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Review Article

A PHARMACOGNOSTICAL AND PHARMACOLOGICAL REVIEW ON *BRYOPHYLLUM PINNATUM* (PANPHUTI)

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ABSTRACT

Bryophyllum pinnatum is usually known as Panphuti which belong to family Crassulaceae growing widely in tropical Africa, tropical America, India, China, and Australia. It is a perennial herb grows 3–5 feet tall, fleshy dark green leaves that are distinctively scalloped and trimmed in red, and bell-like pendulous flowers. The plant contains various active compounds such as alkaloids, triterpenes, glycosides, flavonoids, steroids, bufadienolides, lipids, and organic acids. The pharmacological studies are reviewed and discussed, focusing on that different extracts from this plant have anti-inflammatory, antiallergic, antianaphylactic, antileishmanial, antitumorous, antiulcerous, antibacterial, gastroprotective, immunosuppressive, insecticidal, muscle relaxant, sedative, central nervous system depressant, and analgesic. Conventionally, it is used for the treatment of fever, constipation, nourishment of the hair and treating grey hair, intestinal disorder, and leucorrhea. The current review is created with an intended to focus on the numerous ethnobotanical and traditional use as well as the phytochemical and pharmacological report on *B. pinnatum.*

Keywords: Alkaloids, *Bryophyllum pinnatum,* Bufadienolides, Flavonoids, Hepatoprotective, Immunosuppressive, Phytoconstituents.

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INTRODUCTION

Medicinal plants have been known for times and are extremely respected worldwide as a rich home of helpful agents for the inhibition of diseases and illnesses [1]. Pan phuti plant native to Madagascar. This Wonder plant or Divine plant [2]. Leaf, stem, and root portions and its chemicals have great index in therapeutic [3]. It is a straight, juicy, continuing shrub that develops about 1.5 m tall and reappearances through spores and also vegetatively from leaf bubils. It has a towering deep stems, newly shady olive green leaves that are individually scalloped and pared in bloodshot and shady bell-like swinging floras. This plant can easily be broadcasted concluded stems or leaf harsh. It is an announced attractive plant that is nowadays mounting as a weed everywhere plantation produce [4]. In old-style remedy, Panphuti species have been used to give treatment for inflammation, infections, hypertension rheumatism, and cure of renal stones [5]. Phytochemicals can shield hominid from a variability of syndromes. Phytochemicals are non-nutritive plant mixtures, which ensure caring, medicinal, or illness defensive things. Plants produce these substances to save themselves; however, fresh examination determines that various phytochemicals can guard creatures beside syndromes. There are several phytochemicals in pods and sages and each mechanism contrarily [6]. In the modern years, pioneers are more fascinated to shrub beginning medications as they are greatly biocompatible with minor side effects than the man-made medications. The ordinary yield and class are not reasonable due to slow development degree, overexploitation, and environment demolition which are possibly the key drawbacks to see the ever-growing marketplace request. Additional farming of these rough therapeutically significant plants lacks satisfactory illness free Elite implanting resources due to great vulnerability of the crop for rhizome rot, leaf spot, and microbial wilt [7].

SYNONYMS [8]

Bryophyllum calycinum Salisb., *Kalanchoe pinnata* (Lam.) Pers., *Cotyledon pinnata* Lam., and *Sedum madagascaricum* Clus.

COMMON NAME [9]

Cathedral bells, curtain plant, floppers, good luck leaf, green mother of millions, leaf of life, Mexican love plant, miracle leaf, resurrection plant, and sprouting leaf.

VERNACULAR NAME [10,11]

Sanskrit: *Parnabeeja*, *Asthibhaksha*
English: Air plant
Hindi: Zakhmhaiyat, Pathharchoor
Kannada: Gandukalinga, Kadu basale
Malayalam: Elamarunga
Tamil: Malaikalli, Ranakalli
Telugu: Ranapala
Marathi: Gayamari
Bengali: Koppatha, Pathar kuchi.

TAXONOMICAL CLASSIFICATION [12]

Kingdom: Plantae - plants
Subkingdom: Tracheobionta - vascular plants
Division: Spermatophyta - seed plants
Subdivision: Magnoliophyta - flowering plants
Class: Magnoliopsida - dicotyledons
Subclass: Rosidae
Order: Rosales
Family: Crassulaceae - stonecrop
Genus: *Bryophyllum*
Species: *B. pinnatum* (Lam.) Oken.

MACROSCOPY [13]

Air plant is a pleasing glabrous herb 0.3–1.2 m tall. Twigs obtusely four slanting, mature one are bright colored and newer ones are roseate spotted with snowy. Leaves are mutable and decussate inferior is typically humble/complex, superior ones are 3–5/7 foliate with extended petioles. Petioles are combined by an edge nearby the

stalk. Flyers are oval/elliptic with crenate/notch border. Floras are suspended, in big dispersion panicles with opposed divisions, pedicels willowy. Sepals are red striated, green at the immoral and pale green above. Petals are ruddy florid, puffy, and octagonal at the immoral, lobes three-cornered. Monofilaments green at the base, rose-pink lower the anthers. Anthers are hastate, shadowy. Flairs green. Fruitlet is enclosed in a insistent wispy calyx and corolla. Stones are lesser, oblong-ellipsoid, plane.

MICROSCOPY [14]

1. The tiny character displays a skinny sheet is existing on abaxial side and curved surface on the adaxial side. It has a shrill and adaxial epidermal film is of slight, less protuberant compartments. The stranded tissue of midrib is parenchymatous. The cells are round, pointed, and compressed.
2. The vascular strand is solitary, minor, and semicircular in form. It contains dense parallel orchestra of xylem and comprehensive band of phloem.
3. Xylem component is tapered, pointed, tinny wall. The vascular packs are in upright and parallel plane. The lamina is smooth, the mesophyll is discriminated into palisade and squishy parenchyma. The stomata are anisocytic type, which are established in rich form.
4. The longitudinal segment of greeneries shows occurrence of coiled vessels. The trichomes are lacking on abaxial cross and adaxial cross.

PHYTOCHEMISTRY

Introductory phytochemical examination of altered parts of plant mines of air plant displayed the occurrence of phenols alkaloids, , flavonoids, saponins, tannins, carotenoids, glycosides [15,16,17], sito sterol, anthocyanin,[18] malic acid, quinines, tocopherol[19], lectins [20,21],coumarins[22] and the key component are Bufadienolides-Bryophyllin A (bryotoxin)15; Bryophyllin B (Fig.1); Bryophyllol (Fig.2); Bryophollone (Fig.3); Bryophollenone (Fig.4); Bryophynol (Fig.5) [23].The leaves are originate to hold several chemical constituents including 1-octane3-O-α-L-arabinopyranosyl-(1-6)-glucopyranoside [24,25], isorhamnetin-3-O-a-L-1C4-rhamnopyranoside, 40-methoxy-myricetin-3-O-a-L 1C4-rhamnopyranoside and protocatechuic-40-O-b-D-4C1-glucopyranoside [26], 24-epiclerosterol [24(R)-stigmasta-5, 25-dien-3β-ol], 24(R)-5α-stigmasta-7, 25-dien-3β-ol, 5α-stigmast-24-en-3β-ol and25-methyl-5α-ergost-24 (28)-en-3β-ol [27,28]. A new steroidal derivative, Stigmast-4, 20 (21), 23-trien-3-one was also isolated from the plant leaves extract along with stigmata-5-en-3β-ol , α – amyrin- β-D-glucopyranoside, nundecanyl n-octadec-9-en-1-oate and n-dodecanyl noctadec-9-en-1-oate [29]. Different naturally occurring flavanoids from leaves are flavones, falvans,flavanones,isoflavonoids, chalcones, aurones and

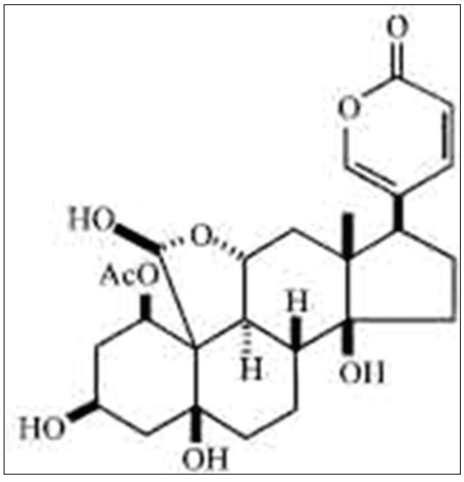

Fig. 1: Bryophyllin

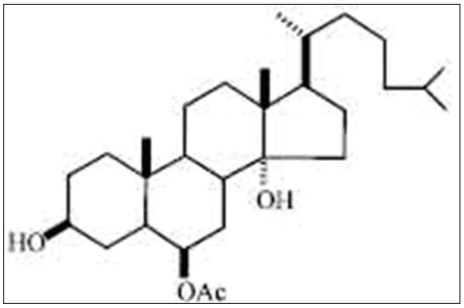

Fig. 2: Bryophyllol

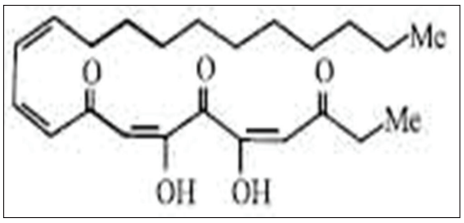

Fig. 3: Bryophollenone

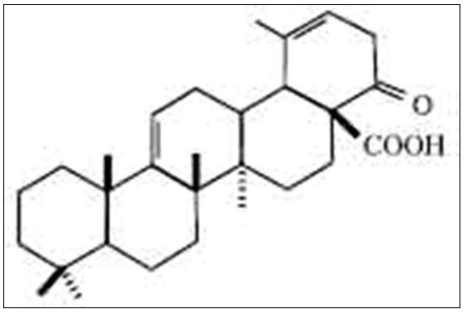

Fig. 4: Bryophollone

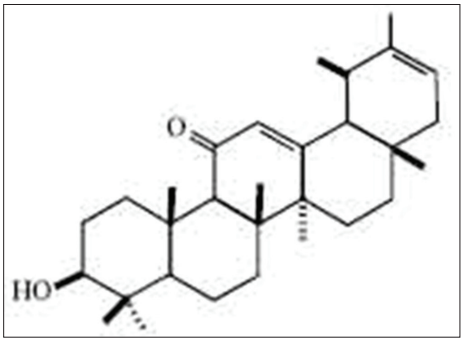

Fig. 5: Bryophynol

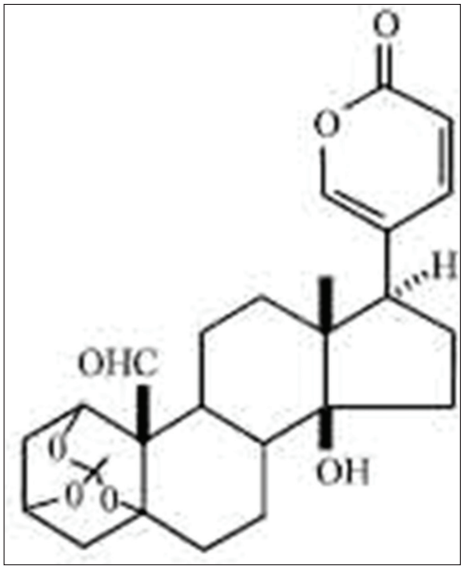

Fig. 6: Bersaldegenin

anthocyanidines[30,31.32],Compounds with potent biological activity are bersaldegenin- 1, 3, 5-orthoacetate [33] and bufadienolide-bryophyllin B [34] and Bryophyllin C ,.The main foundations, comprising calcium, phosphorus, sodium, potassium malate, magnesium and trace essentials (iron and zinc) were also firm in the plant extracts along with vitamins like ascorbic acid (26.42 to 44.03 mg/100 g), riboflavin (0.20 to 0.42 mg/100 g), thiamine (0.11 to 0.18 mg/100 g), and niacin (0.02 to 0.09 mg/100 g) casein hydrlylsate, nicotinamide[35,36,37].

PHARMACOLOGICAL ACTIVITY

Wound healing property

Patil *et al.* discovered the occurrence of wound curative action of Panphuti sheet. Removes from (petroleum ether, water, and alcohol) all the four abstracts, i.e., alcohol and waste petroleum ether displayed important upturn in the infringement power of opening wound when related to control group. Granuloma flouting strength and hydroxyproline contented of granulation tissue in deceased planetary wound model were meaningfully improved when associated to control group. Water quotation displayed major rise in wound shrinkage and development of marks on the 17th post-wounding day in excision wound model. Uniform topical solicitation of aquatic extract speeded the curing procedure in removal wound model [38].

ANTIULCER ACTIVITY

Pal *et al.* showed that a methanolic fraction of leaves was established to retain important antiulcer activity. Premedication experiments in rats shown that the quotation possessed major shielding accomplishment in contradiction of the abdominal cuts tempted by aspirin, indomethacin, serotonin, reserpine, stress, and ethanol; also important shelter on behalf of aspirin-induced ulcer in pylorus-ligated rats and for histamine-induced gastric lesions in guinea pigs; and also significant improvement of the curing method was also establish to occur in acetic acid-induced chronic gastric lesions in rats [39]. Adesanwo *et al.* in his study showed a significant reduction in occurrence of ulceration and mean basal and histamine motivated gastrointestinal acid exudation in a dose reliant mode, therefore, modifying its apply as an antiulcer agent in tradition cure [40].

UTERINE CONTRACTILITY

Pathar kuchi improved shrinkage occurrence by 91% at constant amplitude and repressed oxytocin encouraged narrowing by 20% at continual breadth with faintly reduced regularity. Fenoterol reduced shriveling by 50% with an important reduction in rate [41]. Panphuti more operative and has fewer side effects than old-fashioned labor inhibitors in stopping preterm delivering. In a study Plangger *et al.* related the permissibility and tocolytic things among i.v., instilled plant abstract and beta-agonists. In a reflective study, 67 pairs of expectant females in preterm labor preserved with i.v. air plant or beta-agonists were carefully harmonized for motherly age, gestational age at tocolysis, cardiotocograph documented shrinkages, cervical effacement, preterm previous rupture of the skins, and past of preterm labor. Effects display that expecting women with quotation and beta-agonists were equivalent in the continuation of gestation (6.2 vs. 5.4 days, NS), the gestational stage at delivery (38.0 vs. 37.1 weeks, NS), and the time of hospitalizations but had less opposing things (34.3 vs. 55.2% with palpitation or dyspnea). The new consequence and injury in the *B. pinnatum* collection were equivalent or superior. Hence, established in the administration of preterm labor herb is no less operative than beta-agonists but is expressively improved accepted [42].

HEPATOPROTECTIVE AND NEPHROPROTECTIVE

Liquid of the new leaves is recycled very efficiently for the management of jaundice in Bundelkhand area of India. Yadav *et al.* planned that the liquid of greeneries was originate additional active than ethanolic excerpt as showed by *in vivo* and *in vitro* histopathological studies for hepatoprotective activity of herbal and validates the usage of liquid of plant leaves in folk drug for jaundice [43]. The protective effect on gentamicin-induced nephrotoxicity in rats which may involve its antioxidant and oxidative radical scavenging activities [44].

NEUROPHARMACOLOGICAL

Parnabeeja has been used since 1921 in predictable treatment as an antipsychotic mediator [45-47]. Salahdeen *et al.* showed that the aqueous leaf mine possesses depressant action on central nervous system (CNS). The animals CNS treat with 50–200 mg/kg was established to create rather important reduce in locomotor's movement in dose needy way, with no ptosis at these doses. Likewise in chimney, climbing and inclined screen tests, there was an important defeat of management and reduces muscle tone in animal treated intraperitoneally with aqueous extract in a dose reliant manner. The result indicates considerable alterations in universal behavior pattern, decrease in impulsive mortality, potentiation of pentobarbitone-induced sleeping time in a dose needy manner [48,49].

IMMUNOSUPPRESSIVE

The oily acids existing in Panphuti might be answerable at least in part, for its immunosuppressive result *in vivo* [50]. Rossi Bergmann *et al.* displayed the aqueous extract of grasses origin significant reserve of cell-mediated and humoral immune reactions in mice. The spleen cells of animals pre-treated with herbal abstract exhibited a compact capability to multiply in retort to equally mitogen and antigen *in vitro*. The *in vitro* and topical methods of direction were the most operative by nearly totally eliminating the Ddelayed-type hypersensitivity response. The intraperitoneal and verbal ways reduced the response by 73% - 47% of controls, correspondingly. The exact antibody replies to ovalbumin were also meaningfully summary by handling. Thus, the aqueous extract of leaves keeps immunosuppressive activities. An effort to classify the immunosuppressive constituents presents in Panphuti directed by the lymphoproliferative assays. From the ethanolic abstract, a cleaned fraction (KP12SA) initiate 20-fold added powerful to block murine lymphocyte explosion than the crude extract. Thus, the offers indication that saturated fatty acids present in basil shows significant character on lymphocyte propagation, which clarifies its immunosuppressive result *in vivo* [51].

ANTIBACTERIAL

The occurrence of phenolic component shows so as to the plant has antimicrobial action. Ofokansi *et al.* (2005) reported that plant is helpful in the management of typhoid fever and other bacterial infections, predominantly those caused by *Bacillus subtilis,*

Staphylococcus aureus, Pseudomonas aeruginosa, Klebsiella aerogenes, Escherichia coli, Klebsiella pneumoniae, and Salmonella typhi. In his learn, antibacterial activities of the infusion and methanolic extracts against *S. aureus* American type culture collection (ATCC) *13709, E. coli* ATCC *9637, Bacillus, P. aeruginosa, K. pneumonia,* and *S. typhi* using the agar diffusion process; also adjacent to *S. aureus, E. coli, S. typhi, Klebsiella* spp., and *P. aeruginosa* using an alteration of examiner board way [52-54].

ANTIDIABETIC, ANTI-INFLAMMATORY, AND ANTINOCEPTIVE ACTIVITY

The occurrence of zinc in the vegetation could mean that the plants can play important roles in the management of diabetes, which outcome from insulin breakdown [55]. Ojewole evaluated the antinociceptive result of the herb's aqueous leaf mine by the "hot-plate" and "acetic acid" test models of pain in mice. The antidiabetic and anti-inflammatory things of the plant extract were investigated in rats, using fresh egg albumin-induced pedal edema and streptozotocin-induced diabetes mellitus. The aqueous leaf extract created important ($p<0.05$–0.001) antinociceptive effects adjacent to thermally and chemically induced nociceptive pain stimuli in mice. The plant takes out also appreciable inhibited fresh egg albumin-induced acute inflammation and causes important hypoglycemia in rats. The different polyphenols, triterpenoids and phytosterols, flavonoids, of the herb are speculated to account for the observed antinociceptive, anti-inflammatory, and antidiabetic properties of the plant. It exerts antinociceptive and anti-inflammatory effects probably by inhibiting the release, synthesis, and/or production of inflammatory cytokines and mediators, including prostaglandins, histamine, polypeptide kinins, and so on [56].

HERBAL TONIC

The plant is good sources of ascorbic acids, riboflavin, thiamine, and niacin. Natural ascorbic acid is vital for the body performance, i.e. normal formation of intercellular substances throughout the body, including collagen, bone matrix, and tooth dentine [57]. Therefore, the clinical manifestations of scurvy that is hemorrhage from mucous membrane of the mouth, gastrointestinal tract, anemia, and pains in the joints can be related to the association of ascorbic acid and normal connective tissue metabolism [58]. This function of ascorbic acid accounts for its normal wound healing property. As a result, the plant is used in herbal medicine for the treatment of common cold and other diseases like prostate cancer [58,59]. In a study, an herbal composition comprised extracts of number of herbs including *B. pinnatum* acts as a tonic to improve respiration, aids in the elimination of toxins, and improves overall vitality [60].

PROTEIN PROFILING

Phosphate extraction buffer (pH) was used to extract proteins from the leaves of *B. pinnatum*. On sodium dodecyl sulfate-polyacrylamide gel electrophoresis separation, the results showed that bands on the gel were then excised and digested with trypsin and subjected to liquid chromatography tandem mass spectrometry (MS/MS) for protein identification. Proteinase K has been identified from the MS/MS data. The protein identified was Proteinase K, which is used commercially in digesting of unwanted proteins like keratin [61].

CYTOTOXICITY OF TESTIS

The study revealed the cytotoxic effect of ethanolic extract of leaf of *B. pinnatum* on cells of rat's testis in two different doses (100 mg/kg and 200 mg/kg) orally for a period of 8 weeks. At the dose of 100 mg/kg, the seminiferous tubules were shrunken and intracellular spaces were seen within the epithelium and higher dose (200 mg/kg) showed marked increase in intracellular spaces within the germinal epithelium and reduction of spermatozoa when compared with the control group which showed intact normal histological features of the testes [62].

CYTOTOXIC TO CATTLE

Mckenzie *et al.* investigated that cardiac glycoside poisoning was produced in calves given flower heads of the hybrid *Bryophyllum* species and found that for each plant (except B. tubiflorum), two calves were each given a single dose of 20 g wet weight per kg bodyweight. The results of the calf toxicity experiment with the amounts of bufadienolide measured in the plants suggest that bryotoxins A, B, and C probably account for the observed disease [63,64].

INSECTICIDAL, FUNGITOXIC, AND PHYTOTOXIC ACTIVITY

Alabi *et al.* studied to evaluate the fungitoxic and phytotoxic effects of extracts on the fungal pathogens inducing wilting on cowpea grown in Ago-Iwoye, Southwestern Nigeria. The extract reduces the disease infection rate in treated plants. *Sclerotium rolfsii* Sacc. induced wilting of between 4 and 12% on cowpea seedlings treated with plant extract under field conditions while about 39.6% incidence of cowpea seedlings wilting was observed under control experiment on the same experimental plot. The extracts increased significantly the plant height, shelf life, relative water content, and chlorophyll contents of the cowpea seedlings during both the wet and dry season. On the other hand, the extracts significantly reduced transpiration rate and stomata aperture of treated plant in both seasons. Furthermore, application of these extracts on the cowpea plants significantly enhanced the leaf area index, number of branches and pods per plant, total dry matter per plant, weight per pod, 100 grains weight, and grain yield in both seasons. The extracts also inhibited the release of current photosynthethates from treated plants, thus maintaining the water status of plant and also making photosynthethates which can be oxidized to release energy needed for growth available to treated plants [65].

OTHER ACTIVITY [66]

- It is used against dysentery.
- *B. pinnatum* is used for the treatment of fever.
- Rhizome powdered is used for the treatment of constipation.
- *B. pinnatum* paste is used for the treatment of boil, wound, soar, or cuts.
- The extract of *B. pinnatum* is used for the treatment of roundworms (clotrimazole).
- The extract of the plant is used for the treatment of antipyretic activity.
- Using juice of this as eardrop heals the ear pain. Its natural remedy for ear pain.
- The paste of Pashanbheda mixed with honey is used for the beginners teething trouble.
- It is proved diuretic. Hence, it cures difficult urination.
- It is used as one of home remedies for piles (hemorrhoids).
- The leaf juice is used for the treatment of stomach ache.
- The extract is used for the nourishment of the hair and treating gray hair.
- The leaves are used against intestinal disorder.
- It is also used for the treatment of blood mixed diarrhea.
- The paste is used against leucorrhea.
- The fresh juice of Patharchur can be used to treat jaundice.
- It has importance in the treatment of certain types of cancer and weight management.
- It is the natural treatment for kidney and gallbladder stones.

MARKETED PREPARATION [67]

1. Amantol cream: Its indications are respiratory disorders, sinusitis, bronchitis, allergic reactions, and blocked nose. Ingredients are *Mentha viridis* extract (mint.), *Iresine difusa* (escanel) extract, *Lippia alba* extract (yantria), *Zingiber officinalis* extract (ginger), *B. pinnata* extract (Pakipanga), *Mansia alliacea* extract (ajode monte), mentol, alcanfor, and water cream base, external use only.
2. Parnabija savarasa: Antiobesity.

CONCLUSION

B. pinnatum is very useful plant for treating various diseases such as wound healing, antiulcer, ant diabetic, anti-inflammatory, antinociceptive, and antibacterial, the chemical constituents flavonoid, alkaloid, saponin, and triterpenoid are responsible for this activity.

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AUTHORS' CONTRIBUTION

We declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors. Miss KHOOSHBU PASHA collected the data and analyzed the data. Prof. Imtiyaz Ansari proof-read the whole manuscript, and suggested the necessary changes, and helped in designing manuscript.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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