulgaris</i> (Poaceae) leaf	-	Abortifacient	[58]
<i>Canna indica</i> L (Cannaceae) fruit	-	Abortifacient	[58]
<i>Aerva lanata</i> (Amaranthaceae) leaf	-	Abortifacient	[58]

Table 1: List of some herbal plants used by pregnant women in Nigeria for various purposes. Adapted from [14,58].

Surveys of herbal use during pregnancy in other countries

A recent prospective cohort study on the prevalence and characteristics of alternative medicine, ginger and licorice use among Danish pregnant women attending national prenatal screening program at gestational weeks 10 - 16 revealed that 22.7% of them used herbal form of alternative medicines, with 14.7% reporting daily consumption [32].

An evaluation by Zamawa, *et al.* [33] revealed that 80%, 55%, 50%, 40%, 35% and of pregnant women in Italy, United kingdom, Zimbabwe, Palistine and Taiwan respectively have utilized herbal medicine between 2009 and 2015. They also found in their study that use of Mwanamphepo (*Cissus/vitaceae* plant species) among pregnant women in Malawi was associated with adverse pregnancy outcomes.

A study in Tamale, a city in Northern Ghana revealed a patronage of 43.5 and 52.7% before and during pregnancy respectively [24].

According to Mabina, *et al.* [34] 55% of 229 South African pregnant women patronized herbal medicine [15]. Following a Canadian study, pregnant women believe that medicinal plants are safer than pharmaceuticals due to their natural and less side effects states [35].

In other countries, Australia, United States and Finland, studies revealed that more than 10% of pregnant women employ herbal medicines as remedies during pregnancy [36-38].

Evaluation on the use of traditional medicine amongst pregnant women in a rural Rwandan population revealed a high prevalence of 50 - 80% [1].

Procedures of screening medicinal plants with teratogenic potentials

A teratogenic test evaluates the potential of a test substance to cause birth defects between the period of conception and birth [39].

Due to ethical reasons and inability to conduct teratogenic tests in humans, animal model serves as a substitute [17]. Usually, animals (usually mice, rats, rabbits and guinea pigs) are randomized into control (a vehicle group) and test groups (comprising at least three doses of the extract) and are dosed during the period of organogenesis, the actual embryonic stage where the organ systems differentiate predominantly [40,41]. Most studies employ mice (*Mus musculus*) and rats (*Ratus ratus* or *Ratus norvegicus*) because they have short gestation periods of 20 - 21 days and their organogenesis occur between 6 and 15th days of conception [42,43]. In this protocol, adult sexually active male animals is mated overnight with adult female animals that are in oestrus. The following morning, pregnancy is confirmed by the presence of mating plug on the vaginal orifice of female specie. Confirmed pregnant female animals are separated from the males and are dosed with the test substance between day 6th and the day, 15th of pregnancy (period of organogenesis) or throughout the period of pregnancy using a selected route, oral or intraperitoneal. During this period, the behaviors of pregnant animals are monitored. In the last day of gestation, usually 20 - 21 days, caesarean operation is carried out on pregnant animals. Alternatively, animals are allowed to give birth. Live and dead pups are weighed and are observed for morphological alterations. Resorption is also observed in animals that are subjected to caesarean operations. Organs of pulps are harvested for histopathological analyses. Alternatively, animals could be sacrificed at various stages to monitor the level of effects produced [7,39,43]. According to most studies, majority of pregnant women use herbal remedies orally in their first trimester or throughout the period of pregnancy [14]. These will determine the route and duration of administration of plant extracts with teratogenic potentials.

Results

Some medicinal plants have been screened for teratogenic potentials, as depicted in table 2 below.

Plant family/common name	Experimental studies	Teratogenic effect	Reference
<i>Aspilia Africana</i> (Asteraceae)	Aqueous leaf extract: 750, 1000,1500 mg/kg in Wistar rats	Distortion of the frontal cortex layer.	[44]
<i>Salacia lehmbachii</i> (Celastraceae)	Aqueous and ethanol root bark extract: 250, 500 and 750 mg/kg (p.o) in albino rats	No teratogenic effect.	[45]
<i>Garcinia kola</i> (Guttiferae)	Alcohol seed extract: 200 mg/kg in Sprague-Dawley rats at.	Partial blockage of ovulation, significant reduction in fetal weight and malformed left upper limb.	[46]
<i>Euphorbia helioscopia</i> (Euphorbiaceae)	Latex and leaves extract: 100, 300, 500, 700, 1000, 1500 and 2000 mg/kg in mice.	No teratogenic effect.	[47]

<i>Portulaca oleracea</i> (<i>Portulacaceae</i>)	Leaf and stem methanol and aqueous extracts 75 mg/kg in albino rats.	No teratogenic effect.	[42]
Lime (<i>Citrus aurantifolia</i>), Rutaceae juice	1 ml of undiluted lime per rats.	Reduction in the number of fetuses, crown -rump length and weight and umbilical cord length of the fetus.	[48]
<i>Mentha piperita</i> (<i>Lamiaceae</i>)	Hydroalcoholic extract: 600 and 1200 mg/kg in mice.	No teratogenic effects	[50]
<i>Rauwolfia vomitoria</i> (<i>Apocynaceae</i>)	Ethanol root, bark and leaf extracts: 150 and 250 mg/kg	Numerous osteoblast and osteoclast, hypertrophy, and hyperplasia of bone cells of fetus.	[49]
	Ethanol root bark and leaf extract: 150 mg/kg and 250 mg/kg.	Fetal resorption.	[52]
<i>Vernonia amygdalina</i> (<i>Asteraceae</i>)	Aqueous leaf extract: 400 mg/kg in Wistar rats.	Mental and growth retardation, reduced fetal weight as well as brain weight.	[53]
<i>Carica papaya</i> (<i>Caricaceae</i>)	Aqueous leaf extract: 60 and 120 mg/kg in Wistar rats.	Reduction in fetal weight, crown-rump, tail, head and number of viable fetuses	[54]
<i>Bambusa vulgaris</i> (<i>Poaceae</i>)	Aqueous leaf extract: 250 and 500 mg/kg (p.o) in Dutch rabbits	Reduction in fetus survival rate, abortifacient effect, resorption index and postimplantation loss.	[55]
<i>Dryopteris filix-mas</i> (<i>Dryopteridaceae</i>)	250, 500, 1000 mg/kg of the ethanol leaf extract	High dose caused poor mineralization in the metaphysics of pups femur.	[43]

Table 2: List of some Nigerian herbal plants screened for teratogenic effect.

Aspilia africana (*Asteraceae*), a Nigerian medicinal plants used to ease delivery and lactation as well as other diseases was investigated for teratogenic potential in Wistar rats. Administration of 750, 1000 and 1500 mg/kg doses of the aqueous leaf extract between days 7 and 11 of gestations produced wide-ranging distortion of the frontal cortex layer characterized by numerous vacuations and cellular degenerations in the high dose group as well as distortion of cortical, intermediate and subventricular layers in the medium dose group. Virtually, blood vessels were absent in all the treated groups. The authors suggested the presence of alkaloids in *Aspilia africana* to be responsible for occasional distortion and disarrangement of cells in the developing frontal cortex of the fetuses [44].

An evaluation of the embryonic and the teratogenic profile of *Salacia lehmbachii* (*Celastraceae*), a popular medicinal plant used by Southern Nigerian populace, including pregnant women in the treatment of malaria was carried out. Administration of aqueous and ethanol root bark extract of *Salacia lehmbachii* to albino rats at 250, 500 and 750 mg/kg (p.o) between days 1 to 6 as well as days 7 to 15 of gestation did not produce signs of maternal toxicity, miscarriages and dead of a fetus when compared to control group. The authors remarked that the doses evaluated were not teratogenic to developing fetuses [45].

A study by Akpantah., *et al.* [46] on *Garcinia kola* (*Guttiferae*) alcohol seed extract on estrous cycle, ovulation and fetal development in adult female Sprague-Dawley rats at 2000 mg/kg revealed alterations in the estrous cycle, partially blockage of ovulation, significant

reduction in fetal weight and malformed left upper limb in 7% of the fetuses. They posited that *G. kola* seed may block ovulation by inhibiting cyclooxygenase activity (perhaps COX-2) and prostaglandin synthesis.

Study on the latex and leaves extracts of *Euphorbia helioscopia* (Euphorbiaceae) at 100, 300, 500, 700, 1000, 1500 and 2000 mg/kg body weight revealed no teratogenic effect on mice [47].

In another study, administration of 75 mg/kg dose of aqueous and methanol leaf and stem extracts *Portulaca oleracea* (Portulacaceae), used as an aid in fetal development and prevention of miscarriage in some areas in Benin City, Nigeria did not cause gross morphological changes as well as significant changes in litter size and weights of female albino rats when compared to control group in various days (1 - 5, 6 - 15 and 16 - 20) of gestation. On the other hand, the extracts produced an anti - infertility effect in male rats [42].

Abortifacient and teratogenic effects of lime (*Citrus aurantifolia*), Rutaceae juice that is commonly used as a douche by women for the prevention of pregnancy and sexually transmitted diseases was evaluated using Sprague-Dawley (SD) rats. Administration of 1 ml of undiluted lime prior to the 20th day of gestation resulted in a decrease in the number of fetuses, crown-rump length, weight and umbilical cord length of the fetus when compared with the control group. They recommended that the use of lime should be discouraged during pregnancy [48].

Administration of high dose of ethanol bark and root extracts of *Rauwolfia vomitoria* (Apocynaceae), 150 and 250 mg/kg to pregnant rat revealed numerous osteoblast and osteoclast, hypertrophy, and hyperplasia of bone cells of the fetus when compared with the control group [49]. Another study on the embryotoxicity of hydroalcoholic extract of *Mentha piperita* (Lamiaceae) at 600 and 1200 mg/kg doses during organogenesis in Balb/c mice produced teratogenic effects to the fetuses [50].

A study conducted by Eluwa and co-workers on the comparative teratogenic potentials of crude ethanol root bark and leaf extracts of *Rauwolfia vomitoria* (apocynaceae) (250 and 500 mg/kg) in Wistar rats revealed no gross malformation. However, histological study of the fetal heart showed obvious distortion of the cardiac muscle nuclei and myocardial fibers in the treated groups, particularly those whose mothers were exposed to 250 mg/kg extracts [51]. In a related study, ethanolic root bark and leaf extracts of *Rauwolfia vomitoria* oral doses at 150 and 250 mg/kg body weights administered between days 7 - 11 of gestation revealed no gross morphological malformations, but fetal resorption was found in the groups where the mothers received ethanol root bark extracts. They suggested that intrauterine growth retardation is common with ethanol root bark extract of when compared to the leaf extract [52].

Following the oral exposure of aqueous leaf extract of *Vernonia amygdalina* (Asteraceae) at 400 mg/kg to pregnant Wistar rats between days 8 - 14 and 1 - 21 of gestation produced mental and growth retardation, as fetal weight as well as brain weight reduced when compared to control group. The authors recommended that *Vernonia amygdalina* leaf could affect growth rate and brain development during the second week of pregnancy [53].

Oral Administration of aqueous leaf extract of *Carica papaya*, Caricaceae (that is commonly used as an enema by pregnant women) for seven days (days 12 - 18 of pregnancy) produced a reduction in fetal weight, crown-rump, tail and head and number of viable fetuses of Wistar rats in the group treated with 60 mg/kg, while the group treated with 120 mg/kg produced a resorption of all the fetuses. The authors recommended that the use of *the Carica papaya leaf* should be discourages during the period of gestation [54].

In order to validate the folkloric claim of *Bambusa vulgaris* (Poaceae) leaves, that is used as an abortifacient in Nigeria, Yakubu and Bukoye [55] administered 250 and 500 mg/kg (p.o) of its aqueous extract to Pregnant Dutch rabbits thrice daily between days 18 and 20th of the gestation period and found a reduction in the fetus survival rate by 29 and 0% respectively as well as abortifacient effects of 60 and 100% respectively. Resorption index and post-implantation loss was increased by both doses while serum progesterone, follicle-stimulating and luteinizing hormones were reduced. The extract also triggered vaginal opening.

In another study administration of 250, 500, 1000 mg/kg of the ethanol leaf extract of *Dryopteris filix-mas* (Dryopteridaceae), a popularly used among Southerners in Nigeria for wounds, rheumatoid arthritis, and worm infestations revealed no significant alterations in morphological and histo-architecture of the lungs, femurs, liver, heart and kidneys, except poor mineralization in metaphysis of pups femur at high dose (1000 mg/kg) when compared to control group [43].

Discussion

The present study evaluated the teratogenic effects posed by medicinal plants in Nigeria. Out of thirteen plants screened, only four were reported to be safe, while the other nine caused some teratogenic effects such as resorption, bone deformity, neurological disorders, morphological changes. Some locally used medicinal plants among pregnant women are yet to be screened for teratogenic effects.

Improper consumption of medicinal plants for various purposes during pregnancy could impair fetal development during various stages of pregnancy [45]. This is due to the constituents embedded in medicinal plants. It is well known that the fetus is more susceptible to toxic agents during the first trimester or the first few weeks of pregnancy, where most organs are developing. At this stage, bone malformation can occur in the fetus due to estrogen and flavonoid compounds present in some medicinal plants. For instance, the presence of phytoestrogens in soybean has made it to be restricted during pregnancy because they could reduce the uterine ability to sustain implanting in blastocyte-stage [23].

Flavonoids which could act as agonists and antagonists on human estrogen receptors was postulated to be responsible for poor fetal bone development or bone retardation caused by *Dryopteris filix mas* [43]. Yakubu and Bukoye [55] also attributed the abortifacient effects of *Bambusa vulgaris* to its phytoconstituents, alkaloids, tannins, phenolics, glycosides, saponins, flavonoids and anthraquinones.

In their study, Ekong and co-workers attributed the abortifacient and teratogenic effects of *C. papaya* to its constituents, tannins, papain and cyanogenic glycosides [54]. Papain from *C. papaya* has been found to cause an anti-implantation effect, increased post-implantation loss and embryotoxicity following oral administration to Wistar rats [56].

Balogun., *et al.* [53] opined that the mechanism in which *Vernonia amygdalina* exert its teratogenic effect is uncertain, however, phytochemical analysis of bitter leaf revealed the presence of flavonoids and alkaloids which could also play significant role in fetal malformation [57].

Conclusion

The present review revealed the widespread utilization of medicinal plants among pregnant women in Nigeria even in other developed parts of the world. Among the medicinal plants evaluated, *Aspilia Africana*, *Garcinia kola*, *Citrus aurantifolia*, *Rauwolfia vomitoria*, *Vernonia amygdalina*, *Carica papaya*, *Bambusa vulgaris*, *Dryopteris filix-mas* revealed various teratogenic effects in animal models. The activities reported were due to their phytoconstituents, especially flavonoids.

The assumption that medicinal plants are without adverse effects should be jettisoned. Caution should be taken in using medicinal plants during the period of pregnancy. Physicians, nurses and other healthcare practitioners should take into consideration of the risk involve in using herbs during pregnancy and should also educate their patients on the dangers associated with the use of such remedies. Also, pregnant women should be educated through community education programs on the harmful effects of herbal remedies to the fetus and they should also ensure they seek physicians' advice before the use of medicinal plants. The safety of other common herbal remedies being patronized or used by pregnant women should be ascertained, as such confirmations would aid in educating the populace on safe herbal remedies to patronize.

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