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**REVIEW ARTICLE**

**Uses of *Withania somnifera* (Linn) Dunal (Ashwagandha) in Ayurveda and its Pharmacological Evidences**

**Dr. Sudhanshu Kumar Meher, Dr. Banmali Das, Dr. Purnendu Panda, Dr. G.C. Bhuyan,  
Dr. M.M. Rao**

National Research Institute of Ayurvedic Drug Development, Bhubaneswar, Odisha

\*Corresponding Author E-mail: [drmeher@rediffmail.com](mailto:drmeher@rediffmail.com)

**ABSTRACT:**

*Withania somnifera* (Linn) Dunal commonly known as Ashwagandha belongs to the family Solanaceae (nightshade family) which has got 1250 species widely distributed in the warmer parts of the world. The genus *Withania* is reported to have 23 species and out of which *Withania somnifera* (Linn) Dunal and *Withania coagulans* Dunal are of high medicinal value. Various preparations and forms of *Withania somnifera* (Linn) Dunal (Ashwagandha) i.e. powder, decoction, oil, smoke, poultice etc. have been advised for the cure of various disorders such as skin disorders, nervous disorders, intestinal affections, venereal diseases, rheumatism, emaciation of children and as a tonic for all kinds of weakness and in geriatrics. It also promotes vigor and stamina and is regarded as aphrodisiac and rejuvenator. The plant is usually erect, branched, unarmed shrub, up to 1.25 meters height and grows throughout the drier parts and sub-tropical India. Mainly cultivated in Madhya Pradesh and Rajasthan and it has huge internal consumption in India and also being exported. It is prone to several pests and diseases which need to be take care during cultivation. Withaferin A and Withanolide D are two main withanolides contribute to the most of biological actions. It has pharmacological action in almost all systems of the human body. It has also some side effects and contraindication. Number of pharmacological studies have been conducted and a wide range of biological activities have been observed such as anti inflammatory property, hepato-protective activity, infertility activity, anti bacterial activity, psychotropic/anti anxiety activity, anti convulsant activity, skin care activity, healthy hair activity, immune-modulator activity, anti peroxidative action, anti ageing effect, macrophage activating effect, haemopoitic effect, antibiotic activity, anti-tumour activity, anti-hyperglycemic effect, morphine tolerance and dependence-inhibiting effect, cardio tonic activity, hypo lipidemic, anti-atherogenic activity, positive inotropic activity, hypoglycemic effect, anti-oxidant activity, anti-carcinogenic activity etc. This review presents morphology of the plant, geographical distribution, cultivation and market value, plant pathology, Ayurvedic properties, chemical ingredients, medicinal uses in Ayurveda, side effects and contraindications, pharmacological evidences of *Withania somnifera* (Linn) Dunal (Ashwagandha).

**KEYWORDS:** Ashwagandha, *Withania somnifera* (Linn) Dunal, Ayurveda, Pharmacological evidences

**INTRODUCTION:**

Since the early human existence, many natural products came into practice for human welfare by sheer perception or by trial and error. Because of this practice, in fact, every country including India, China, and Egypt developed its own medical system. Thus the Indian Medical System-Ayurveda came into existence. Throughout human existence, plants were virtually all that was available to healers. The raw materials used for Ayurvedic medicines were dried herbal powders or their

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extracts or mixtures of products. In today's concept even though synthetic products have taken a front seat, 25 to 30 percent of modern drugs are derived from some parts of higher plants. In fact, botanical medicines have made a comeback. *Withania somnifera* (Linn) Dunal (Ashwagandha) is an important drug in Indian system of Medicine used widely by physicians as single as well as in combinations with other drugs since time immemorial. It is commonly known as Ashwagandha which belongs to the family Solanaceae (nightshade family) which has got 1250 species widely distributed in the warmer parts of the world. The genus *Withania* is reported to have 23 species and out of which *Withania somnifera* (Linn) Dunal and *Withania coagulans* Dunal are of high medicinal value. It is classified as a rasayana in Ayurveda and expected to promote physical and mental health, restore the body and increase longevity. It has been glorified over time for its dual capacity to energise and calm at the same time. It is well known for its actions like Immunomodulator / Rasayan karma, general tonic in arthritis, aphrodisiac, used in rheumatism, debility from old age etc.

#### Synonyms

- *Physalis somnifera* Linn.
- *Withania kansuensis* Kuang and A. M. Lu
- *Withania microphysalis* Suess.

#### Vernacular names:

Bengali- Ashwagandha  
Eng.-Winter Cherry, Indian Ginseng  
Gujarati-Asundha, Ghodaasoda  
Hindi-Asgund, Panir  
Malayalam-Amukkiram, Pevetti  
Marathi-Asgund, Asvagandha  
Odia-Aswagandha  
Punjabi-Ak, Aksan, Asgund, Asgund Nagori, Isgand  
Tamil-Amukkasi, Ashuhan  
Telgu-Ashwagandha  
Urdu-Asgandhu, Gaori

#### Morphology of the plant:

The plant is usually erect, branched, unarmed shrub, grows up to 1.25 meters height. The parts above the ground, specially the stem, the veins and the calyx are covered with a sparsely hairy tomentum. Branches are round. Leaves are simple, petiolate, ovate, entire, exstipulate, acute, glabrous and up to 10 cm long. The leaves on vegetative shoots are alternate, and large while those on floral branches are opposite, arranged in pairs of one large and one small leaf and somewhat laterally, having in their axil a cymose cluster of 5 to 25 inconspicuous pale green flowers. Fruit, a berry enclosed in the green persistent calyx, green when unripe and orange red when mature containing numerous small capsicums like seeds<sup>1</sup>.

#### Geographical Distribution:

*Withania somnifera* (Linn) Dunal grows throughout the drier parts and sub-tropical India. It is widely distributed in North-Western India, Bombay, Gujarat, Rajasthan, Madhya Pradesh, Uttar Pradesh, Punjab plains extending to the mountain regions of Punjab, Himachal Pradesh and Jammu, ascending to a height of 1500 meters. The wild growth of this species has also been reported from Pakistan, Afghanistan, Israel, Egypt, Jordan, Morocco, Spain, Canary Island, Eastern Africa Congo, South Africa etc.

#### Cultivation and market value:

Mainly cultivated in Madhya Pradesh and Rajasthan and the varieties cultivated are Jawahar Asgandh-20, Jawahar Asgandh-134 and Rakshita. The cultivation of Ashwagandha does not need much attention and labour. The crop is grown even on soil which is unsuited for other crops. The propagation method is direct sowing of seeds (broadcasting) and planting time is June to September. No special preparation or cure of the land is required to plant this crop. The crop is mainly grown on residual fertility. Hence, no fertilizers applied. However, addition of nitrogenous fertilizers such as ammonium sulphate produces plants with heavy leaf growth and small roots. No irrigation is given throughout the growing period. Excessive rainfall is harmful because it leads to extensive weed growth. Major disease is damping off, seedling rotting, and seedling blight. Seed treatment with Captan 3 gm/kg of seeds is recommended. The plants produce flower and fruit in December and January. Hence the crop is ready in six months and harvesting starts from January and continues up to last March. A yield of 300-400 kg roots/hectar in addition to 50-75 kg seeds/hectar obtained at the end of six months. It has huge internal consumption in India and also being exported.

#### Plant pathology

*Withania somnifera* is prone to several pests and diseases.

1. Leaf spot disease caused by *Alternaria alternata* is the most prevalent disease, which is most severe in the plains of Punjab, Haryana, and Himachal Pradesh. Bio-deterioration of its pharmaceutically active components during leaf spot disease has been reported<sup>2</sup>.
2. The *Choanephora cucurbitarum* causes a stem and leaf rot of *Withania somnifera*<sup>3</sup>.
3. A treehopper, feeds on the apical portions of the stem, making them rough and woody in appearance and brown in colour. The apical leaves are shed and the plant gradually dies<sup>4</sup>.
4. The carmine red spider mite (*Tetranychus urticae*) is the most prevalent pest of the plant in India<sup>5</sup>.

**Ayurvedic properties:**

Rasa- Tikta, Kasaya, Madhura, Guna- Snigdha, Laghu, Virya- Usna, Vipaka- Madhura, Doshakarma- Kapha Vata Samaka

**Chemical ingredients-**

Steroidal alkaloids and lactones known as withanolides specifically Withaferin A and Withanolide D are two main withanolides contribute to the most of the biological actions of withania. Withanine, Withaniol, Anaferin, Tropine and many other Alkaloids and Steroids are present.

**Medicinal uses in Ayurveda:**

Useful part of Ashwagandha is mainly the root. Seeds, leaves and fruits are also used as medicine.

*External Uses:* Ashwagandha leaves and root paste is applied on enlarged cervical glands or swelling of other glands as it reduces oedema and pain, oil massage is done in vata diseases and weakness. In ear discharge the juice of Ashwagandha leaves is used as eardrops. For healing of blisters, black ashes of the roots are applied. The dried leaves are ground to a powder from which a paste is made and used in the treatment of burns and wounds and also for a sunscreen upon women's faces.

*Internal uses:*

*Nervous system:* Ashwagandha root is sedative, tranquilizing and nervine tonic, hence helps in tonic nerves and useful in fainting, giddiness and insomnia (The species name somnifera means "sleep-inducing" in Latin)<sup>6</sup>. It is also used as an "adaptogen" to help the body cope with daily stress, as a general tonic and for improving thinking ability. It also improves the brain's memory functions like attention and concentration, hence helping with the symptoms of Parkinson's, Alzheimer's and other neuro-degenerative diseases. It enables the body to reserve and sustain vital energy throughout the day while promoting sound, peaceful sleep at night. Ashwagandha benefits, strengthens and tones all muscle tissues including the heart and lungs. It increases muscle tone while concurrently soothing muscular inflammation. It is an ideal remedy for muscular aches, pains, and stiffness, weakness and low body weight.

*Digestive system:* The bark powder of Ashwagandha is appetizer, carminative and anthelmintic and hence is used in abdominal pain, constipation and worms.

*Circulatory system:* Ashwagandha has an effect on the heart, purifies the blood and reduces oedema. So it is used in weakness of heart, blood disorders and oedema. The decoction is used in rheumatoid arthritis.

*Respiratory system:* Ashwagandha is an expectorant and has anti asthmatic property, due to which it is useful in cough. Ashwagandha ash along with ghee and honey is effective in asthma. If phlegm is thin, it is used in the form of ash or its alkaline extract is used. Decoction of bark should be given in low dose for cough and asthma. It is also used as a tonic in the above conditions.

*Reproductive system:* Ashwagandha is considered as sukrala i.e. semenagogue which increases semen. It is well known for its aphrodisiac property and is used in semen disorders. A mixture of 5 gms of Ashwagandha powder, 10 gms of ghee and sugar along with 250 ml milk is a good tonic, nutritious and aphrodisiac. It completely cures puerperal backache and leucorrhoea caused due to endometritis.

*Urinary system:* It is a diuretic and used in oliguria or anurea.

*Skin:* Ashwagandhadhi churna is indicated in wrinkle skin and premature ageing and premature graying of hair. It is used in vitiligo and other skin diseases.

*Satmilkaran:* It increases weight, improves immunity and is an aphrodisiac. Used in debilitation diseases and marasmus in children.

**Medicines in market:** Ashwagandhadhi Churna, Balarista, Ashwagandha Rasayana, Ashwagandha Ghrit, Ashwagandharishta, Dhatupoustika Churna, Phala Kalyan Ghrita, Rasaraj Rasa etc.

**Side effects and contraindications:** Ashwagandha is not recommended in case of hyperthyroidism or pregnancy and can in high doses provoke certain intestinal problems. In strong doses, Ashwagandha can have a hypnotic effect. Hence should be started with small doses then increased gradually. Ashwagandha is best taken in the evening, because in strong doses the plant can act as a sedative.

**Pharmacological evidences:**

**1. Anti inflammatory property:** The alcoholic extract has significant anti-inflammatory property in both acute and chronic types of inflammation. The decoction of root on oral administration against carrageenin induced inflammation, produced marked anti inflammatory property<sup>7</sup>. The extract of leaves on experimental models of sub acute models of inflammation and CCl<sub>4</sub> induced hepatotoxicity in albino rats exhibited anti inflammatory effect<sup>8</sup>. Ashwagandha possessed marked anti-inflammatory effect against denaturation of protein *in vitro*. The effect was plausibly due to the alkaloid and withanolide contents of Ashwagandha<sup>9</sup>.

**2. Hepatoprotective activity:** Alcoholic extract of the leaves of the plant was found to significantly inhibit CCl<sub>4</sub> induced alterations in transaminase activity and pentobarbitone sleeping time indicating presence of hepatoprotective activity. This was confirmed through histopathological studies<sup>10</sup>.

**3. Infertility activity:** Roots have infertility activity in mice and did not completely abolish oestrus or mating but it delayed the processes. Roots have also effect to produce infertility mating and caused decreased in litter size, tuber roots have no uterine stimulant activity on isolated guinea pig uterus<sup>11</sup>.

**4. Anti bacterial activity:** The leaves exhibited anti-bacterial and anti fungal property. It was effective against gram positive bacteria and *Helminthosporium sativum* (fungus)<sup>12</sup>.

**5. Psychotropic/Anti anxiety activity:** Total alcoholic extract on oral administration in albino rats caused decreased locomotor activity and learning behavior, potentiated barbiturate hypnosis, increase in the whole brain tissue level of serotonin and histamine. It induced depletion of catecholamines and Ach in the brain<sup>13</sup>. The aqueous suspensions of roots of Ashwagandha and the Korean drug Ginseng were tested comparatively for 2 pharmacological activities, namely Anti-stress activity by the 'mice swimming endurance test' and anabolic activity by noting gain in body weights and levator ani muscle in rats showed a significant increase in mice swimming time by Ginseng and Ashwagandha as compared to the control group. Significant increase in body weights in the Ashwagandha treated group was better than Ginseng. Gain in wet weights of the levator ani muscle were also significant in Ginseng and Ashwagandha treated groups, however, the weight gain of dried levator ani muscles showed comparable results for both these drugs<sup>14</sup>.

**6. Anti convulsant activity:** Dried powder, decoction and alcoholic extract showed anti convulsant property against electro shock and phenobarbitone, the alcoholic extract being much more potent<sup>15</sup>.

**7. Skin care:** Its potent antioxidant properties help protect the skin against free radical damage and slow down the ageing process by firming up the skin for a more youthful look. Ashwagandha stimulates DHEA, which is a precursor to both testosterone and estrogen and stimulates the production of natural skin oils. It also promotes the production of vital compounds and proteins for healthy skin such as hyaluronan for skin hydration, elastin to keep the skin supple and collagen for skin strength. For glowing skin Ashwagandha can be used as a toner with dried ginger and lemon.

**8. Healthy Hair:** Used in shampoos, Ashwagandha is believed to help improve scalp circulation and strengthen the hair, as well as help get rid of dandruff. It also appears to stimulate production of melanin, the pigment responsible for the colour of hair. So, it may actually reverse graying of hair and it also helps deal with hair loss.

**9. Immuno-modulator activity:** Ashwagandha has shown a significant modulation of immune reactivity in animal models. Administration of Ashwagandha was found active like immunosuppressive drugs, viz, cyclophosphamide, azathioprin and prednisolone. Treatment with Ashwagandha was found to significantly increase Hb concentration, RBC count, platelet count, and body weight in mice<sup>16</sup>. Administration of asgandh extract was found to significantly reduce leucopenia induced by cyclophosphamide (CTX) treatment. Administration of Asgand extract increase the number of CTX treated animals, compared to the CTX alone treated group<sup>17</sup>. Administration of asgand extract was found significantly reduce leucopenia induced sub lethal dose of gamma radiation<sup>18</sup>.

**10. Anti peroxidative action:** The importance of *Withania somnifera* root extract in the regulation of lead toxicity with special reference to lipid peroxidative process has been investigated in liver and kidney tissues. While lead treatment (0.5 mg/kg body wt. / day for 20 days) enhanced hepatic and renal lipid peroxidation (LPO), administration of plant extract in the doses of 0.7 g/kg and 1.4 g/kg body wt. / day along with equivalent doses of lead acetate for 20 days significantly decreased LPO and increased the activities of antioxidant enzymes, viz., superoxide dismutase (SOD) and catalase (CAT), thus retaining normal peroxidative status of the tissues. It was suggested that the ameliorating role of root extract of *W. somnifera* in the lead intoxicated mice could be the result of its antiperoxidative action<sup>19</sup>.

**11. Anti ageing effect:** Double blind clinical trial carried out to study the effect of plant on prevention of ageing in 101 normal healthy males in 50-59 years age group. Root powder (0.5gm) was given orally three times a day for 1 year. Results showed statistically significant increase in Hb%, RBC, hair melanin, and seated stature in treated group in comparison to placebo group. Decrease in serum cholesterol was more in treated group than in placebo group<sup>20</sup>.

**12. Macrophage activating effect:** The chemotactic activity of macrophages and production of Interleukin-1 (IL-1) and tumor necrosis factor (TNF) were significantly reduced in mice treated with the carcinogen achratoxin A (OTA). Administration of Ashwagandha with other drugs was found to significantly inhibit OTA-

induced suppression of macrophage chemotaxis and production of IL-1 and TNF- by macrophages<sup>21</sup>.

**13. Haemopoitic effect:** The combination of Ashwagandha and ginseng (*Panax ginseng*) was orally administered in rats for 90 days using three doses. There was significant increase in body weight, food consumption and liver weight and improved haemopoisis was observed<sup>22</sup>.

**14. Antibiotic Activity:** The antibiotic activity of the Ashwagandha roots as well as leaves experimentally shown that Withaferin A in concentration of 10µg/ml inhibited the growth of various Gram-positive bacteria, acid-fast and aerobic bacilli, and pathogenic fungi. It was active against *Micrococcus pyogenes var aureus* and partially inhibited the activity of *Bacillus subtilis* glucose-6-phosphate-dehydrogenase. Withaferin A inhibited Ranikhet virus. The shrub's extract is active against Vaccinia virus and *Entamoeba histolytica*<sup>23-25</sup>. Asgand showed the protective action against systemic Aspergillus infection. This protective activity was probably related to the activation of the macrophage function revealed by the observed increases in phagocytosis and intracellular killing of peritoneal macrophages induced by Ashwagandha treatment in mice<sup>26</sup>. Antibiotic activity of Withaferin A is due to the presence of the unsaturated lactone-ring. The lactone showed strong therapeutic activity in experimentally induced abscesses in rabbits, being somewhat stronger than that of Penicillin. It substantiates the reputation of the leaves as a cure for ulcers and carbuncles in the indigenous system of medicine<sup>27</sup>.

**15. Anti-tumour Activity:** Withaferin A, withanolide D and E exhibited significant antitumour activity in vitro against cells derived from human epidermoid carcinoma of nasopharynx (KB) and in vivo against Ehrlich ascites carcinoma, Sarcoma 180, Sarcoma Black (SBL), and E 0771 mammary adenocarcinoma in mice in doses of 10,12, 15 mg/kg body weight. Growth of Ehrlich ascites carcinoma was completely inhibited in more than half the mice which survived for 100 days without the evidence of growth of the tumour. They also acted as a mitotic poison arresting the division of cultured human larynx carcinoma cells at metaphase and in HeLa cultures similar to star metaphase. Withaferin A caused mitotic arrest in embryonic chicken fibroblast cells. Methylthioacetate colchicines potentiated the effect of Withaferin A. the presence of an unsaturated lactone in the side-chain to which an allelic primary alcohol group is attached at C25 and the highly oxygenated rings at the other end of the molecule may well suggest specific chemical systems possessing carcinostatic properties<sup>28-30</sup>. Withaferin A has been shown to possess growth inhibitory and radio-sensitizing effects on

experimental mouse tumours<sup>31</sup>. Administration of Withaferin A in mice inoculated with Ehrlich ascites carcinoma cells was found to inhibit tumour growth and increase tumour-free animal survival in a dose dependent manner<sup>32,33</sup>. The alcoholic extract of the dried roots of the plant as well as the active component Withaferin A isolated from the extract showed significant antitumour and radio-sensitizing effects in experimental tumours in vivo, without any noticeable systemic toxicity. One hour treatment with Withaferin A in a non-toxic dose of 2.1 µM before irradiation significantly enhanced cell killing. Withaferin A gave a sensitizer enhancement ratio (SER) of 1.5 for in vitro cell killing of V79 Chinese hamster cells at a non-toxic concentration of approximately 2 µM. SER increased with drug dose<sup>32,33</sup>.

**16. Anti-hyperglycemic Effect:** Asgand along with other ingredients of a composite formulation (Transina) have been reported to decrease streptozocin (STZ) induced hyperglycemia in rats. This anti-hyperglycemic effect may be due to pancreatic islet free radical scavenging activity because the hyperglycemic activity of STZ is a consequence of decrease in pancreatic islet cell superoxide dismutase (SOD) activity leading to the accumulation of degenerative oxidative free radicals in islet-beta cells<sup>34</sup>.

**17. Morphine Tolerance and Dependence-Inhibiting Effect:** Repeated administration of Asgand in mice attenuated the development of tolerance to the analgesic effect of morphine. Asgand also suppressed morphine-withdrawal jumps, a sign of the development of morphine dependence<sup>35</sup>. Administration of glycol-withanolides of *Withania somnifera* was found to suppress morphine-induced inhibition of intestinal motility and to attenuate the development of tolerance to the analgesic effect of morphine in mice<sup>36</sup>.

**18. Cardio tonic Activity:** The constituents of withania structurally being similar to digoxin are demonstrated to exhibit cardiotonic activity and provide a salutary effect in CHF<sup>37</sup>.

**19. Hypolipidemic and Anti-Atherogenic Activity:** Withania has profound hypocholesteremic, hypolipidemic and anti-atherogenic activity. The anti-atherogenic activity of Caps HT2, a botanical medicine comprising of several plants including *W. somnifera* against vascular intimal damage and atherogenesis which leads to various types of cardiovascular diseases was demonstrated. The formulation scavenges free radicals, inhibited lipid peroxidation, delayed the plasma re-calcification time and enhanced the release of lipoprotein lipase enzyme. It also inhibited platelet aggregation comparable to heparin. The formulation altered atherogenic index and reduced the body weight with rise

of high density lipoprotein cholesterol levels in hyperlipidemic rats. In a clinical study and herbal cocktail containing withania used as an adjunct to conventional anti-ischemic drugs has been found to reduce total cholesterol, triglycerides and increase high density lipoprotein cholesterol in the post myocardial infarction patients. The hypolipidemic and antiatherogenic potential is an additional benefit of its usefulness in cardiovascular diseases<sup>38-41</sup>.

**20. Positive Inotropic Activity:** Withania has been reported to reduce blood pressure due to autonomic ganglion blocking action and myocardial depressant effects as well as positive inotropic and chronotropic effects<sup>41</sup>. The alkaloids had a prolonged hypotensive, bradycardiac and respiratory-stimulant action<sup>42</sup>.

**21. Hypoglycemic Effect:** Hyperglycemia is a major risk factor of cardiovascular diseases. Withania favorably alters blood and urine glucose levels, glycated hemoglobin and liver enzymes in diabetic rats<sup>38,43</sup>.

**22. Anti-oxidant activity:** Some of the chemicals found in *Withania somnifera* are powerful antioxidants. Studies conducted on rats' brains showed the herb produced an increase in the levels of three natural antioxidants-superoxide dismutase, catalase and glutathione peroxidase<sup>44</sup>. These findings are consistent with the therapeutic use of *Withania somnifera* as an Ayurvedic rasayana. The antioxidant effect of active principles of *Withania somnifera* root may explain the reported anti-stress, cognition-facilitation, anti-inflammatory and anti-aging effects produced by them in experimental animals, and in clinical situations<sup>45</sup>.

**23. Anti-carcinogenic activity:** Ashwagandha is reported to have anti-carcinogenic effects. Research on animal cell cultures has shown that the herb decreases the levels of the nuclear factor kappa B, suppressed the intercellular tumor necrosis factor, and potentiates apoptotic signaling in cancerous cell lines<sup>46</sup>. One of the most exciting of the possible uses of Ashwagandha is its capacity to fight cancers by reducing tumor size<sup>47</sup>. To investigate its use in treating various forms of cancer, the antitumor effects of *Withania somnifera* have been studied by researchers. In one study, the herb was evaluated for its anti-tumor effect in urethane-induced lung tumors in adult male mice. Following administration of Ashwagandha over a period of seven months, the histological appearance of lungs of animals which received the herb was similar to those observed in the lungs of control animals<sup>48</sup>.

## CONCLUSION:

*Withania somnifera* (Linn) Dunal commonly known as Ashwagandha in Ayurveda medicine possesses numerous pharmacological activities supported by experimental and clinical studies. Further studies will enhance the support of its multifarious action on living organisms.

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