Plant Secondary Metabolites-a necessary resource for both man and papilionid butterflies across West Bengal, India

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Introduction:

- WHO has reported the utilization of traditional medicines amongst 80% populace from developing nations

- Plant secondary metabolites (PSM) or more specifically alkaloids, terpenoids, flavonoids, glycosides, coumarins, saponins and tannins constitutes the basis of such formulations as used by folklore therapists

- Butterflies have developed an innate skill to recognise and utilize such plants as reliable ovipositing substrate.

- Several species have devised strategies to overcome the defensive substances (PSM) characteristics of plant taxa

Methodology

The entire study was conducted between June 2019 to May 2020 across tribal dominated districts of West Bengal (East and West Midnapore, Darjeeling, Jalpaiguri, Purulia and Bankura), India

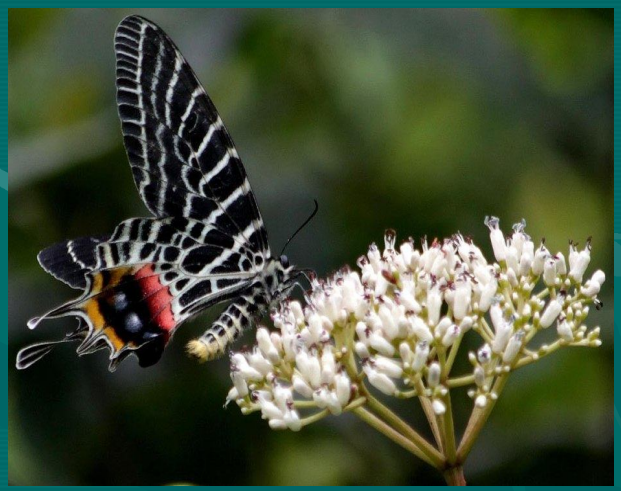
Documentation of papilionid butterflies utilizing medicinal plants as their larval resource

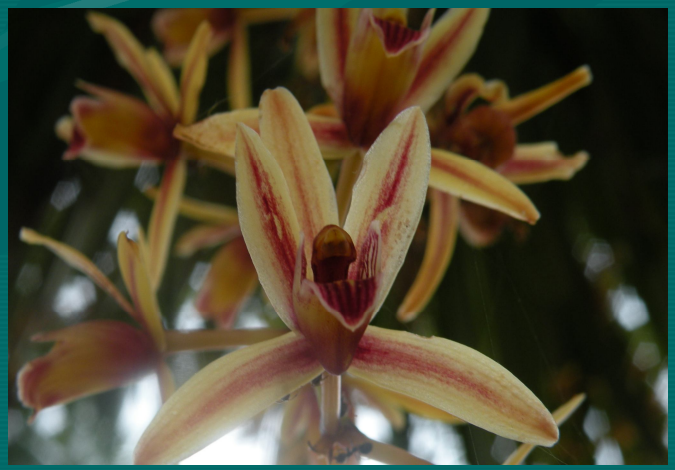
Detailed ethno-medicinal survey conducted

Determination of polyphagy index $PI = (A \times B)^{½}$

Determintion of medicinal utilization value $Uvs = \Sigma Us / ns$

Results

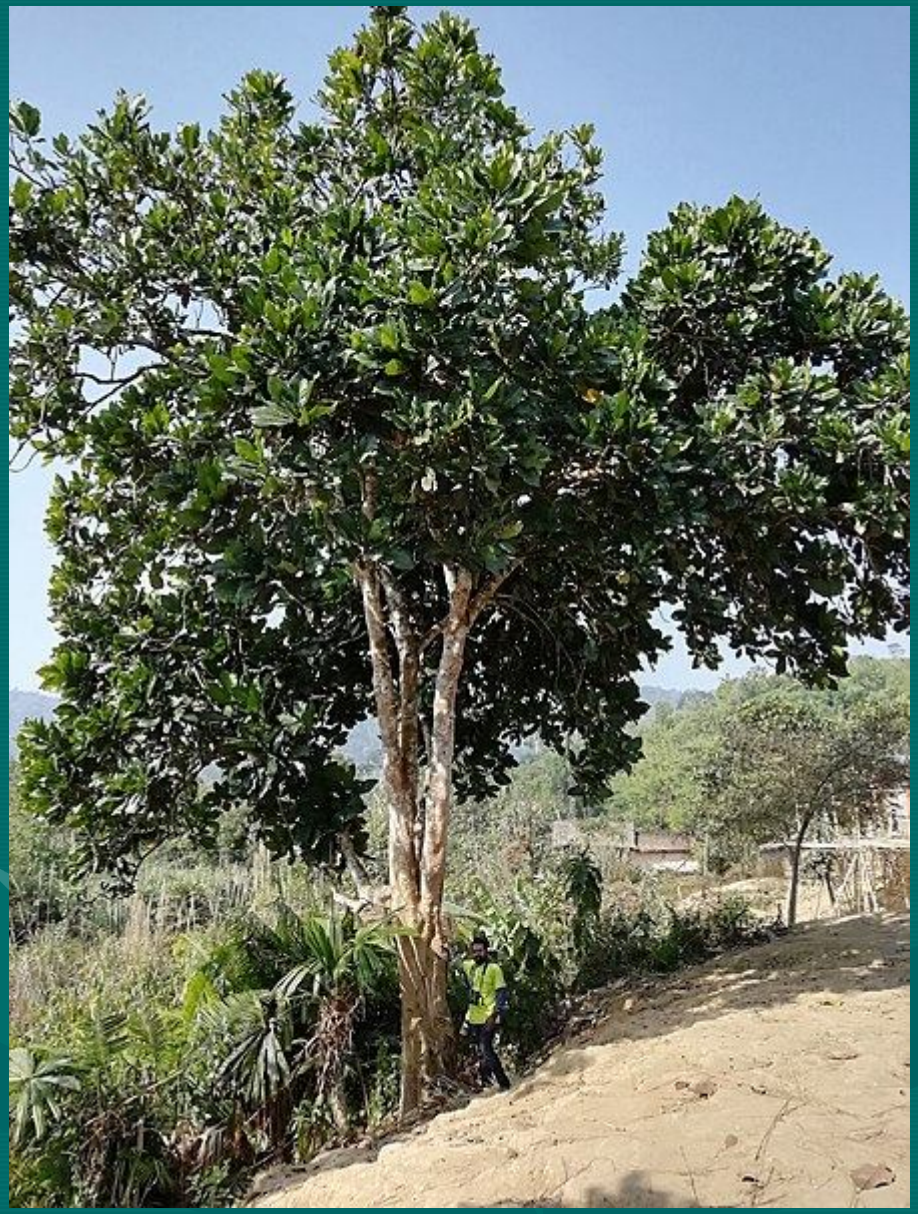




Magnolia grandiflora

Magnolia grandiflora L	**Antiinflammatory, diaphoretic, stimulant, prevention against cold, headache and stomach ache**

Medicinal Utilization values: 0.32



Magnolia pterocarpa Roxb.	Effective in treatment of fever and cough

Medicinal Utilization values : 0.30

Magnolia pterocarpa_

Michelia doltsopa

Michelia doltsopa **Buch.-Ham. ex DC.**	**Treatment of dyspepsia, gonorrhea, stomach disorders, tonsillitis, fever. Also useful as deworming agent**

Medicinal Utilization values: 0.31

Michelia champaca

Family: Magnoliaceae ***Michelia champaca* Linn.**	**Anti-inflammatory, analgesic, nerve soothing effect, treatment of skin diorders, gout. Effective in aromatherapy**

Medicinal Utilization values: 0.39

Cinnamomum tamala

Cinnamomum tamala **Nees.**	**Is known to be an astringent with carminatine properties. Beneficial for the treatment of itch, diarrhoea, colic, rheumatism, fever, anaemia, nausea and vomiting**

Medicinal Utilization values: 0.30

Cinnamomum camphora

Cinnamomum camphora **(L.) J. Presl**	**Camphor used to treat high fever, measles, delirium, whooping cough, melancholia, chronic bronchitis, uterine pain, asthma, gonorrhoea, rheumatism, headache and influenza**

Medicinal Utilization values: 0.37

Persea odorattisima

Persea odoratissima **(Nees) Kosterm.**	**Anti-inflammatory, antiseptic, antiviral, anti-allergic, effective againest snakebite, burn wounds, improves cardiac output, reduces congestive heart failure and cardiac arrhythmia**

Medicinal Utilization values: 0.30

Polyalthia longifolia

Family: Annonaceae *Polyalthia longifolia* Hk. f. & T.	Treatment of fever, skin disease, diabetes, hypertension, constipation. Known for its anti-inflammatory ,anticancer, antimicrobial, antiulcer activity

Medicinal Utilization values: 0.32

Annona reticulata

Annona reticulata L	**Treatment of epilepsy, dysentery, cardiac problem, worm infection, constipation, haemorrhage, antibacterial infection, dysuria, fever, hyperthyroidism and ulcer, Possess ntitumor, antifertility and abortifacient properties,**

Medicinal Utilization values: 0.32

Annona squamosa

Annona squamosa **Linn**	**Beneficial for cardiac disease, hyperthroidism and cancer, Used as a purgative and applied on ulcer and wounds. Possess antitumor, antidiabetic, antimicrobial, antihyperlipidemic and hepatoprotective activity.**

Medicinal Utilization values: 0.30

Uvaria lurida

Uvaria lurida Hk. f. & T.	Treatment of inflammatory disease, rheumatism, acute allergic reaction, inflammatory liver disease and swollen joints.

Medicinal Utilization values: 0.19

Litsea glutinosa

Litsæa glutinosa (Lour.)C.B.Rob.	Treatment of furnacle, traumatic injury, reducing swelling and soreness.

Medicinal Utilization values:0.16

Litsea polyantha

Litsæa polyantha Juss.	Treatment of fractures and dislocation. Cures gonorrhea, skin disease, boil, diarrohea, pain and bruises

Medicinal Utilization values: 0.24

Aristolochia indica

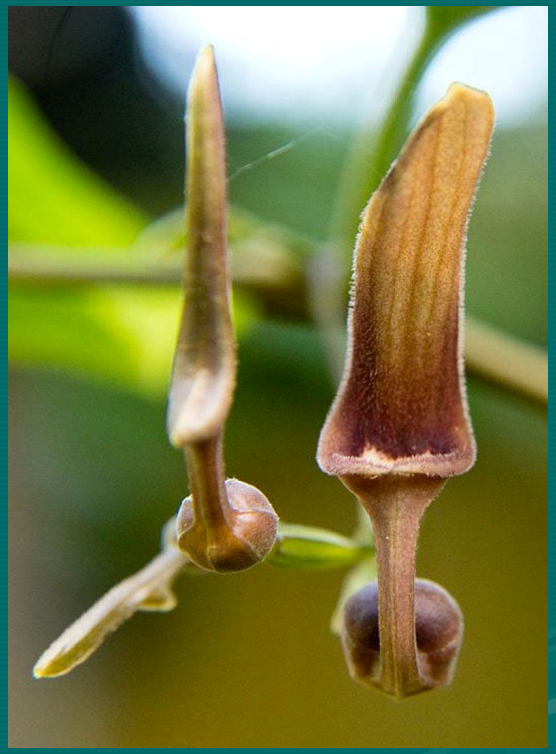
Aristolochia indica L.	Effective against cholera, fever, bowel problems, ulcers, leprosy, and skin diseases. Also being employed as an abortifacient and antineoplastic

Medicinal Utilization values: 0.47

Aristolochia saccata

Aristolochia saccata Wall.	Provides relief from fever, diarrohea and dysentry

Medicinal Utilization values: 0.23



Aristolochia tagala

Aristolochia tagala Cham. & Schlect.	Effective against stomachache, snakebite ,dental problems and rheumatism

Medicinal Utilization values: 0.36

Glycosmis pentaphylla

Family: Rutaceae *Glycosmis pentaphylla* Correa.	Treatment of bilious complaints, cough, jaundice, fever, inflammation, rheumatism, anaemia, vermifuge. Also known for its hepatoprotective, antiinflammatory, antimicrobial, antiulceritive, chemoprotective, antipyretic, antitumor, wound healing and insecticidal activity.

Medicinal Utilization values: 0.37

Toddalia asiatica

Treatment of sprains, convulsions, intercostal neuralgia, cough, malaria, garstral dysentery, snakebite and furnucle. Possess antiviral, antimalarial and anticancer effect

Medicinal Utilization values: 0.27

Murraya koenigii

A **number of pharmacological activities such as anti-tumor, anti-oxidative, anti-mutagenic and anti-inflammatory have been reported**

Medicinal Utilization values: 0.27

Zanthoxylum acanthopodium

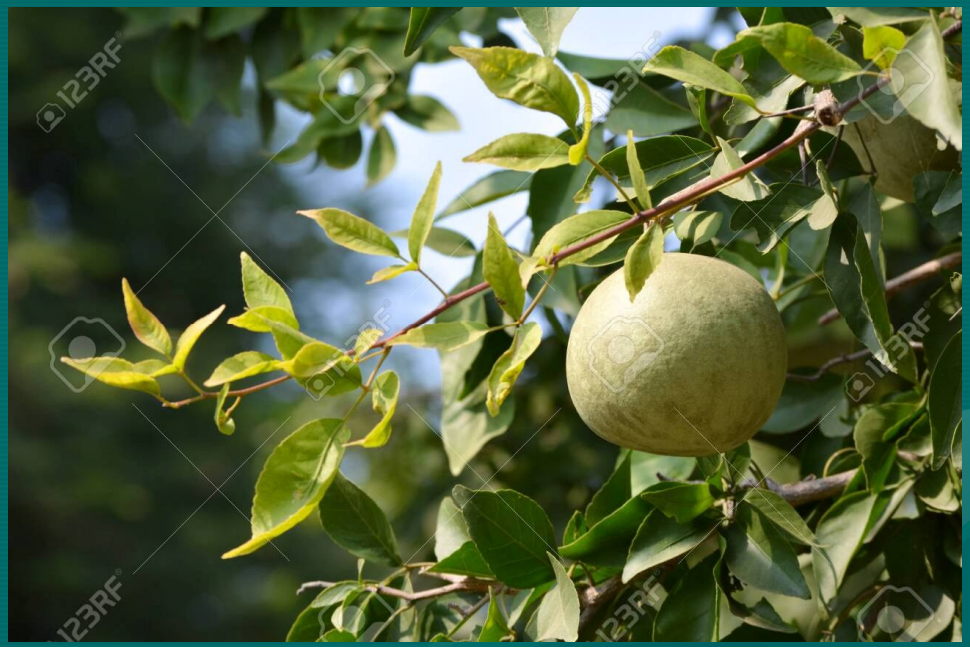
Treatment of fever, gastric problems, liver complaints and dental problems. Possess antihelminthic and carminative properties.

Medicinal Utilization values: 0.18

Clausena excavata

Treatment of nausea, constipation and cardio-vascular disorders, Also possess anti-inflammatory and spasmolytic properties.

Medicinal Utilization values: 0.29



Aegle marmelos

Known to lower blood glucose levels. Plant also possesses antifungal properties

Medicinal Utilization values: 0.22

Citrus aurantifoliun

Effective against dyspepsia, asthma, obesity, sleeplessness

Medicinal Utilization values: 0.38

Citrus grandis

Possess antioxidant, antimicrobial and antidiabetic properties. Effective as a cardiac stimulant and stomach tonic.

Medicinal Utilization values: 0.32

Citrus medica

Acts as astringent and to treat blood disorders. Also possess analgesic, antidiabetic, antitumor, antimicrobial and hypocholesterolamic properties.

Medicinal Utilization values:0.44

Citrus limon

Provides relief from cough and cold, fever, soreness, rheumatism, kidney disorders, cardiac diseases, anaemia and digestive problems

Medicinal Utilization values: 0.23

LARVAL PAPILIONIDS

Spot swordtail

Lim,e butterrly

Common jay

tailed jay

5 bar swordtail

Crimson rose

Red helen

Common mormon

HigHly PolyPhagous species

Graphium cloanthus Westwood	**Family: Magnoliaceae** *Michelia champaca* Linn. *Michelia doltsopa* Buch.-Ham. ex DC. **Family: Lauraceae** *Cinnamomum camphora* (L.) J. Presl. *Persea odoratissima* (Nees) Kosterm.
Graphium sarpedon (Linnaeus)	**Family: Annonaceae** *Polyalthia longifolia* Hk. f. & T. **Family: Lauraceae** *Cinnamomum camphora* (L.) J. Presl *Persea odoratissima* (Nees) Kosterm
Graphium eurypylus (Linnaeus)	**Family: Annonaceae** *Annona reticulata* L *Polyalthia longifolia* Hk. f. & T. **Family: Lauraceae** *Cinnamomum camphora* (L.) J. Presl

PI values:3.873

Graphium doson (C.& R. Felder)	**Family: Magnoliaceae** *Michelia champaca* Linn *Magnolia grandiflora* L **Family: Annonaceae** *Polyalthia longifolia* Hk. f. & T.
Graphium agamemnon (Linnaeus)	**Family: Magnoliaceae** *Michelia champaca* Linn **Family: Annonaceae** *Annona squamosa* Linn *Annona reticulata* L *Polyalthia longifolia* Hk. f. & T
Papilio polytes Linnaeus	**Family: Rutaceae** *Glycosmis pentaphylla* Correa. *Citrus grandis* (L.) Osbeck *Citrus limon* (L.) Burm. f. *Aegle marmelos* Correa. *Citrus medica* Linn. *Murraya koenigii* Spreng.

PI values:3.464

Papilio demoleus **Linnaeus**	**Family: Rutaceae** ***Glycosmis pentaphylla*** **Correa.** ***Citrus grandis*** **(L.) Osbeck** ***Aegle marmelos*** **Correa.** ***Citrus medica*** **Linn.**

PI values:3.000

Stictly monophagous species

Graphium chironides (Honrath)	**Family: Magnoliaceae** *Magnolia pterocarpa* Roxb.
Graphium nomius (Esper)	**Family: Annonaceae** *Polyalthia longifolia* Hk. f. & T
Atrophaneura polyeuctes (Doubleday)	**Family: Aristolochiaceae** *Aristolochia tagala* Cham. & Schlect.
Atrophaneura aidoneus (Doubleday)	**Family: Aristolochiaceae** *Aristolochia saccata* Wall.
Troides helena (Linnaeus)	**Family: Aristolochiaceae** *Aristolochia tagala* Cham. & Schlect.

PI values:1.000

DISCUSSION:

A cocktail of terpenes (α-pinene, sabinene, β-myrcene, limonene, β-phellandrene, ocimene, germacrene-A, bisabolene, germacrene-B, oxygenated sesquiterpenes and 3-hydroxy-2-butyrate) released by fourth instar larva along with aliphatic acids and their esters in fifth instar are worth mentioning.

Papilionii exudates reveal presence of terpenoids in fourth instar followed by aliphatic acids in final instar stage

Graphini (*G. doson* and *G.antiphates*) are known to possess aliphatic acids and their esters in both the final instar stages

troidinii upon sequestering AAs are know to generate a primary line of defence against birds and vertebrates

Acknowlegment:

The author is highly grateful to Prof. Narayan Ghorai for his valuable suggestion and cooperation during the study. The constant support and encouragement of the faculty members of the Department of Zoology, West Bengal State University is also acknowledged.


THANK YOU