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An Analysis of Origin and Medicinal Properties of Lotus

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ABSTRACT: ***In China and India, the perennial aquatic plant Nelumbo nucifera Gaertn has been utilized as a medicinal herb. For more than 400 years, it has been documented in China's most renowned medical book. In traditional medicine, several parts of the plant (leaves, seeds, flower, and rhizome) may be utilized. The various parts of the plant are said to have beneficial effects in the treatment of pharyngopathy, pectoralgia, spermatorrhoea, leucoderma, smallpox, dysentery, cough, haematemesis, epistaxis, haemoptysis, haematuria, metrorrhagia, hyperlipidaemia, fever, cholera, hepatopathy, and hyperdipsia in traditional medicine. Researchers have made significant attempts to validate N.nucifera's usefulness via rigorous pharmacological tests, based on traditional claims for its usage as a treatment for a variety of illnesses. N.nucifera has been found to have anti-ischemic, antioxidant, anticancer, antiviral, antiobesity, lipolytic, hypocholestemic, antipyretic, hepatoprotective, hypoglycaemic, antidiarrhoeal, antifungal, antibacterial, antiinflammatory, and diuretic properties in pharmacological investigations. The plant has been used to isolate a broad range of phytoprinciples. The current study aims to bring together traditional, ethnobotanic, phytochemical, and pharmaceutical knowledge on Nucifera nucifera.***

KEYWORDS: ***Aquatic, Flower, Lotus, Medicine, Nelumbo Nucifera.***

1. INTRODUCTION

Nelumbo nucifera, which is currently classified as a monogeneric species in the Nymphaeaceae family, is known by a variety of common names and synonyms, including Indian lotus, Chinese water lily, and holy lotus (Nelumbium nelumbo, N. speciosa, N. speciosum and Nymphaea nelumbo). Only two species of Nelumbo exist in the world: N. lutea Willd. (Synonyms: N. pentapetala (Walter) Fernald and Nelumbium luteum Willd.) and N. nucifera (synonyms: N. speciosa Willd, Nelumbium speciosum Willd, Nelumbium N. Druce, and Nymphaea N. L). The Indian or holy lotus, N. nucifera Gaertn., is distributed across Asia and Australia, while the American lotus or water chinquapin, N. lutea, is found in eastern and southern North America. N. lutea is classified as a subspecies of N. nucifera. N. nucifera, also known as lotus, kamala, or padma in India, is an aquatic plant that requires lots of room and full light to flourish. It bears green fruits and strong, spreading yellow rhizomes. Aerial and floating orbicular leaves are big, 20-90 cm in diameter, abruptly sharp to create a short tip, petiolate, whole glaucous, non-wettable, firmly cupped in the case of aerial leaves and flat in the case of floating leaves. Fruit is a clump of non-degradable nutlets. Ripe nutlets are ovoid, roundish, or oblongish in shape, up to 1.0 cm long and 1.5 cm wide, with a firm smooth brownish or grayish black pericarp that is slightly longitudinally striated, pedunculated, and seeded. The ripe carpel is filled with seeds. There are two types of ‘kamala': one with white flowers, known as ‘pundarika' or ‘sveta kamala,' and the other with pink or reddish-pink blooms, known as ‘rakta kamala [1].'

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, Sep 2022

Lotus is an aquatic perennial plant. It is a member of the Nelumbonaceae family, which has just one genus, Nelumbo, and two species, Nelumbo nucifera Gaertn. and Nelumbo lutea Pear., which are known as Asian and American lotus, respectively. Lotus refers to Asian lotus, which is found predominantly in Asia and northern Oceania, while American lotus is found mostly in the eastern and southern portions of North America, as well as northern South America. These two species have different exterior morphologies, such as petal color and form, leaf shape, and plant size, due to their separation by the Pacific Ocean. Despite this, they have the same chromosomal number (2n = 16) and have a similar life style, with each generation having a life span of approximately five months. Crossing these two species may result in an F1 generation that is completely sterile. Despite the fact that there are only two species of lotus in taxonomy, there are many germplasms all over the globe with diverse genetic origins and phenotypes, particularly in Asia. The lotus is also a primitive eudicot, making it a significant species in plant phylogeny and evolution research [2].

Because of its religious importance in Buddhism and Hinduism, the Asian lotus is also known as holy lotus. In Chinese traditional culture, it is an excellent emblem. Sacred lotus is a popular decorative plant because of all of these characteristics. It's also a popular food and traditional medicinal plant in Southeast Asia, having a high economic worth. With thousands of years of lotus cultivation and breeding history, China is considered one of the main hubs for lotus cultivation and breeding. Large numbers of lotus cultivars have been produced as a consequence of extensive breeding, domestication, and cultivation, with varying shape and other characteristics. According to their practical use, farmed lotus is classified into three categories: rhizome, seed, and flower lotus. The lotus rhizome and seed are not only edible, but they may also be utilized for lotus multiplication, while the flower lotus is mostly employed for decoration and environmental betterment. Sacred lotus may be divided into two ecotypes, temperate lotus and tropical lotus, based on the climatic areas they are used to. After blooming, the rhizome of the temperate lotus enlarges, and the leaves wither. The tropical lotus, on the other hand, has a whip-like rhizome that has a longer green phase and blooming time [3].

The holy lotus has piqued the scientific community's attention due to its significance in gardening, therapeutic application, and plant phylogeny. Having adequate basic information about this plant will definitely help with lotus breeding and application. The genomes of two holy lotus germplasms were recently sequenced and published, allowing for further research into this plant. There are over 1000 scientific papers on various parts of the lotus to date, with half of them published in the past decade. In this study, we reviewed the most recent advances in holy lotus research in order to offer a complete understanding of the fundamental biology and economic applications of this essential plant, which may also be useful in future lotus breeding and germplasm improvement investigations [4].

1.1.Unique Properties of Lotus:

Lotus contains not just the typical characteristics of an aquatic plant, but also certain distinctive characteristics that set it apart from other plant species. Seed lifespan, leaf ultra-hydrophobicity, and floral thermoregulation are among these characteristics. Understanding the processes that contribute to the development of these distinct characteristics is critical not only for fundamental plant biology, but also for bionics applications [5].

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, Sep 2022

The lifespan of the lotus fruit is well-known. It has been claimed that lotus seeds buried underground for over 1300 years in China's northeast may still germinate. Understanding the fundamental process of lotus seed lifespan may help improve seed storage in agriculture, as well as human health care [6]. Ultra-hydrophobicity, commonly known as the "lotus effect," is shown by Lotus leaves. This ultra-hydrophobicity trait may guarantee that the top epidermis of the leaf is not coated with water, allowing the stomata to function normally. Ultra-hydrophobicity is thought to be an advantage in the development of the lotus as a result of this. It is accomplished, according to studies, by a thick coating of waxy papillae on the surface of the lotus leaf. Further research revealed that the readily rolling water droplets may aid in the removal of dirt particles stuck to the leaf surface, resulting in a self-cleaning effect that is highly dependent on the contact angle. Two wax biosynthesis-related genes from the lotus were cloned and transformed in Arabidopsis, resulting in a change in the cuticle wax structure in flower stems and proving their role in the production of extra-long fatty acids. More research into the chemical compositions and structure of lotus leaves may be extremely useful in developing materials with super hydrophobicity and self-cleaning properties [7].

Floral organ thermogenesis, which occurs independently at the receptacle, stamen, and petal, is another unique characteristic of the lotus. This feature was discovered in the floral organs as a consequence of a cyanide-resistant alternative oxidase pathway, which prompted considerable research into alternative oxidases and plant uncoupling mitochondrial proteins. This thermogenic characteristic seems to be biologically essential for the lotus' sexual reproduction by attracting insect pollinators. According to studies, the produced heat may either offer a warm habitat for thermo-sensitive pollinators or assist in the production of volatile chemicals that attract flying insects, particularly beetles. Heat is generated only before anthesis, which culminates in pollination and a fertilized ovary. After anthesis, there is no need to attract pollinators, and the floral organs' primary role, particularly the receptacle, shifts to photosynthesis. Exploring the mechanism that regulates this kind of metabolic shift will be crucial [8].

1.2.The Flower of Lotus:

The lotus flower is one of China's top ten traditional renowned flowers, and it is also India and Vietnam's national flower. It is commonly grown for its aesthetic value, which may be ascribed to its beautiful color and varied form and shape. Flower color and form are the two most important elements in determining the aesthetic value of ornamental plants. The three primary hues of lotus petals are white, red, and yellow, with the first two colors seen exclusively in Asian lotus and the latter in American lotus. Many cultivars with mixed hues have been developed via breeding and artificial selection in order to increase their aesthetic value. The concentrations of carotenoids and anthocyanins, respectively, are primarily responsible for the yellow and red hue of various genotypes, according to a large-scale study of the pigment composition of different germplasm. Anthocyanin biosynthesis regulation is comparable in lotus and Arabidopsis, according to a genome-wide study of the MYB gene family, and overexpression of NnMYB5 in Arabidopsis resulted in anthocyanin accumulation in immature seeds and flower stalks. Despite this resemblance, a comparative proteomics analysis of white and red cultivars revealed that the lack of anthocyanin production in the white flower lotus may be due to the expression of the ANS gene. Further investigation revealed that the two cultivars

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, Sep 2022

had distinct amounts of methylation in the promoter regions of the ANS gene, indicating epigenetic control of this gene's expression. However, the gene that causes the red and white lotus cultivars to have differing levels of methylation on the promoter of the ANS gene is yet unclear. In addition, certain cultivars have a genetically consistent speckled hue, which is yet unknown. Exploring the mechanism behind the control of spotted color in lotus will be crucial not only for flower lotus breeding, but also for expanding our understanding of plant flower colouring [9].

1.3.Rhizome and Seeds:

Because of its edible rhizome and seeds, lotus is not only an attractive plant, but also a food. Lotus has a subterranean stem that has been morphologically changed. The subterranean stem of the temperate ecotype is expanded in fall, which is known as rhizome. The rhizome is a popular edible vegetable because it includes a lot of carbohydrates, proteins, and vitamins. The economic worth of a lotus rhizome is mainly determined by its size. Furthermore, the larger rhizome may aid the lotus in surviving winter during its bud hibernation, as well as providing substrates and energy for asexual propagation. This process is comparable to the tuberization of potatoes, which has been shown to be controlled by a complex genetic network. As a differentiating characteristic between temperate and tropical lotuses, it may also aid in the study of the lotus' development and domestication. In a lotus, rhizome expansion seems to be closely linked to blooming. The expansion usually happens after blooming. Genetic and transcriptome research focused on the expansion of this rhizome have been performed with the goal of improving its output in agricultural agriculture.

Apart from its lifespan, lotus seed is also delicious, whether fresh or dried, and contains chemicals such as alkaloids, flavonoids, and some micronutrients, which provide it further therapeutic usefulness. Varying lotus cultivars have different sizes and numbers of seeds per seedpod. In the development of lotus seeds, it is critical to improve both nutrition and yield. Comparative proteomics and metabolomics investigations on lotus seeds were performed throughout their development to accomplish this, which not only improved our knowledge of lotus seed development, but also identified candidate genes important for lotus seed size. Furthermore, a comparative transcriptome study was performed between two lotus germplasms with differing seed size and seed number per seedpod characteristics. Seed yield, like rhizome yield, is a quantitative characteristic that needs more genetic research. Meanwhile, because of its therapeutic value, a thorough study of its metabolites throughout seed growth is required [10].

1.4.Uses of lotus described in traditional medicine:

Humans have utilized plants as a source of medicine since the dawn of humanity. Many traditional societies' indigenous knowledge has been formalized, recorded, and ultimately incorporated into structured medical systems such as ayurveda, siddha, unani, and other Indian systems. This plant is used as a diuretic and anthelmintic in Ayurvedic medicine to treat strep throat, vomiting, leprosy, skin disorders, and mental fatigue. It is used in traditional medicine to treat tissue inflammation, cancer, skin disorders, leprosy, and as a poison antidote. Rhizomes are used to treat haemorrhoids and are also used to treat diarrhea, chronic dyspepsia, and have nutritional, diuretic, and cholagogue properties. The stem is used as a diuretic, anthelmintic,

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, Sep 2022

and to cure strangury, vomiting, leprosy, skin illness, and mental fatigue in traditional Ayurvedic medicine. Haematemesis, epistaxis, haemoptysis, haematuria, metrorrhagia, and hyperlipidaemia are all treated with the leaves. Diarrhoea, cholera, fever, and stomach ulcers may all be treated with the flowers. In Asia, the seeds and fruits are used as a health food and to treat a variety of ailments, such as poor digestion, enteritis, chronic diarrhoea, insomnia, palpitations, spermatorrhoea, leucorrhoea, dermatopathy, halitosis, menorrhagia, leprosy, tissue inflammation, cancer, fever, and heart complaints, as well as an antiemetic, poisoning antid Lotus seedpods are occasionally used in traditional medicine to help with hemostasis. Coughs may be treated with a mixture of seed powder and honey. Traditional Chinese medicine uses lotus seed embryos to treat mental problems, sleeplessness, high fevers (with restlessness), and cardiovascular illnesses.

2. DISCUSSION

Lotus (Nelumbo nucifera) is a perennial aquatic basal eudicot that belongs to the tiny Nelumbonaceaceace family, which only has one genus and two species. It is a significant horticultural plant that has been extensively utilized, particularly in Southeast Asia, for decorative, nutritional, and medicinal purposes. The lotus has recently gotten a lot of attention from the scientific community. A growing number of academic articles devoted to it have been published, shedding insight on the species' secrets. We examined the most recent research on the lotus, including phylogeny, genetics, and the molecular processes behind its distinctive characteristics, as well as its economically significant qualities. Meanwhile, existing limits in lotus research were addressed, and possible future directions were suggested. With the production of germplasm suited for laboratory operation and the construction of a regeneration and transformation system, we think the lotus will become an important model plant in horticulture.

Pharmacological studies on N.nucifera have revealed that its various organic and aqueous extracts have a wide range of multidimensional pharmacological activities, including anti-ischaemic, antioxidant, hepatoprotective, anti-inflammatory, anti-fertility, anti-arrhythmic, anti-fibrosis, antiviral, antiproliferative, antidiarrheal, hypoglycaemic, and psychoactive properties. A broad variety of chemical components are also said to be present in the plant. These chemicals may be used as a starting point for the development of new medicinal medicines. Further research on N.nucifera should be planned to study the molecular mechanism(s) of action of isolated phytoprinciples utilizing specialized biological screening models and clinical trials, as well as to find new leads from them, now that primary investigations are available. In addition, research should be conducted to standardize the different extracts of N.nucifera for usage in particular herbal compositions. The information provided here emphasizes the value of traditional medicine. Nucifera nelumbo

3. CONCLUSION

Lotus is receiving increasing interest from the scientific community because to its importance in the everyday lives of people in South and East Asia, as well as in agricultural and therapeutic uses. There have been many research on virtually every element of this plant, including phylogeny and evolution, genomics, genetics and breeding, and therapeutic use. With the publication of its genome material, -omics and molecular genetics research focused on the

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, Sep 2022

plant's economic characteristics have risen to the fore, and will certainly have a significant impact on lotus breeding. Unfortunately, there are still certain constraints that hinder research on this species, particularly molecular biology research. The first one may be the genome's assembly and annotation, which still needs to be enhanced. Second, in the scientific community, there is no widely recognized lotus cultivar or germplasm that is frequently utilized for fundamental biology research. Because of its genetic homozygozity, the sequenced germplasm 'China Antique' may be an excellent choice. Finally, the poor effectiveness of the regeneration and transformation mechanism makes it difficult to conduct molecular genetic research on the lotus, which are necessary for studying gene function.

The lotus plant's unpredictable development and lengthy life span (five months each generation) are the fourth and final factors that restrict its cultivation in confined spaces. A variety of cultivars with tiny plant architecture and short life spans (three months' generation time) were produced via artificial selection in lotus, which are extremely popular in the decorative market, and called 'Wan Lian' (bowl lotus). It may be feasible to produce germplasm with both tiny plant size and the 'China Antique' genetic background by crossing these bowl lotus with 'China Antique' and then backcrossing breeding. This kind of germplasm may be appropriate for laboratory culture and, as a result, for future molecular research. Finally, lotus may be considered a developing model of horticulture plants, capable of being used to investigate a variety of unique characteristics in plants.

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