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RESEARCH ARTICLE

Traditional use of *Lablab purpureus* (L.) Sweet as an abortifacient and antifertility among Karbi tribe of Assam, North East India

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Abstract

Lablab purpureus (L.) Sweet, a multipurpose leguminous plant is traditionally used as an antifertility and abortifacient agent among the Karbi, an indigenous tribe living in Assam, North East India. The present study emphasizes the scientific validation of the indigenous utilization of this plant extract as an antifertility and abortifacient along with their physicochemical, phytochemical, and in silico ADME features. Fresh roots (450 gm) are processed for physicochemical, preliminary phytochemical screening, and GC-MS analysis. Organoleptic studies, moisture content, swelling index, flow properties (Carr's index and Hausner ratio), extractive values (highest in aqueous extract), and ash content revealed the plants are potential sources of phytomedicines having the minimum required parameters as per WHO standards. The value of Carr's index (22%) and Hausner's ratio (1.27) indicates that the powder drugs have greater inter-particle interactions, which signifies poor flowing powder. Phytochemical screening of root extracts showed the presence of flavonoids, tannins, phenolic compounds, alkaloids, coumarins, and terpenoids. GC-MS analysis revealed the presence of Arsenous acid tris(trimethylsilyl; Cyclic siloxane compounds; Pivalic Acid, 2-Methylpropyl Ester; Propanoic Acid, 2,2-Dimethyl-, Ethyl Ester and N-(Trifluoroacetyl)-N, O, O', O''-Tetrakis (Trimethylsilyl) Norepinephrine, having potential reproductive and developmental toxicity and also stimulates progesterone production. According to SwissADME, drug-like properties of Arsenous Acid, Tri (Trimethylsilyl) Ester, Heptasiloxane, and Pivalic Acid, etc., identified in the root extract have the potential for use as an orally active antifertility and abortifacient medicine. Since *L. purpureus* (L.) Sweet *purpureus* been used traditionally by the Karbi tribe for ages and contains bioactive compounds showing antifertility and abortifacient activities, it may be considered an important ethnomedicine which may aids in further drugs discovery process.

Keywords

abortifacient; antifertility; ADME; arsenous acid; bioactive compound; *Lablab purpureus*; medicinal plants

Introduction

Medicinal plants are used as home remedies, over-the-counter drug products, and as raw materials for the pharmaceutical industry in many developed and developing countries, representing a substantial proportion

of the global drug market (1). Plant or plant products are an important source for managing poor health and have been investigated for novel drugs for the development of new therapeutic agents (2). Many medicinal plants are used in traditional remedies and evaluations of phytocompounds are the most important in medicinal plant research (2, 3), *Lablab purpureus* (L.) Sweet, commonly known as a Dolichos bean, is a multipurpose leguminous plant holding a unique position as a vegetable among legumes because of its high level of nutritional value. The Karbi, an indigenous tribe of Assam, is well known for its therapeutic utilization of various plants (4, 5) found in their vicinity. In Karbi, *L. purpureus* is locally known as *thepak* and its root extracts have been traditionally used as an antifertility and abortifacient for unintended pregnancies. The scientific evaluation of the traditional use, its efficacy and the physicochemical properties present in the root extract is very important for traditional drug formulations and assessing the quality for human consumption. The present study signifies the potential use of *Lablab purpureus* (L.) Sweet especially as antifertility and abortifacient for the presence of its bioactive compounds.

Materials and Methods

Collections and identification of the plant

The roots and inflorescence of *Lablab purpureus* (L.) Sweet, for the experiments, were freshly collected from Karbi Anglong district of Assam state, India (25^0 55' 29.658'' N and 93^0 30'31.9968'' E) from homestead gardens of a village falling under the study area. It is a cultivated plant and widely distributed in the study area. The plant was collected carefully in the presence of the participating informants and village head without disturbing its natural habitat. The plant was identified following the standard works of literature (6–11) and the herbarium specimen was deposited at the GUBH, Department of Botany, Gauhati University, Guwahati, and authenticated (vide accession number No. Herb/GUBH/2024/10, dated 11-2-2024).

Drying and Processing:

The freshly collected roots were washed thoroughly (10 times) with distilled water and dried by shade drying method in Institutional Biotech Hub, Department of Botany, Nowgong College (Autonomous), Nagaon, Assam, for one week at room temperature and with occasional indirect sunlight also. After drying, these are then ground into a fine powder and are used for the determination of macroscopic and physicochemical properties and also for preparation of various solvent extracts.

Determination of Total Physicochemical Parameter:

Morphological studies, i.e. macroscopic parameters and organoleptic studies like shape, size, color, odor, and taste along with physicochemical analysis were carried out using simple determination techniques, following WHO standard procedure (1, 12). The sample powder was carried out for the determination of pH, swelling index, flow properties (Hausner ratio, Carr's index), total moisture content, total ash, water-soluble ash, soluble extractive values in water and solvents like ethanol and methanol (1, 12). Each study was performed in triplicate and mean values with standard deviation (SD) were calculated.

Preparation of the methanol extract:

All the chemicals used for the present study were of analytical grades. 10 g of sample powder was weighed and packed in a Soxhlet apparatus and continuous extraction was done using Methanol (150 ml) for 16 hours after adjusting the temperature, and boiling point of solvent i.e., 64.6°C. The extract obtained was concentrated at 50°C and stored in a desiccator.

Preliminary phytochemical screening

Preliminary phytochemical screening (Flavonoids, Tannins, Phenolic compounds, Saponins, Terpenoids, Phlobatannins, Steroids, and Coumarins) was done to analyze the bioactive compounds present in the plant sample following standard procedure with a little modification (13–15). The qualitative results are expressed as + for the presence and as – for the absence of a bioactive compound in the extract.

Gas Chromatography-Mass Spectroscopy (GCMS) and Identification of compound:

GC- MS of the herbal extract was recorded in Perkin Elmer GC model Clarus 680 with softwareTurbo Mass ver 5.4.2 and library search with NIST-2008 which was performed at Sophisticated Instrumentation Facility (SIF), School of Advanced Sciences, Chemistry division, VIT, Vellore and in Central Analytical Instrumentation Facility (CAIF), Guwahati Biotech Park (GuBH), Guwahati, Assam. Interpretation of the mass spectrum of GC-MS was carried out using the database of the National Institute of Standards and Technology (NIST). The mass spectrum of the unknown component was compared with the spectrum of the known components stored in the NIST library, 2008.

In silico ADME Parameters:

The physicochemical, pharmacokinetic, and drug-likeness properties of phytochemical compounds, identified from the methanol extract of the plant sample, were estimated using an online server http://www.swissadme.ch/ accessed on 02-02-2024, for ADME (absorption, distribution, metabolism, and excretion) properties and drug predictability (16).

Results and Discussion

Traditional use of *Lablab purpureus* (L.) Sweet:

L. purpureus (L.) Sweet is a herbaceous, climbing, shortlived plant with a vigorous taproot and a widely cultivated legume as an important nutritional vegetable crop. The ease of maintenance of the crop plant is another advantage of its favored cultivation in most households. Assam, India, has numerous genotypes of *L. purpureus* (L.) Sweet which is a very rich source of gene pool (17). The Karbi people consider all species of *Lablab* as important vegetable plants and as delicacies of Karbi cuisine. Besides this, it is also served as an important medicinal plant,

usually of gynaecological concern. The root extracts are known to be used both as an antifertility and abortifacient agent for managing unwanted pregnancies among the Karbi tribe which is reported for the first time.

Fresh roots usually from a plant that is two to three years older, are believed to provide more efficacy and are selected for antifertility purposes. The folk narrates that the plant root of one to less than a year older shows less to no efficacy, so usually roots from older plants are considered. About 100g (gram) of the root is cut and grounded to get its highly concentrated extract of about 10 ml (milliliter). The root extract of about 10 ml is mixed with 5 ml root extract of *Mimosa pudica* L. along with grains of *Oryza sativa* L., which are used as a contraceptive for birth control. The extract mixtures are taken orally for five days during the menstrual period to be continued for 2 months for effective contraceptive measures.

The concentrated crude extract of the roots is also used as an abortifacient agent for managing unintended pregnancies. The concept behind using an abortifacient agent is for reasons like spacing between children, limiting the number of children, and also for unintended, unplanned, or risky pregnancies. Unplanned or unwanted pregnancies happen when a woman plans to space between children or when she wants no more children but is conceived due to failed contraceptives. About 10 ml (approximately) of concentrated crude extract of the root is taken orally twice in the morning and evening with an empty stomach during the initial stage of pregnancy, usually in the first trimester to abort the unwanted fetus. Although the measures are not openly practiced; whenever required, these are made easily available by local herbal practitioners, elderly women, birth attendants, etc. A few local traditional medicinal practitioners typically trim the roots of about 5 to 10 cm (approx.) and keep it in an earthen pot for use when necessary.

Pharmacognostic studies of the root of *Lablab purpureus* (L.) Sweet:

Morphological studies, i.e. macroscopic parameters and organoleptic studies like shape, size, color, odor, and taste were recorded and presented in Table 1. A macroscopic identity of the plant materials is based on shape, size, colour, surface characteristics, texture, fracture characteristics, and appearance of the cut surface. A mature root of 2 to 3 years older is tough and woody and its surface is rough and wavy and has a thickness of about 3 to 4 cm. The upper bark upon peeling or rubbing has a slight characteristic smell when taken closely, but it withers off early. The section of the peeled bark is pale in colour. Determination of macroscopic characteristics and physicochemical properties of herbal drug powder is an essential step towards establishing the identity and purity of the herbal formulations (1).

The physicochemical properties of the root of *L. purpureus* (L.) Sweet were carried out for the determination of various parameters (Table 2). The swelling index is 3.8%, which signifies an average value of their ability to uptake water; the loss of moisture on drying is 6.95 ± 0.02%, which is in an acceptable range as higher moisture content may lead to decomposition of the crude powder during storage. The minimum moisture content of a powder drug is essential to prevent powder from decomposition and the value between 10–20% is reported as an ideal range according to Sumbul and his co-workers (18). Further, the ash content was analyzed to judge the identity or purity of crude drugs and the total ash value (7.8 ± 0.002%) and water-soluble ash (5.6 ± 0.26%) are presented in Table 2. The extractive value of the crude powder for various solvents was also determined and found that the yield of water-soluble extractive (16.9 ± 0.02%) was more in comparison to methanol soluble extractive (4.2 ± 0.01%) followed by ethanol-soluble extractive (1.8 ± 0.01%). The amounts of extracts obtained by extracting the crude drug with different solvents are indicative of approximate measures of their chemical constituents. Water-soluble extractives are indicative of

Table 2. Physicochemical parameters of *Lablab purpureus* (L.) Sweet.

Parameters	Value
Swelling index %	3.8%
Loss on Drying (LOD %)	6.95 ± 0.02%
Bulk density	0.11g/ml
Tapped density	0.14g/ml
Hausner Ratio	1.27
Carr's index %	22%
Water soluble extractive %	16.9 ± 0.02%
Methanol soluble extractive %	4.2 ± 0.01%
Ethanol soluble extractive %	1.8 ± 0.01%
Total Ash value (%)	7.8 ± 0.002%
Water soluble ash (%)	5.6 ± 0.26%

Table 1. Macroscopic characteristic of the root of *Lablab purpureus* (L.) Sweet.

Parameters	Features
Shape	Semi-hard appeared woody
Size	3.32 cm thickness (2 years old root) 1.27 cm thickness (1 year old root)
Colour	The fresh root is light brown to reddish brown in colour, Dried root is a translucent brown, pale colour when the bark is removed
Surface	Rough, wavy
Odour	Characteristics or slightly aromatic when rubbed
Taste	Cold, mild with a slight sweetness

water-soluble active constituents of crude drugs, such as tannins, sugars, plant acids, mucilage, glycosides, etc. (18). Traditionally, maceration of coarse root powder with water is followed to obtain an extract for oral administration and no other solvents are used; so, water, here, is an ideal solvent for extraction of various phytocompounds. The flow properties of the powder drugs for the parameters - bulk density, tapped density, Carr's index, and Hausner ratio were measured at 0.11g/ml, 0.14g/ml, 22%, and 1.27 respectively. This value indicates that the powder drugs have greater interparticle interactions, which signifies poor flowing powder. A Carr's index below 15% and Hausner's ratio below 1.25 is considered good flowability (19). Since it is a seasonal plant, the roots are collected freshly, cut into varying lengths and after drying, they are bundled and stored in an earthen pot. This is how the Karbi tribe managed it for further utilization whenever necessary.

Preliminary phytochemical analysis:

The phytochemical analysis of the methanolic extract reveals the presence of various bioactive compounds, such as flavonoids, tannins, phenolic compounds, alkaloids, coumarins, and terpenoids (Table 3). In the aqueous extract, compounds such as tannins, phenolic compounds, saponin, steroids, and terpenoids remain absent. Derivatives of these phytocompounds are known to have antifertility and abortifacient effects when taken orally.

Effects of bioactive compounds identified from the root extract:

GC-MS analysis revealed the presence of potential bioactive compounds reported to produce different biological effects (Table 4). The potential bioactive compound identified includes- Propanoic Acid, 2, 2-Dimethyl-, Ethyl Ester; Pivalic Acid, 2-Methylpropyl Ester, 2 -Butanone, 1-(2-Furanyl)- (RT 8.384); 1, 3- Dioxolane, 2-Pentadecyl-; 1, 3- Dioxolane, 2- (3-Bromo 5, 5, 5- Trichloro - 2, 2- Dimethylpentyl) - (RT 26.586), Heptasiloxane, 1,1,3,3,5,5,7,7,9,9,11,11,13,13-Tetradecamethyl-; Hexasiloxane, 1,1,3,3,5,5,7,7,9,9,11,11 Dodecamethyl-, N-(Trifluoroacetyl)-N,O,O',O''-Tetrakis(Trimethylsilyl) Norepinephrine (RT 29.917); Cyclotrisiloxane, Hexamethyl-;Heptasiloxane,1,,3,3,5,5,7,7,9,9,11,11,13,13-Tetradecamethyl-; Arsenous Acid, Tri (Trimethylsilyl) Ester; Tris (Tert-Butyldimethylsilyloxy) Arsane (RT 32.328).

The Arsenic-containing compound arsenous acid tris(trimethylsilyl) ester is detected in the root of *L. purpureus*,(L.) Sweet and it is toxic and can cause serious health problems if ingested in large amounts. Arsenic and its methylated metabolites can easily cross the human placenta and increase the risk of miscarriage, stillbirth, poor fetal growth, and increased infant death rate (20, 21). Inorganic arsenic has an endocrine disruptor in the placenta and exposure to arsenic or its arsenous compound in early pregnancy, increases inflammation in the placenta and reduces T-cell numbers in the placenta, causing a disruption of immune balance and increasing the risk factors for infectious diseases (22). Arsenic compounds are toxicant, carcinogenic, and teratogenic as well (23). Cyclic siloxane compounds induce hyperplasia in multiple tissues and are potential genotoxicants, cytotoxicants, and immune system disruptors (24, 25). According to the material safety data sheet, Pivalic Acid, 2-Methylpropyl Ester (26), maternal toxicity was observed in laboratory animals at 800 mg/kg/day, but there were no effects at 400 mg/kg/day. The no-observable-adverse-effect level (NOAEL) for maternal toxicity was 400 mg/kg/day and for developmental toxicity, it was 800 mg/kg/day. Traditionally, the root extract was orally administered at an approximate amount of 10 ml. Hence, at a high dosage, it is likely to cause both maternal and developmental toxicity. The compound, Propanoic Acid, 2,2-Dimethyl-, Ethyl Ester; 1,3-Dioxolane, 2-Pentadecyl-, and 1,3-Dioxolane, 2-(3-Bromo-5,5,5-Trichloro-2,2-Dimethylpentyl) - also produced maternal toxicity at high dosage (1.15g/kg) where the NOAEL was judged to be 580 mg/kg/day. It may cause developmental toxicity as it is an ethyl pivalate or pivalic acid which is toxic. Another compound identified in the root extract of this plant, 2-Butanone, 1- (2-Furanyl)- is slightly fetotoxic (27). The norepinephrine-containing compound (N-(Trifluoroacetyl)-N,O,O',O''-Tetrakis (Trimethylsilyl) Norepinephrine) shows a decrease in reproductive success at a higher dose (500 mg/kg). Aydin *et al*. (28), reported developmental and reproductive toxicity in animal models. Besides, norepinephrine-containing compounds also stimulate progesterone

Table 3. Results of preliminary phytochemical screening of *Lablab purpureus* (L.) Sweet.

Phytocompound	Test	Methanolic extract	Aqueous extract
Flavonoid	NaOH Test	+	+
	Lead Acetate	+	+
Tannins and	Ferric chloride Test	+	-
Phenolic compound	Ferric chloride Test	+	-
Saponin	Frothing Test	-	-
Alkaloid	Dragendorff Test	+	+
Terpenoid	Chloroform Test	+	-
Phlobatannin	HCl Test	-	-
Steroid	Chloroform Test	-	-
Coumarin	NaOH Test	+	+

Here "+" indicates presence, and "–" indicates absence of the particular phytocompound.

Table 4. Bioactive compound identified in methanol extract of *L.purpureus* and its biological effects.

Sl.No.	Compound name	Molecular weight (g/ mole)	Formula	Biological effects	References
1	Heptasiloxane, 1,1,3,3,5,5,7,7,9,9,11,11,13,13-Tetradecamethyl-	504	$C_{14}H_{44}O_6Si_7$	Antimicrobial and Insecticidal activity, potential genotoxicants, cytotoxicants, and immune system disruptors.	(24, 25)
2	Pivalic Acid, 2-Methyl propyl Ester	158	$C_9H_{18}O_2$	Maternal toxicity (<400 mg/kg/day) and developmental toxicity (<800 mg/kg/day) at high doses.	(26)
3	2-Butanone, 1- (2-Furanyl)-	138	$C_8H_{10}O_2$	Slightly fetotoxic	(27)
4	N-(Trifluoroacetyl)-N,O,O',O''-Tetrakis(Trimethylsilyl) Norepinephrine	553	$C_{22}H_{42}F_3NO_4Si_4$	Decrease in reproductive success at higher dose (500 mg/kg); Causes developmental and reproductive toxicity; stimulates progesterone production	(28, 29, 37)
5	Arsenous Acid, Tri (Trimethylsilyl) Ester	342	$C_9H_{27}AsO_3Si_3$	Toxicant teratogenic and carcinogenic.	(31, 32)
6	Hexasiloxane, 1,1,3,3,5,5,7,7,9,9,11,11-Dodecamethyl-	428	$C_{12}H_{36}O_5Si_6$	Antibacterial, antiseptic, skin-conditioning acidulant	(33, 34)
7	Propanoic Acid, 2,2-Dimethyl-,Ethyl Ester	130	$C_7H_{14}O_2$	It is an ethyl pivalate (pivalic acid) which is toxic; and shows developmental toxicity	(35)
8	1,3-Dioxolane, 2-Pentadecyl-	284	$C_{18}H_{36}O_2$	High dose (1.15g/kg) showed maternal toxicity. NOAEL were both judged to be 580 mg/kg/day	(36)
9	1,3-Dioxolane, 2-(3-Bromo-5,5,5-Trichloro-2,2-Dimethylpentyl)-	354	$C_{10}H_{16}BrCl_3O_2$	Maternal and developmental toxicity at high dose (1.15g/kg).	(36)

production (29), which is primarily responsible for preventing pregnancy by inhibiting follicular development and thereby preventing ovulation. The inhibition of implantation, reduction of estrogen level, and increment of progesterone level are the possible mechanisms of the antifertility effect (30). The Karbi tribe has traditionally used *L. purpureus* (L.) Sweet as an antifertility and abortifacient and it is rightly claimed that this has ethnomedicinal properties since the root extract of the plant has been shown to contain bioactive compounds with potential reproductive and developmental toxicity (Fig. 1).

SwissADME Profiling:

The ADME (Absorption, Distribution, Metabolism, and Excretion) parameters including drugs likeness and inhibitors, are important in the drug discovery process (38) and the bioactive compounds reported in the present study have high Gastrointestinal (GI) absorption except the compound N-(Trifluoroacetyl)-N, O, O', O''-Tetrakis (Trimethylsilyl) Norepinephrine (Table 5). The compounds illustrated good oral absorption with a good bioavailability score (0.55) signifying the orally administered compounds reach the systemic circulation

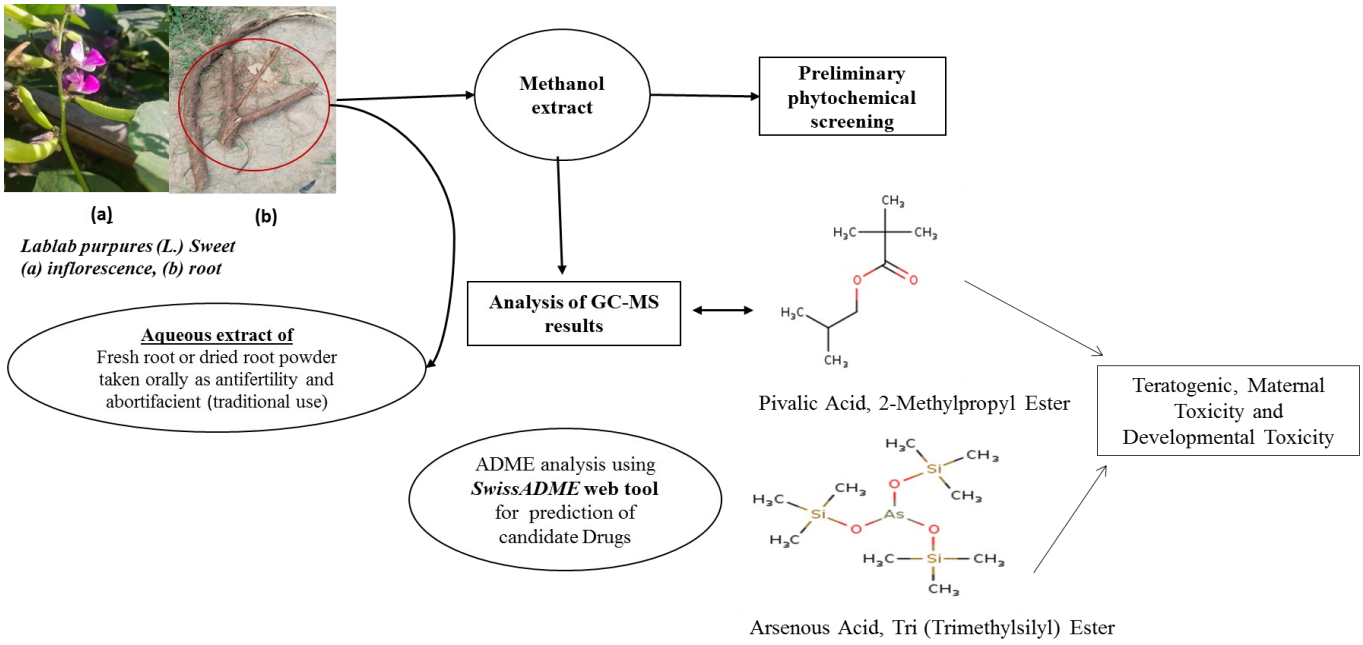

Figure 1. *L. purpureus* (L.) Sweet with few of its bioactive compounds.

Table 5. In silico analysis of Pharmacokinetics and Druglikeness properties of a compound identified in the root extract of *Lablab purpureus*.

SL No.	Compound	Pharmacokinetics				Drug likeness	
		GI absorption	BBB permeant	P-gp substrate	Log K_p (skin permeation)	Bioavailability Score	Lipinski's rule
1	Arsenous Acid, Tri (Trimethylsilyl) Ester	High	Yes	Yes	-5.22 cm/s	0.55	Yes; 0 violation
2	Heptasiloxane,1,1,3,3,5,5,7,7,9,9,11,11,13,13-Tetradecamethyl	High	Yes	Yes	-4.40 cm/s	0.55	Yes; 1 violation
3	Hexasiloxane, 1,1,3,3,5,5,7,7,9,9,11,11-Dodecamethyl-	High	Yes	Yes	-4.66 cm/s	0.55	Yes; 0 violation
4	Pivalic Acid, 2-Methyl propyl Ester	High	Yes	No	-5.24 cm/s	0.55	Yes; 0 violation
5	Propanoic Acid, 2,2-Dimethyl-, Ethyl Ester	High	Yes	No	-5.76 cm/s	0.55	Yes; 0 violation
6	1,3-Dioxolane, 2-Pentadecyl-	High	No	No	-2.63 cm/s	0.55	Yes; 0 violation
7	1,3-Dioxolane, 2-(3-Bromo-5,5,5-Trichloro-2,2-Dimethylpentyl)-	High	Yes	No	-5.30 cm/s	0.55	Yes; 0 violation
8	2-Butanone, 1- (2-Furanyl)-	High	Yes	No	-6.35 cm/s	0.55	Yes; 0 violation
9	N-(Trifluoroacetyl)-N,O,O',O''-Tetrakis (Trimethylsilyl) Norepinephrine	Low	No	Yes	-4.10 cm/s	0.55	Yes; 1 violation

based on Lipinski's rule (39).Two compounds, namely Heptasiloxane,1,1,3,3,5,5,7,7,9,9,11,11,13,13Tetradecamethyl and N- (Trifluoroacetyl)- N,O,O',O''- Tetrakis (Trimethylsilyl) Norepinephrine, although having MW>500, but can be considered as an orally active drug as per Lipinski's rule (40).

The compounds also can cross the blood-brain barrier (BBB) except 1,3-Dioxolane, 2-Pentadecyl- and N-(Trifluoroacetyl)-N,O,O',O''-Tetrakis(Trimethylsilyl) Norepinephrine. The GI absorption and BBB access are two pharmacokinetics parameters important to estimate in various drug discovery processes (41); thus the presented compound can be predicted as a candidate drug for further drug discovery processes. The compound Arsenous Acid, Tri (Trimethylsilyl) Ester, Heptasiloxane,1,1,3,3,5,5,7,7,9,9,11,11,13,13-Tetradecamethyl, Hexasiloxane, 1,3,3,5,5,7,7,9,9,11,11-Dodecamethyl-, Pivalic Acid, 2-Methylpropyl Ester, Propanoic Acid, 2,2-Dimethyl-, Ethyl Ester, 2-Butanone, 1-(2-Furanyl)- are the substrate of the Permeability glycoprotein (P-gp) which is an essential biological barrier for removing toxins and plays a significant role in drug absorption and disposition. Arsenic-containing compounds such as arsenous acid tris (trimethylsilyl) ester can cross the placenta, which can directly influence the physiological and anatomical development of the fetus (42). Most of the identified compounds are also non-inhibitors of important Cytochrome P450 enzymes like CYP1A2, CYP2C9, CYP2C19, and CYP3A4. However, the compounds 1,3-Dioxolane, 2-Pentadecyl- and N-(Trifluoroacetyl)-N,O,O',O''-Tetrakis (Trimethylsilyl) Norepinephrine inhibit CYP1A2 and CYP3A4 respectively. The Cytochrome P450 enzymes are involved in the metabolism of many drugs and pregnancy has differing effects on the apparent activity of the various enzymes (43, 44). When any of these enzymes get inhibited by any drugs, it has an apparent effect on pregnancy and potentially increases the risk of toxicity during pregnancy (43). Skin permeation values show a negative value which implies that they are not permeable through the skin and hence are not suggested candidates for transdermal drug delivery.

Conclusion

The scientific studies of the traditional use of medicinal plants for managing unintended pregnancy by the Karbi tribe of Assam were discussed in the present study. The analysis of the physicochemical properties of the traditional medicines revealed the nature of the powdered drugs and helped to check the quality control of the extract formulations that can be considered as important pharmaceutical products as antifertility and abortifacient agents. To be scientifically safe in handling and accurate dosage of indigenous medicinal herbal drugs, alternative measures for safe abortion and effective contraceptive measures in the form of processed pharmaceutical drugs can be suggested. The presence of a potential bioactive compound having reproductive and developmental toxicant and its drug-likeness properties validates the importance of this medicinal plant among the Karbi tribe and the drug can be considered as an orally active drug likely to be used as a potential antifertility and abortifacient activity-based on SwissADME drugs parameters.

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Authors' contributions

RT contributed to the major ethnobotanical investigation, biochemical analysis of phytocompound, in silico studies, sample preparations and overall analysis and interpretations of data and writing the manuscript; RJ assisted in biochemical analysis, DB assisted in sample preparation and a few laboratory experiments and FY was involved in the improvement of the manuscript, interpret and cross-checked the data. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: : Authors do not have any conflict of interest to declare.

Ethical issues: None.

References

1. World Health Organization. Quality control methods for herbal materials. World Health Organization, 2011. https://apps.who.int/iris/handle/10665/444479. Accessed on 25 December 2023.
2. Katiyar C, Gupta A, Kanjilal S, Katiyar S. Drugs discovery from plant sources: An integrated approach. Ayu. 2013; 33 (1). https://doi.org/10.4103/0974-8520.100295.
3. Sofowara A, Ogunbodede E, Onayade A. The role and place of medicinal plants in the strategies for disease prevention. Afr J Tradit Complement Altern Med. 2013; 10 (15): 210-29.
4. Teronpi V, Singh HT, Tamuli A K, Teron R. Ethnozoology of the Karbis of Assam, India: Use of ichthyofauna in traditional health-care practices. Anc Sci life. 2012; 32 (2), 99–103. https://doi.org/10.4103/0257-7941.118547
5. Terangpi R, Yasmin F. Medicinal Plants used as Abortifacient among Karbis of Assam, India. J. Nat. Remedies. 2021; 21(4), 297 –302. https://doi.org/10.18311/jnr/2021/26142
6. Singh A, Abhilash PC.Varietal dataset of nutritionally important *Lablab purpureus* (L.) Sweet from Eastern Uttar Pradesh, India. Data in brief, 2019; 24 103935, 1-10. https://www.sciencedirect.com/science/article/pii/S2352340919302860
7. Valenzuela H, Smith J. Green Manure crops: Lablab, College of Tropical Agriculture and Human Resources. 2002; 1-10.
8. Kanjilal UN, Kanjilal PC, Das A. Flora of Assam, Assam Govt. Press, Shillong. 1997; Reprint, Vol. 1-5.
9. WFO: *Lablab purpureus* (L.) Sweet. https://www.worldfloraonline.org/taxon/wfo-0000181603. 2024. Accessed 20 January 2024.
10. *Lablab purpureus* (L.) Sweet. India Biodiversity Portal; Available from https://indiabiodiversity.org/observation/show/17856568. Accessed on 02 Feb 2024.
11. *Lablab purpureus* (L.) Sweet. International Plant Names Index; Available from https://www.ipni.org/n/90501-3. Accessed on 2 Feb 2024.
12. Khandelwal, K.R. Practical Pharmacognosy.19th Ed. Nirali Prakashan Publications. 2008.
13. Das BK, Al-Amin MM, Russel SM, Kabir S, Bhattacherjee R, Hannan JM (2014). Phytochemical Screening and Evaluation of Analgesic Activity of Oroxylum indicum. Indian J. Pharm. Sci., 2014; 76(6), 571–575. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4293694/
14. Gul R, Jan SU, Faridullah S, Sherani S, Jahan N. Preliminary Phytochemical Screening, Quantitative Analysis of Alkaloids, and Antioxidant Activity of Crude Plant Extracts from Ephedra intermedia Indigenous to Balochistan. Sci World J. 2017; 5873648. https://doi.org/10.1155/2017/5873648.
15. Singh PK, Singh J, Medhi T, Kumar A. Phytochemical Screening, Quantification, FT-IR Analysis, and in Silico Characterization of Potential Bio-active Compounds Identified in HR-LC/MS Analysis of the Polyherbal Formulation from Northeast India. ACS Omega. 2022; 7 (37), 33067-78. https://doi.org/10.1021/acsomega.2c03117.
16. SwissADME. Swiss Institute of Bioinformatics; available from http://www.swissadme.ch/ accessed on 02-02-2024.
17. Asati BS, Yadav DS (2004). Diversity of horticultural crops in North Eastern Region. ENVIS Bulletin: Himalayan Ecology. 2004; 12(1): 1–10. https://kiran.nic.in/pdf/publications/Diversity_of_Horticulture.pdf
18. Sumbul S, Ahmad MA, Asif M, Akhtar M, Saud I. Physicochemical and phytochemical standardization of berries of Myrtus communis Linn. J Phar Bioallied Sci. 2012; 4(4), 322–26. https://doi.org/10.4103/0975-7406.103266.
19. Etti CJ, Yusof YA, Chin NL, Tahir SM. Flowability properties of *Labisia pumila* herbal powder. Agriculture and Agricultural Science Procedia. 2014; 2:120-27.
20. Winterbottom EF, Ban Y, Sun X, Capobianco AJ, Marsit CJ, Chen X, Wang L, Karagas MR, Robbins DJ. Transcriptome-wide analysis of changes in the fetal placenta associated with prenatal arsenic exposure in the New Hampshire Birth Cohort Study. Environ Health. 2019; 18:100. https://doi.org/10.1186/s12940-019-0535-x.
21. Quansah R, Armah FA, Essumang DK, Luginaah I, Clarke E, Marfoh K, Cobbina SJ, Nketiah-Amponsah E, Namujju PB, Obiri S, Dzodzomenyo M. (2015). Association of arsenic with adverse pregnancy outcomes/infant mortality: a systematic review and meta-analysis. Environmental health perspectives. 2015; 123(5), 412–21. https://doi.org/10.1289/ehp.1307894.
22. Ortiz-Garcia NY, Cipriano Ramírez AI, Juarez K, Brand Galindo J, Briceño G, Calderon Martinez E. Maternal Exposure to Arsenic and Its Impact on Maternal and Fetal Health: A Review. Cureus. 2023; 15(11), e49177. https://doi.org/10.7759/cureus.49177.
23. Islam K, Wang QQ, Naranmandura H. Molecular Mechanisms of Arsenic Toxicity. Editor(s): James C. Fishbein, Jacqueline M. Heilman, Advances in Molecular Toxicology, Elsevier. 2015; 9: 77 -107, https://doi.org/10.1016/b978-0-12-802229-0.00002-5.
24. Khalid A, Algarni AS, Homeida HE, Sultana S, Javed SA, Rehman ZU, Abdalla H, Alhazmi HA, Albratty M, Abdalla AN. Phytochemical, Cytotoxic, and Antimicrobial Evaluation of *Tribulus terrestris* L., *Typha domingensis* Pers., and *Ricinus communis* L.: Scientific Evidences for Folkloric Uses. Evidence-based complementary and alternative medicine. 2022; 6519712. https://doi.org/10.1155/2022/6519712.
25. Tilley SK, Fry RC. In Systems Biology in Toxicology and Environmental Health, 2015
26. Pivalic acid. Safety Datasheet; available from https://datasheets.scbt.com/sc-250736.pdf. Accessed on 10 Jan 2024.
27. Toxicological profile for 2-Butanone. US Department of Health and Human Services; Available from https://www.ncbi.nlm.nih.gov/books/NBK590518/pdf/Bookshelf_NBK590518.pdf. Accessed on 20 Jan 2024.

28. Aydın A, Tugcu G. Toxicological assessment of epinephrine and norepinephrine by analog approach. Food and chemical toxicology: an international journal published for the British Industrial Biological Research Association. 2018; 118, 726–32. https://doi.org/10.1016/j.fct.2018.06.028.

29. Piccinato CA, Montrezor LH, Collares CA, Vireque AA, Rosa e Silva AA. Norepinephrine stimulates progesterone production in highly estrogenic bovine granulosa cells cultured under serum-free, chemically defined conditions. Reproductive biology and endocrinology. 2012; 10:95. https://doi.org/10.1186/1477-7827-10-95.

30. Gebrie E, Makonnen E, Zerihun L, Debella A. The possible mechanisms for the antifertility action of methanolic root extract of Rumex steudelii. Afr Health Sci. 2005; 5(2):119-25.

31. Alhazmi HA, Khalid A, Sultana S, Abdelwahab SI, Ahsan W, Oraiby ME, Bratty MA. Determination of Phytocomponents of Twenty-one Varieties of Smokeless Tobacco using Gas Chromatography-Mass Spectroscopy (GC-MS). S Afr J Chem. 2019, 72:47–54.

32. Kuivenhoven and Mason. Arsenic toxicity. National Library of Medicine; available from https://www.ncbi.nlm.nih.gov/books/NBK541125/. Accessed on 10 Jan 2024.

33. Oluwayinka O, Dorcas J, Ibrahim S, Binda A, Opeoluwa F, Barnabas K. Phytochemical analysis, antioxidant and anti-inflammatory potential of *Feretia aponanthera* root bark extracts. BMC Complementary and Alternative Medicine. 2018; 18. https://doi.org/10.1186/s12906-017-2070-z.

34. Rehman YU, Iqbal A, Ali G, Alotaibi G, Ahmed A, Ayaz M. Phytochemical analysis, radical scavenging and glioblastoma U87 cells toxicity studies of stem bark of buckthorn (Rhamnus pentapomica R. Parker). BMC: Complement Med Ther. 2024; 24: 12. https://doi.org/10.1186/s12906-023-04309-w.

35. Propanoic acid, 2, 2-dimethyl-, ethyl ester. NIST Chemistry WebBook, SRD69; available from https://webbook.nist.gov/cgi/cbook.cgi?ID=3938952&Units=SI. Accessed on 09 Jan 2024.

36. 1,3-Dioxolane. ECHA CHEM; available from https://echa.europa.eu/registration-dossier/-/registered-dossier/15807/7/9/2. Accessed on 09 Jan 2024.

37. Hirsch KS, Fritz HI. Teratogenic effects of mescaline, epinephrine, and norepinephrine in the hamster. Teratology. 1981; 23(3), 287–91. https://doi.org/10.1002/tera.1420230302.

38. Abdullahi M, Adeniji SE. In-silico Molecular Docking and ADME/Pharmacokinetic Prediction Studies of Some Novel Carboxamide Derivatives as Anti-tubercular Agents. Chemistry Africa. 2020; 3: 989–1000. https://doi.org/10.1007/s42250-020-00162-3

39. Martin YC. A bioavailability score. Journal of Medicinal Chemistry. 2005; 48(9), 3164–70. https://doi.org/10.1021/jm0492002.

40. Lipinski CA, Lombardo F, Dominy BW, Feeney PJ. Experimental and computational approaches to estimate solubility and permeability in drug discovery and development settings. Advanced Drug Delivery Reviews. 2001; 46(1-3): 3–26. https://doi.org/10.1016/s0169-409x (00)00129-0.

41. Daina A, Michielin O, Zoete V. SwissADME: a free web tool to evaluate pharmacokinetics, drug-likeness and medicinal chemistry friendliness of small molecules. Sci Rep. 2017; 3 (7): 42717. https://doi.org/10.1038/srep42717.

42. Jensen TK, Frederiksen H, Kyhl HB, Lassen, TH, Swan SH, Bornehag CG, Skakkebaek NE, Main KM, Lind DV, Husby S and Anderrson AM. Prenatal Exposure to Phthalates and Anogenital Distance in Male Infants from a Low-Exposed Danish Cohort (2010–2012). Environmental Health Perspectives. 2012; 124 (7), 1107 – 1113. https://doi.org/10.1289/ehp.1509870.

43. Hebert MF (2013). Impact of pregnancy on pharmacokinetics of medications. J Popul Ther Clin Pharmacol. 2013; 20 (3): 350-57.

44. Estabrook RW. A passion for P450s (rememberances of the early history of research on cytochrome P450). Drug metabolism and disposition: the biological fate of chemicals. 2003; 31:1461–1473.