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PHARMACOGNOSTIC AND PHARMACOLOGICAL REVIEW ON *CHOEROSPONDIAS AXILLARIS*

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ABSTRACT

Herbal plants are probably assured for a comeback as like sources of ethnic health products in the main due after their vast desire in accordance with synthesize complicated combinations on structurally diverse compounds, which ought to furnish a safer than more holistic approach in conformity with disease cure and prevention. *Choerospondias axillaris* (CA) Linn belonging to the family Anacardiaceae, who have various pharmacognostic properties. CA includes extensive sorts on bioactive compounds as flavonoids, vitamin C, phenols, quercetin, gallic acid, daucosterol. Its bark and fruits were consists properties like anti- inflammatory, detoxification, hemostasis, burn treatments. Furthermore, pharmacological activities like antioxidant immunity stimulant, hepatoprotective, cardioprotective activities have been additionally acknowledged recently. Till now, no action has been published in conformity with elaborate the pharmacognostic functions of CA Linn. The existing decrial is therefore, an endeavor to relinquish a clear estimate of its pharmacognosy and phytochemistry and a considerable survey over its pharmacological activities.

KEYWORDS: *Choerospondias axillaris*, Pharmacognostic, Pharmacological and Bioactive Compounds.

INTRODUCTION

Natural products with therapeutic properties are as ancient as like ethnical civilization and for a long interval. Mineral, plant and animal products were the predominant source of drugs. Almost every ancient civilization herbs played a major role in treating ailments and for revitalizing body systems. Majority of modern medicine, individual pure drugs emerged or

drive into derived active principles, their semi- synthetic and synthetic analogs hold served as much an essential path to instant pharmaceuticals. Global testing and processing of novel medicinal drug along with its potency is evolving day by day. Several methods are applied for the evaluation on medicinally active crude drugs for instance morphological, phytochemical and pharmacological or a variety of chemical screening. Different medicinally active compounds within medicinal plants shed a vital function within the control of disease. Fruit of *Choerospondias axillaris* containing vitamin C, Phenol and flavonoid compounds are consumed to enhance the immunity and neutralize free radicals formed in the body. Vitamin C is required to form collagen, growth, reproduction, resist diseases and for immunity.[1] Its bark and fruit have the functions of anti- inflammation, detoxification, hemostasis and treatment of external burns. Ten compounds were isolated from the dry fruit of *Choerospondias axillaris*. Their structures were elucidated as dihydroquercetin, quercetin, protocatechuic acid, gallic acid, 3,3'-di-o-methylellagic acid, beta-sitosterol, daucosterol, stearic acid, triacontanoic acid and octacosanol.[2] Different research have reported that plants with constituents like quercetin, protocatechuic acid, gallic acid, beta- sitosterol and octacosanol have potent anti hyperlipidemic properties.

The present epoch requires a modern biologically active remedy molecule, which reveals therapeutic activity, so as to enhance the large spectrum of medicinal usages.

Figure 1: *Choerospondias axillaris.*

Table 1: Taxonomical classification.

Plant name	*Choerospondias axillaris* Linn.
Division	Tracheophyta
Class	Magnoliopsida
Subclass	Rosidae
Order	Sapindales

Family	Anacardiaceae
Genus	*Choerospondias*
Species	*axillaris*

Table 2: Vernacular name.

Language	Vernacular name
English	Hog plum
Nepali	Lapsi
Hindi	Lupsi
Chinese	Guangzao

General description

C. axillaris is a large, deciduous, edible native fruit tree of Anacardiaceae family and also known as hog plum. Hog plum is a deciduous tree that can grow up to 30 meters tall, though is usually smaller. Native to hilly region in Nepal (850–1900 m), the tree has also been reported from India, China, Laos, japan and East Asia. The plant is especially valued for its edible fruit and is being increasingly cultivated for this purpose. Fruits are consumed fresh, pickled and processed for preparing a variety of sweet and sour, tasty food and candy.[3] Its fruits containing vitamin C, Phenol and flavonoid compounds are consumed to enhance the immunity and neutralize free radicals formed in the body. The fruit wall (pericarp) is used medicinally to promote the flow of blood. Lapsi is reported to be consumed during religious ceremonies for its symbolic significance. It is used for medicine, and as a business commodity. Its wood is used for fuel and construction. Its forage is occasionally used to feed livestock.[4,5] The outer bark of lapsi as dark grey or red brown and the inner bark as red. The bark is also described as cracked, and peeling in vertical flakes. The bark is used for treating secondary burns.[6] Its fruit is about 3 centimeters long and has a soft whitish sour flesh and green to yellow skin. Fruit consist 5 depressions at top, with 1 large stone with up to 5 holes. The fruit is made into pickles, fruit tarts, and sour, spicy candy in Nepal. The tree has long been cultivated in rural Nepal for its fruit. The fruit is nutritious and has a price comparable to the mandarin orange on the Nepalese market.[7] It is also used as a pioneer fruit tree in reforestation projects. Plants commence fruiting when about 7 - 10 years old from seed. Leaves are compound, alternate and spiral, glabrous, imparipinnate, leaflets opposite, narrowly ovate or lanceolate, margin toothed or not, domatia hairy. Midrib flat above, secondary veins oblique, widely parallel, tertiary veins reticulate. Stipules are absent. In relevance to habitat and ecology it is fairly common in hill evergreen forest.

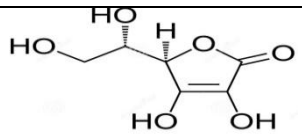
Established trees and seedlings grow from February to November December, at which time leaves begin to abscise. Lapsi trees begin to lose their leaves beginning mid to late November with the majority of leaf drop occurring early to mid-December. Trees may hold on to their leaves up to January. Dormancy lasts until February when bud break occurs. Flowers develop soon after bud break and continue for about 2 weeks. Flowering only occurs after 7 to 10 years of growth (Paudel, 2003).[7]

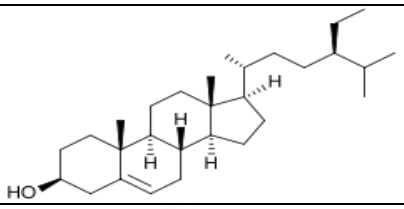
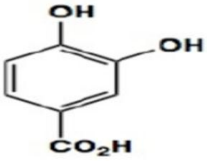
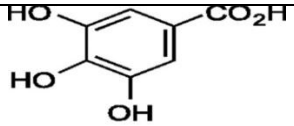
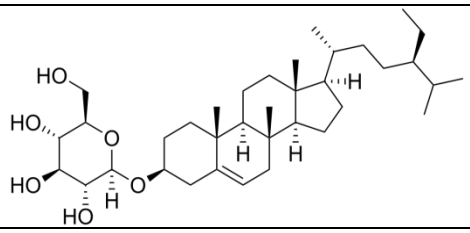
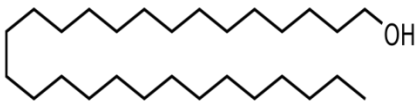
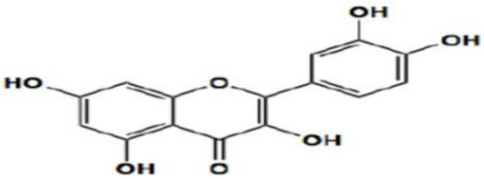
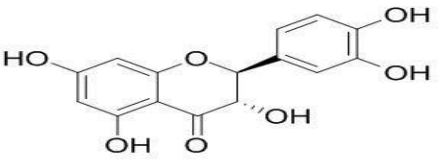
Bioactive constituents

The crops were typically consists of flavonoids, alkaloids, triterpenoids, n-alkanes, tannins and saponins. *C. axillaris* leaves and fruits reported in imitation of contain dihydroquercetin, quercetin, protocatechuic acid, gallic acid, 3,3'-di-o-methylellagic acid, beta-sitosterol, daucosterol , stearic acid, triacontanoic acid, octacosanol by IR, EI-MS and NMR. The bark was stated in imitation of contain fatty alcohols, flavonols, 1-octacosanol, Quercetin, taxifolin. Shyam Narayan labh et al implicated the availability on a number of Polyphenols, carotenoids (provitamin A), vitamins C and E present in fruits have antioxidant and free radical scavenging activities and play a significant role in the prevention of many diseases.[8]

The volatile organic compounds in the ethanol extracts of *Choerospondias axillaris* were mainly alcohols, petroleum ether extracts were mainly alkanes and organic acids, and phenyl ethanol extracts were mainly esters. Among the three kinds of jujube extracts, nonanal, beta-caryophyllene, humus and caryophyllene oxides and other bioactive Volatile organic compounds (VOCs) were observed. The total content of VOCs from high to low was petroleum ether extract, ethanol extract and benzene/ethanol extract.[9]

Table 03: The structures of some of the important bioactive constituents.

Name	Structure
Vitamin c (ascorbic acid)	
Stearic acid	

Sitosterol	
Protocatechuic acid	
Gallic acid	
Daucosterol	
Triacontanoic acid	
Octacosanol	
Quercetin	
dihydroquercetin	

Bioactivities of *C. axillaris* and Potential use in pharmacology

C. axillaris is both an edible and medicinal fruit. It has a growing popularity and economic importance due to its nutritive value and medicinal effects, but comprehensive information on the chemical composition and bioactivity of its fruits is still lacking. Therefore investigation in the antioxidant, antimicrobial and antiproliferative effects and chemical composition of peel polyphenolic (PP) and flesh polyphenolic (FP) extracts from *C. axillaris* has been tested.[10]

Choerospondias axillaris commonly known as Lupsi/Lapsi and has been reported to have several properties for the treatment of various diseases. Methanolic extract of the *Choerospondias axillaris* fruit was used for determining phytochemical, antioxidant and anti-inflammatory properties. Antioxidant activity of *Choerospondias axillaris* fruit was determined by free radicals scavenging assays and bioactive compounds were identified via LC-MS/MS analysis. Anti-inflammatory effect was investigated in rheumatoid arthritis (RA) and Osteo Arthritis (OA) primary cells and also in Collagen Induced Arthritis (CIA) rat models. Different studies showed significant decline in the levels of inflammatory cytokines. Docking analysis revealed that quercetin inhibits TNF-α having -9.1 kcal/mol binding energy and 10.13 μm inhibitory constant. Observed results suggest that the underutilized fruit *Choerospondias axillaris* can be used to reduce the inflammation of inflammatory diseases like RA.[11] The presence of polyphenols, carotenoids vitamins C and E in fruits have antioxidant and free radical scavenging activities.[11]

Variety of ailments can be cured by using the different components of this plant like fruits, leaves, bark. The plant is acknowledged for its hepatoprotective endeavor into rats and antioxidant strong against cyclophosphamide induced abnormalities in rats. Fruits can also be ingested to raise the immunity.

Table 04: Scientific Work and Pharmacognostic Approaches of *C. Axillaris.*

Pharmacological activity	**Part of plant used**	**Process of extraction**	**Impression**
Enhancing Growth	Fruit	Ethanolic Extraction	All the rohu (fish) fed with diets supplemented with ethanol extract of lapsi fruit showed better growth than control group. Results indicate that rohu needs vitamin C Supplemented diet for better growth. Several species of fish including rainbow trout and Korean rockfish fed with diet containing sufficient vitamin C showed better growth. Growth rates in fishes depend upon the amount of vitamin C present in the diet. [1]

Antioxidant Properties	Fruit	Ethanolic Extraction	Different concentrations of the extracts of lapsi *C. axillaris* ranging from 10 to 640µg/ml were tested for their anti-oxidant capacity as measured by DPPH radical scavenging assay method. Higher radical scavenging effect was observed in both the ethanol and aqueous extracts of lapsi fruits. The solvent appears to be ideal for extracting antioxidant molecules (after testing the radical scavenging power of different plants using aqueous and ethanol Solvent). Ethanolic extract scavenged more than 99% of DPPH radicals at 640 µg/ml concentration, while aqueous extract recorded 91%. Both the extracts are comparable to the ascorbic acid (95%) which served as control. The higher radical scavenging effect observed in the test sample may be attributed to the ability of the lapsi fruits to donate its electron to free radicals in other to break the chain of reaction. [8]
Anti-inflammatory Action	Fruit	Methanolic Extraction	Anti-inflammatory effect was investigated in RA and Osteo. Arthritis (OA) primary cells and also in Collagen Induced as arthritis (CIA) rat models. In-vitro and in-vivo studies show significant decrease in the levels of inflammatory cytokines. Docking analysis revealed that quercetin inhibits TNF- α having -9.1Kcal/mol binding energy and 10.13µM. Inhibitory constant. Quercetin also inhibits IL-6 having -6.6 kcal/mol binding energy and 21.9 µM inhibitory Constant. *C. axillaris* fruit can be used to minimize the Inflammation of inflammatory diseases. [11]
Immunological Action	Leaves	Methanolic Extraction	The mid and high dose of total flavones from leaves of *C. axillaris* (TFLCA) and levamisole (0.0025 g/kg significantly enhanced the phagocytic activity of mononuclear macrophage in mice. TFLCA enhanced phagocytic function, cellular immunity and humoral immunity in dose depend manner. It was also involved in regulation of immune response. [12]
Cardiovascular Action	Fruit	Methanolic Extraction	Pretreatment with total flavonoid of *C. axillaris* TFC strongly Improved cardiac function, obviously reduced heart pathologic leasons in ischemia/reperfusion (I/R) rat hearts. TFC protect the heart from I/R injury by increasing the levels of catalase, glutathione peroxidase and superoxide dismutase in heart homogenate, and decreasing that of malondialdehyde level.

			These effects were associated with the decrease in TUNEL- positive nuclear staining, BAX and Caspase-3 levels and the increase in BCL-2 expression. [13]
Cytotoxic-Action	Fruit	Methanolic Extraction	Fruit extract exhibited differential cytotoxic effect when tested in a panel of pediatric cancer cell lines. Bioassay guided fractionation led to purification of 5 new Hydroquinone based metabolites, choerosponols A-E (1-5), bearing unsaturated hydrocarbon chains. The Structures of natural products were determined using a combination of 1D and 2D NMR, ECD spectroscopy. The Purified compounds were evaluated for their cytotoxic and anti-proliferative activities, revealing that one, which contains a benzofuran moiety, exhibited over 50-fold selective anti-proliferative activity against Ewing sarcoma and medulloblastoma cells with growth inhibitory (GI50) values of 0.19 and 0.07 µM, respectively. [14]
Hematological Properties	Fruit	Ethanolic Extraction	Significant differences were observed in hematological parameters of treated diets fed groups to that of control fed group in common carp *cyprinus carpio* fingerlings. Hb, RBC, PCV, WBC and other blood Indices were observed to be significantly higher in the treated groups as compared to the control. It was concluded that a minimum amount 0.4% (0.4g kg-1) of lapsi fruit extracts in fish feeds elicited more increase in hematological parameters of common carp. [15]

Our body defense instruction is well set up against reactive oxygen species (ROS) by means of the help of antioxidants. The ROS are the hazardous by way of out of the medicinal factor over consider fruits are most intrinsic as an anti-inflammatory, anti-oxidant, anti-stress, anti-proliferative and cardioprotective activity products generated at some stage in normal cell aerobic respiration. Lapsi sap contains many compounds, some of which have medical applications. One protease has been found to treat secondary burns (Upadhyay, 2013).[16] Extracts of lapsi have been found to have antiviral properties and have been used to treat herpes simplex virus (Jo et al. 2005).[17] Flavonoid and phenolic extracts, quercetin and gallic acid respectively, of lapsi fruit have been used as a medicine for cardiovascular diseases (Wang, Gao, Zhou, Cai, & Yao 2008).[18] Quercetin has also been shown to reduce the development of neurodegenerative diseases (Bentz, 2009).[19] The phenolic compounds hold antioxidant activity, fit according to their redox properties via which they act as like

hydrogen donors, reducing agents and singlet oxygen quenchers. Phenolics are the secondary drive into metabolites that are easily handy in the plant kingdom and bear abundant services between cosmetic, food and pharmaceutical industry. [20]

DISCUSSION

Since ancient times immemorial human beings are relied on plants for the survival. The relationship among ethnical and plants has been close during the development of human culture. The ancient ethnic gained abilities on the medicinal value of the herbs by way of the use of them for different ailments. Several remedies can be derived from natural resources that can be incorporated in the treatment of ailments over mankind. Since the dawn about civilization, among addition in imitation of cultivation regarding plants for food and livelihood however some person may cultivate herbs for medicinal purpose. The search for instant biologically active compounds from herbal sources has always been regarding significant activity. Most often, a desired biological explanation is not due according to certain factor though rather after a combination of bioactive plant components.

Hence, crude extracts need to be screened because of organic endeavor and after any active banish must be fractionated directed including bioassays in accordance with exploit the bioactive compounds. *C. axillaris* yields the fruits with high amount of vitamin C which can be consumed fresh, pickled or processed into variety of sweet and sour fruit products and candy. Natural antioxidants present in the plants scavenge harmful free radicals from our body when consumed in the diets.[21] They play very important role in human health and beneficial in combating against several diseases like cardiovascular disorders, lung damage, inflammation etc.[22]These free radicals are highly unstable and when over produced in the body, it can damage the cells and tissues and may involve in several diseases. Thus, there is a need for antioxidants of natural origin because they can protect the body from any free radicals related diseases.[23]

Aqueous and alcoholic extract of fruits has revealed the presence of most of the phytoconstituents and moreover the presence of these phytochemical compounds in the ethanolic extract has showed maximum antibacterial activity in several studies.[24]

CONCLUSION

The current attempt was to censure and assemble updated information on a top mentioned factor of *C. axillaris* including mechanism based pharmacological venture of the plant. These

compositions embellish the key potential over *Choerospondias axillaris* and also originate focus on the viable modern therapeutic usage for the betterment on pharmaceutical entities for superior health outweigh in the future.

Conflict of interest statement

We declare that we have no conflict of interest.

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