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A Review on: Antioxidant and Neuroprotective Potential of Bombax Ceiba Flowers: Implications for Parkinson's Disease Research

Pratiksha Ramdas Damse[1], Dr. Ganesh Phadtare[2], Dr. Sanjay Arote[3], Shubham Hanumant Dhavale[4], Smita Ashok Donagaon[5], Smita Sandip Jathar[6], Nisha Chandrakant Kalekar[7]

[1, 4, 5,6,7]*Student, IVM's Krishnarao Bhegade Institute of Pharmaceutical Education and Research, Talegaon Dabhade, Pune*

[2]*HOD, Department of Pharmacology, IVM's Krishnarao Bhegade Institute of Pharmaceutical Education and Research, Talegaon Dabhade, Pune*

[3]*Principal, IVM's Krishnarao Bhegade Institute of Pharmaceutical Education and Research, Talegaon Dabhade, Pune*

Abstract: ***Parkinson's disease (PD) is a progressive neurodegenerative disorder characterized by the selective loss of dopaminergic neurons in the substantia nigra, leading to motor and non-motor impairments. Oxidative stress, neuroinflammation, mitochondrial dysfunction, and neuronal apoptosis play a central role in the pathogenesis of PD. Although current pharmacological treatments provide symptomatic relief, they do not prevent neuronal degeneration, highlighting the need for safer and more effective neuroprotective agents. Medicinal plants rich in bioactive phytochemicals have gained attention as potential therapeutic alternatives. Bombax ceiba, an important plant in traditional medicine, is known for its diverse pharmacological properties, and its flowers are particularly rich in flavonoids, phenolics, tannins, and saponins. These constituents exhibit strong antioxidant and anti-inflammatory activities, which are essential in combating neurodegenerative processes. While direct evidence supporting the anti-Parkinson activity of Bombax ceiba flowers is currently lacking, their phytochemical profile and reported pharmacological actions strongly suggest a promising neuroprotective potential. This review summarizes the botanical characteristics, traditional uses, phytochemical composition, antioxidant and anti-inflammatory properties of Bombax ceiba flowers and discusses their possible implications in Parkinson's disease research. It also highlights existing research gaps and emphasizes the need for systematic experimental studies to validate their role as a novel plant-based neuroprotective agent in PD.***

Keywords: ***Bombax ceiba, Flowers, Parkinson's disease, Antioxidant activity, Neuroprotection, Phytochemicals, Neurodegeneration, Medicinal plants***

I. INTRODUCTION

Parkinson's complaint(PD) is a habitual, progressive neurodegenerative complaint substantially characterized by the loss of dopaminergic neurons in the substantia nigra region of the brain. This leads to motor symptoms similar as temblors, severity, bradykinesia, and postural insecurity. The major pathological mechanisms involved in PD include oxidative stress, mitochondrial dysfunction, neuroinflammation, and apoptosis of neurons. Presently available medicines similar as levodopa give characteristic relief but do n't help neuronal degeneration. Traditional drugs are being used more and more in the treatment of affections(1). Because of the wide use of drug, the WHO and numerous exploration- acquainted enterprises have inve)sted heavily in traditional herbal drug disquisition. Out of the 1562 certified specifics(from 1994 to 2014) 654 were natural product derivations, while the remaining 76 were either unchanged natural products or botanicals(2). Scientific attestations of medicinal shops came a thrust field of exploration as a result of this growing attention to traditional drug. The scientific validity of the red silk- cotton tree(for different natural conditioning) has been reviewed in the exploration(3)

A. Morphology

Growing to a height of 40 measures and a range of 6 measures, it's a altitudinous evanescent tree with pinpoints that are thick and stiff that cover the youthful stems and branches that stretch out horizontally. The dinghy can be any shade from light cadaverous slate to argentine tableware. There's an cornucopia of quencher in the tremendously large, sanguine flowers.Pine trees are characterised by their emulsion leaves, which have a palmate shape. Digitate, robust, spreading, and hairy, it has a common petiole

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and 15 – 30 cm long leaves. From 10 to 20 centimetres in length, the naiads vary in size. The fruit capsules can be as long as 15 mm and can be dark in colour.

Outside, they contain multitudinous black seeds that are oblong in shape, inversely distributed, sticky, and covered in thick silky hair. You can not beat the agreeableness and flavour of apple pulp. The colour of semul goo can range from pale brown to a deep, dark brown(4,5)



Fig.01 Flower



Fig.02 Flower

B. Botanical Profile of Bombax ceiba

1) Family: Malvaceae
2) Common names: Semal, Red silk cotton tree
3) Distribution: Widely found in India, Sri Lanka, and Southeast Asia
4) Flowers: Large, bright red, rich in nectar, and medicinally important
5) Traditionally, flowers are collected, shade-dried, and used in powdered or extract form

Table 1: Taxonomical Classification

TAXONOMICAL CLASSIFICATION	
Kingdome	Plantae
Sub-Kingdome	Tracheobionta - Vascular plants
Division	Magniophyta
Class	Magniolipsida
Subclass	Dilleniidae
Order	Malvales
Family	Malvaceae (Bombacaceae)
Genus	Bombax
Species	Ceiba

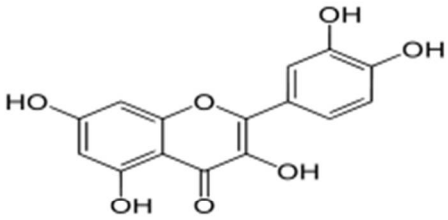
C. Phytoconstituents

The list of phytochemicals most commonly found in food includes flavonoids, carotenoids, coumarins, polyphenols, lignans, catechins, indoles, phenolicacids, isothiocyanates, saponins anthraquinones, procyanidins, phenylpropanoids, and many more (6–11).

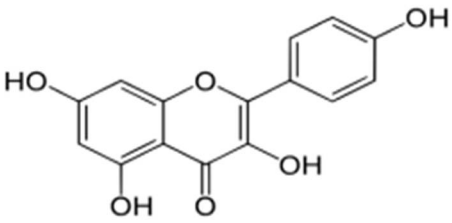
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Flavonoids -

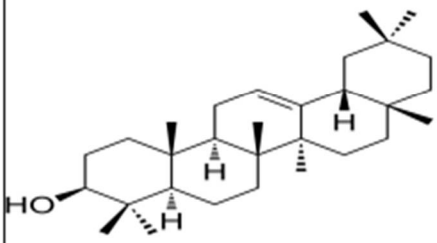


Quercetin

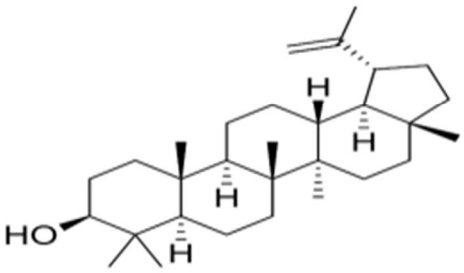


Kaemferol

Terpenoids –

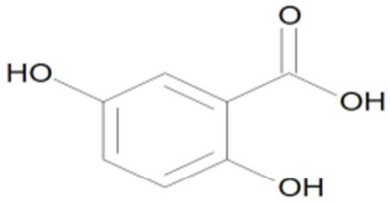


β-amyrin

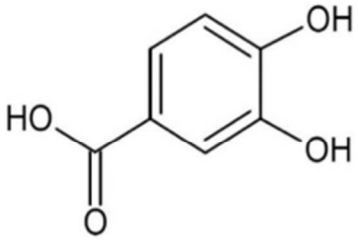


Lupeol

Phenolic acids –

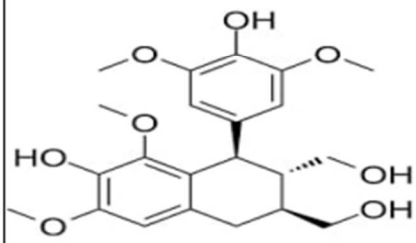


Gentisic acid

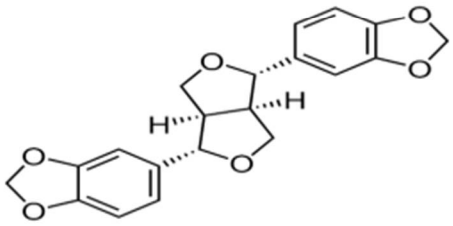


Protocatechuic acid

Lignans –



(+)-lyoniresinol 2a-O-β-D-glucopyranosid



Sesamin

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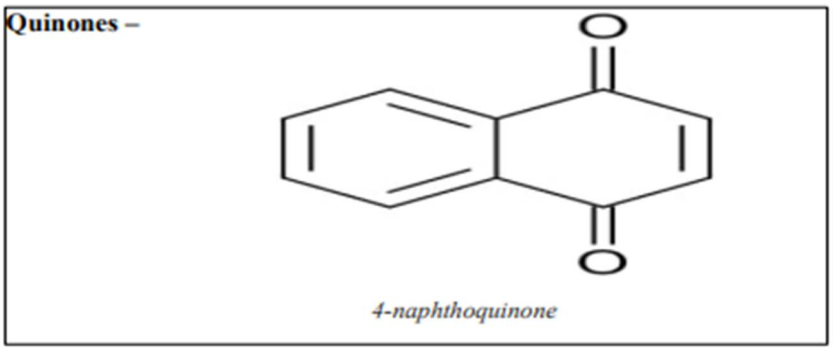




Figure 3 Parts of plant *Bombax ceiba*

D. Bombax ceiba medical use(7,12)

Table 2 Uses of Bombax ceiba plant

Parts of plant	Uses
Black pepper + *Bombax ceiba* root and ginger powder	Get rid of a cough or cold with just a little.
Water + root powder of Red silk cotton tree	Assistance in leucorrhea.
Vidari (Ipomoea digitata) root + Red silk cotton tree root powder + shatawar and misri	Managing ejaculation and sperm problems; take this mixture with milk twice day.
Water+ *Bombax ceiba* grinded leaves	It is useful for blood cleansing.
Water +Thorny section of the *Bombax ceiba* tree stem or thorn paste	Apply to the affected region to aid with dermis issues such as acne, pimples, and hyperpigmentation.
Paste of *Bombax ceiba* bark	Helps to lighten scabsinstigated by sores, acne vulgaris, and burns.
Bombax ceiba flower powder + Desi ghee + Honey + Milk	Helps to reduces Weakness.

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II. PHARMACOLOGICAL ACTIVITIES[11]

A. Analgesic Activity

Mangiferin, was shown to have a considerable quantum of antioxidant in the D.P.P.H. trial. Acetyl and cinnamonoyl composites were n't important effective than mangiferin, but methyl and 3, 6, 7- trimethylether tetraacetate derivations were inert. It seems both the free- OH groups and the catechol half are necessary for the antioxidant exertion. Mangiferin demonstrated hepatoprotective parcels against liver injury generated by carbon tetrachloride, indicating its eventuality as a free revolutionary scavenger in vivo. Crude factory excerpts and pure mangiferin showed significant analgesic goods in mice when tested on hot plates and acetic acid- convinced writhing, but no acuteanti-inflammatory exertion. The analgesic goods of factory excerpts were discovered to be opioid receptor independent when administered with naloxone. Although mangiferin had a small impact on the neuronal position, it demonstrated a robust contact with the receptor in the fringe(13).

B. Anthelmintic Activity

People in Southern Punjab, Pakistan, have traditionally employed B. malabarica as an anthelmintic. Tests were conducted on live Paramphistomum explanatum, which was removed from buffalo and placed in 0.9 phosphate- softened saline. Anthelmintic-exertion of a methanolic excerpt of B. malabarica leaves was determined at boluses of 10, 25, 50, and 100 mg/ mL. substantiation suggests that the excerpt kills or causes P. explanatum to lose its capability to move on its own. There was a statistically significant kill of all trematodes within 45 twinkles after using the excerpt. The most effective attention of the excerpt was 100 mg/ mL. In 1850 ± 0.62 twinkles, it rendered trematodes immobile, and in 2217 ± 0.48 twinkles, it killed them(15,166).

C. Antimicrobial or Antibacterial Action

The effectiveness of factory excerpts in combating multidrug- resistant Salmonella typhii was estimated in both methanol and water- grounded trials. Strong antibacterial exertion was demonstrated by Salmalia malabarica methanol excerpts. After collecting and drying the factory corridor, they were standardised and uprooted using methanol and acetone. We used the agar slice prolixity system to find out how well it worked against Klebsiella pneumoniae, a kind of bacteria. The results were estimated in comparison to those of the more traditional antibiotics piperacillin and amikacin(17,18).

D. Hepatoprotective Activity

Comparing the B. ceiba flower methanol extract (MEBC) to the control, the researchers observed that M.E.B.C. reduces T.B.A.R.S. and Enhances G.S.H. levels. MEBC reduced the amount of necrosis but did not completely undo the hepatic damage brought on by INH and RIF [34]. Hepatoprotective potential of a methanolic extract of B. ceiba flowers was evaluated for hepatotoxicity resulting from the intraperitoneal administration of 2 anti-tubercular medications, isoniazid and rifampicin, to rats durations of 10 and 21 days.ALP, ALT, AST, and total bilirubin were lower in MEBC subgroup at all doses, but total protein levels were higher than in control group. MEBC dramatically raised G.S.H. (reduced glutathione) levels and decreased T.B.A.R.S. at all dosages. Based on the analysis of biochemical data and histological tests, MEBC reduced the amount of necrosis but did not completely reverse the liver damage produced by RIF and INH(19,20).

E. Anti-Obesity Activity

When administered a methanolic excerpt of B. ceiba stem at attention of 200 and 400 milligram/ kg, fat rats fed a high- fat for 10 weeks exfoliate some of their redundant weight. The high- fat diet's negative goods were lessened by B. ceiba excerpt on a number of parameters, similar as weight and mass indicator of body, Foot indicators, serum glucose, lipid profile labels, towel TBARS, A.L.T., A.S.T., nitrate and nitrite situations, fat pads, relative liver volume, sweet input, towel glutathione situations, and serum HDL. This could be as a result of Lupeol, a phytoconstituent, modulating PTP- 1B and FAS signalling in rats(23).

F. Diuretic Exertion

Diuretic action of B. ceiba fruit waterless and ethanol excerpts began to work after 5 hours and persisted for over to 24 hours when administered oral boluses of 200 and 400 milligram/ kg, independently. Dehydrated rats' urine affair is dramatically increased by both excerpts. After 5 hours, the water-answerable excerpt(400 mg/ kg) had the same effect as the gold standard medicine, frusemide. Although it has no perceptible impact on specific graveness or pH, the water- grounded excerpt enhances the excretion of electrolytes in urine(21).

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G. Angiogenesis Activity

The methanol-based stem bark extract contains lupeol, which at dosages of 50 and 30 µg/mL prevents human umbilical venous endothelial cells from forming tubes. Lupeol had no effect on formation of cancer cells in several cell lines, such as SK-MEL-2, A549, and B16-F10 melanoma(22–25).

H. Aphrodisiac Activity

It was investigated whether B. ceiba root extract had any stimulating effects. For 28 days, extracts were administered orally by gavages at dosage of 400 milligram/kg body weight daily. This sexual behaviour study included pre- and postejaculatory interval (PEI) measurements at 0, 7, 14, 21, and 28 days, as well as mount latency (ML), ejaculation latency (EL), intromission lag (IL), intromission frequency, mounting frequency, ejaculation frequency (EF), and other parameters. The levels of ML, IL, EL, and PEI were significantly reduced by the extract ($p < 0.05$). Significant improvements in MF, IF, and EF were also observed in the extract ($p < 0.05$). Male mice that were physically active and those that were not exhibited the same results(26,27).

I. Cancer Cell Growth Inhibition

The 7 human cancer cell lines tested (ACHN,HeLa,MCF-7, C32, COR-L23, A375, and LNCaP) were all positively affected by the antioxidant and anti-proliferative properties of B. ceiba flowers. Using the HL-60 cell line, researchers examined the anticancer effectiveness of BCM extract in vitro. The quantity of BCM was varied from 1 to 100 µg/mL, and density was raised to 1.5×106 cells/millilitre. The cells were then subjected to different treatments for different amounts of time(5).

III. PARKINSON'S DISEASE AND RATIONALE FOR USING BOMBAX CEIBA FLOWERS(28-30)

Parkinson's disease pathology involves:

1) Dopamine depletion
2) Oxidative stress
3) Neuroinflammation
4) Mitochondrial dysfunction

Plant extracts rich in antioxidants and anti-inflammatory compounds can:

a) Reduce oxidative damage
b) Protect neurons from degeneration
c) Delay disease progression

Since Bombax ceiba flowers are rich in flavonoids and phenolics, they are scientifically suitable candidates for PD research.

IV. CONCLUSION

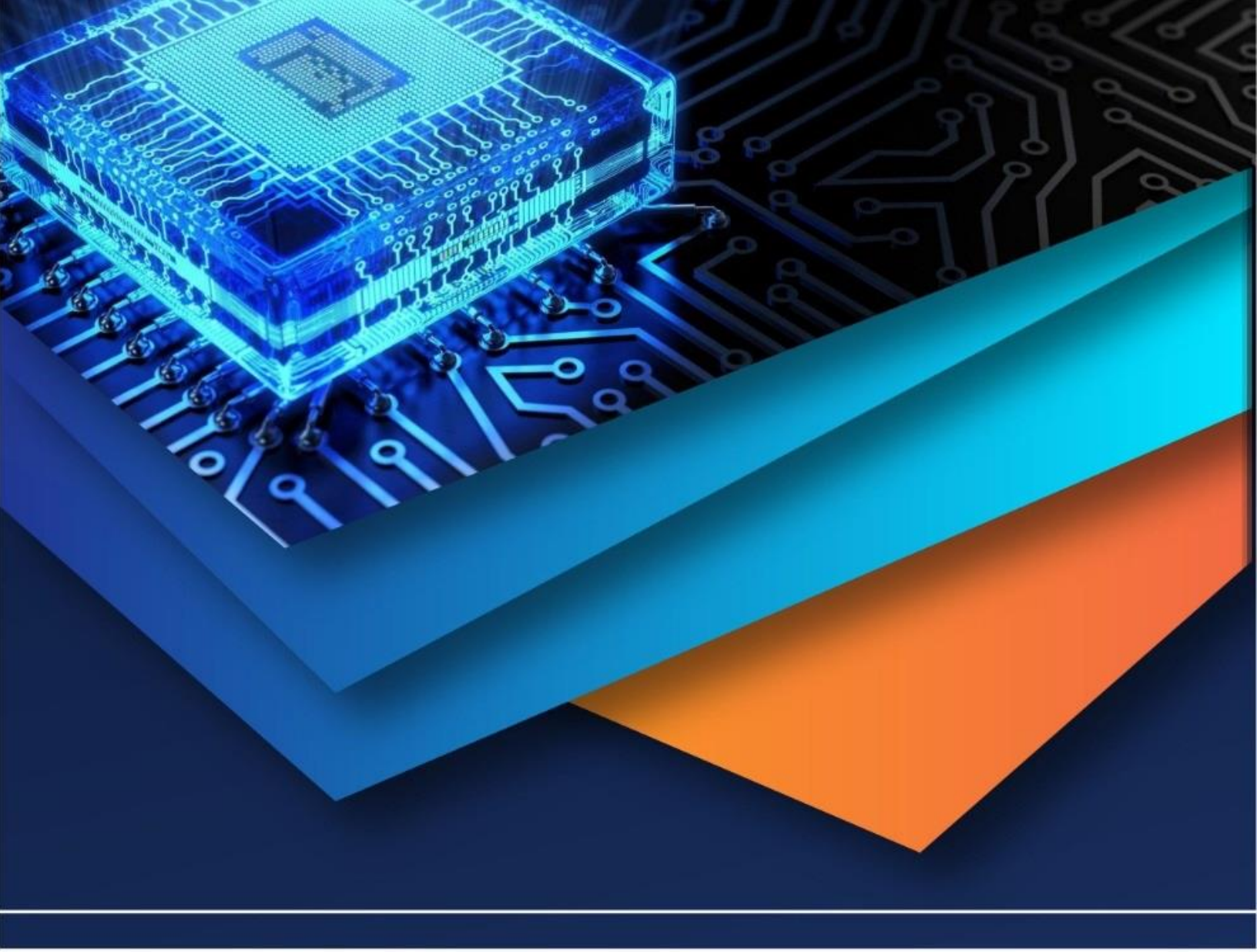
Bombax ceiba flowers are a rich source of antioxidant andanti-inflammatory composites. Although there's no direct substantiation of theiranti-Parkinson exertion, their pharmacological profile explosively supports a implicit neuroprotective part. The absence of PD-specific studies on flower excerpts highlights a major exploration occasion. Methodical disquisition of Bombax ceiba flowers in experimental Parkinson's complaint models could lead to the identification of a novel, factory- grounded neuroprotective agent.

The numerous uses of Bombax ceiba include purifying the blood, adding the thickness of semen, acting as a procreator of semen, acting as a uterine alcohol, treating injuries, acne, saturation, snap, coughs, and haemorrhoids, among numerous others. Many scientific confirmation studies have been conducted on the factory, despite its expansive use for colorful affections. Among the numerous bioactivities of the factory, its antioxidant andanti-inflammatory parcels stand out. The shops are largely salutary for health and illness treatment because to their significant pharmacological conditioning, which include anticancer, antidiabetic, antiviral, antipyretic, diuretic, aphrodisiac, hepatoprotective, antimicrobial, and antibacterial parcels. The pharmacological goods of phytochemicals like lupeol, β- siterol, and mangiferin vary when tested in a laboratory setting. Differences in bioactivities seen in shops gathered from colorful regions demonstrate the profound impact of original climate on factory phytochemical factors. To ameliorate their utilisation, pharmacologically active chemicals from colorful corridor of this factory still need to be linked and insulated. fresh disquisition and understanding of the bioactivities shown are largely encouraged.

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