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Pharmacological importance of *Nardostachys jatamansi* DC: A potential therapeutic agent in different pathological ailments

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ABSTRACT

Nardostachys jatamansi (Nj.Cr) DC. is an endangered, primitive and therapeutic agent in the family Valerianaceae. The herbs and rhizomes of this hairy, perennial, dwarf and herbaceous plant are used for medicinal purpose. Mostly herbs and rhizome are used for this hairy, perennial, dwarf and herbaceous plant. Nardostachys jatamansi has been reported to have many therapeutic activities like antifungal, antimicrobial, antioxidant, Hepatoprotective and cardioprotective properties. It is also useful in the management of insomnia and CNS disorders. The vasodilator, bronchodilator, spasmolytic and platelet aggregation inhibition activities of the plant have also been reported. In phytochemical analysis jatamansone, Nardostachone and actinidine have been reported to be present in the plant.

This review article is summary of the potential benefits of this medicinal plant as reported in literature. The review also highlights the need for the use of this plant in Ayurveda system of medicine and future prospects for further research.

Keywords: Jatamansone, Nardostachone, vasodilator, platelet aggregation.

INTRODUCTION

Nardostachys jatamansi, DC.(NJ.Cr) (Family: *Valerianaceae*) locally known in urdu as Blachar (Urdu) is native to the elevated ranges of Himalyas in Nepal but also found in high lands of Sikkim, Bhutan and Punjab. It is an erect perennial herb about10-60 cm in height, with long stout, woody root stock. The radical leaves are elongated and spathulated, while few cauline leaves are sessile, oblong or sub-ovate. Flowers are rosy in dense cymes, with pale pink or blue in coloration. The rhizomes are traditionally used in management of epilepsy, anxiety and in amnesia, while among the cardiovascular effects, it decreases the heart rate and hence used as antihypertensive. It is used as a diuretic, emmenagogue, deobstuent and in cholera. The oil obtained from rhizomes part of plant is used for growth and blackness of hairs. The infusion of the roots has been used in the management of mental disorders, insomnia, and disorder of the blood and circulatory system (1). In the herbal system , plant has been mentioned as hepatotonic, cardiotonic, diuretic and analgesic(2). Scientific investigations on *Nardostachys jatamansi,* DC. revealed its antibacterial and antifungal activities (3). It is also found to be effective in the prevention of cognitive impairment and neuro-degeneration (4). Plants roots were reported to possess analgesic and anti-malarial activities (5). Nj.Cr has many other activities which are reviewed in this article.

Chemistry of *Nardostachys jatamansi* DC

Nardostachys jatmansi is reported to have essential oils rich in coumarins and sesquiterpenes (6)Major sesquiterpenes are Jatamansone and Valerone [7.8] as shown in figure 1 while the rest of sesquiterpenes are Jatamansol, jatamansic acid, dihydrojatamansin, nardosatchone (figure 2) [9]. Some minor contributors like jatamol A, jatamol B.[10], nardosinone, spirojatamol [11], jatamansinone, oroseolol, oroselone, valeranal, seselinnardostachyins [12], seychelane, seychellene, cuomarin and xynthogalin have also been reported [13.14] as well as Alkaloids and actinidines (figure 1) have been reported.

The phytochemical investigation of hydro alcoholic extract of *Nardostachys jatamansi* have shown the presence of flavonoids, carbohydrates, tannins, steroids, alkaloids, sterols, tannins, flavonoids, mucilage ,gums, terpenes and glycosides [15].

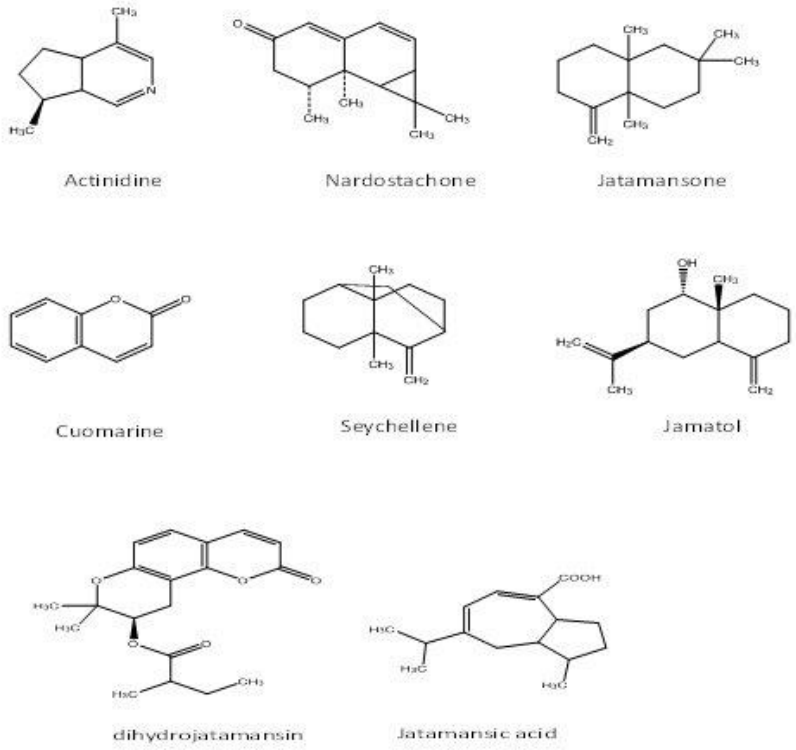

Figure No. 1 Showing different constituents of plant Nj.Cr with their chemical structures

Pharmacological applications

Nj.Cr has been found to be a potential therapeutic agent in the treatment or management of different pathological states of the body as highlighted below.

Antioxidant potential of Nj. Cr

An aqueous extract of Nj.Cr was used to investigate the antioxidant potential and anticataleptic agents by inducing catalepsy in rat by administering haloperidol in rat model [16]. Nj.Cr was found to be safe ranging from 5 mg/kg to 5000 mg/kg body weight. Toxicity was evaluated by following OECD guidelines 423 (acute toxicity class method).

Weight of animals remained same before and after treatment. So toxicology has no concern as no symptoms appeared after 14 days of observation and treatment. Haloperidol induced catalepsy was effectively treated by median dose that is 250mg/kg while the results remain similar by increasing the dose up to 500 mg/kg. It has been observed that by treatment of Nj.Cr in haloperidol oxidative stress model, activity of Superoxide dismutase (SOD), total antioxidant capacity (CAT) and reduced glutathione (GSH) is increased and free radicals produced in haloperidol induced model were quenched [17].

Antioxidant role of Nj.Cr was further studied in chronic fatigue syndrome model of rats [18]. In this study antidepressant and antistress effects of Nj.Cr was evaluated by swimming of rats for 15 min. per day for 21 days. Pinax ginseng was used as positive drug while Nj.Cr was used in 200mg/kg and 500 mg/kg doses and one control group without any treatment. These findings have shown that chronic fatigue syndrome CFS has significant increased lipid peroxidation, nitrite and SOD levels and reduced catalase levels in rats. Administration of Nj.Cr resulted in attenuation of the augmented values of lipid peroxidation, nitrite and SOD levels and increased catalase activity. These finding depict that swimming increased stress level of rats and administration of Nj.Cr mitigated the stress thereby showing that Nj.Cr has antioxidant activity.

Antioxidant activity of Nj.Cr was studied by using restraining of rat in restrainers for 4 hours by immobilizing them by using tape and then in 5th hours, animals were sacrificed by cervical dislocation [19]. Out of four groups 2 groups were treated with Nj.Cr 200mg/kg and 500 mg/kg respectively. The third group received vehicle only while fourth group received stress only. So it was observed that Nj. Cr groups attenuated the stress induced membranous lipid peroxidation (LPO) and nitric oxide (NO) in brain and stomach and antioxidant enzyme catalase. Antioxidant potential was further endorsed [20]) by comparing antioxidant activities of *Valeriana officinalis*, *Nardostachys jatamansi* and *Valeriana sisymbriifolia*. The study was concluded that *Nardostachys jatamansi* and *Valeriana sisymbriifolia* and some other species of Valeriana are good alternative antioxidant for *Valeriana officinalis*.

Antioxidant potential and acetyl cholinesterase inhibition activity was done in sleep deprived amnesic rats by using methanolic extract of roots of *Nardostachys jatamansi* DC. [21]. This study demonstrated that NJ.Cr showed neuroprotective activity by inhibition of AChE and antioxidant activity which enhances memory like the synthetic drug Piracetam.

Hepatoprotective action

Hepatoprotective role of Nj.Cr has been evaluated by biochemical evaluation of liver enzymes by using thioacetamide [22]. Elevated levels of enzymes in response to thioacetamide were normalized by using 50 % ethanolic extract of Nj.Cr. The hepatoprotective action of the plant may be due to its antioxidant potential.

Cardiotonic, antihyperlipidemic and respiratory disorder actions

In the Unani system of medicine, Nj.Cr has been used as a cardiotonic agent and it is applied in the management of respiratory disorder but scientific justification is required to endorse this Ayuverdic claim. However few attempts have been made to elucidate the possible role of Nj.Cr in cardiovascular system and respiratory disorders. Limited data is available for cardiovascular activity. Antiarrythmic and

anticonvulsant activites of the plant have been studied [23]. Same research group also studied the hypotensive action of essential of Nj.Cr in same year [24.25].

Rhizomes of *Nj.Cr*were applied on mitochondrial respiration and lysosomal hydrolases in myocardial injury induced by doxorubucin [26]. In the study, single intrapertoneal injection of doxorubicin containing 15mg/kg was introduced and myocardial injury was induced. Some abnormalities like loss of myofibrils, mitochondrial swelling and cytoplasmic vacuolization were observed. These abnormalities were prevented by pre-treatment with 500mg/kg dose of ethanolic extract of *Nj.Cr*. for seven days. The authors are of the view that the fficacy of *Nj.Cr* is due to its antioxidant activity and attenuation of the stress in rats.

Another study [27] demonstrated that *Nj.Cr* has significant effect on lipid status by acting on lipid metabolizing enzymes when given in doxorubicin induced injury at a dose of 500mg/kg dose for 7 days. While 50% ethanolic extract was found to have increased HDL/total Cholesterol ratio in triton induced dyslipidemic rats. It was also seen to reduce the ratio of total cholesterol to phospholipid ratio [28].

Antifungal and antibacterial activity

Some plants are traditionally known for their specific therapeutic activities. For example, Gymnema sylvestre is known for its diabetic activity and *Ginko biloba* for neurotonic actions. Few historical medicinal plants have classical multiple therapeutic actions in different pathological disorders like *Gensing, Cardamum* and *Nigella sativa* and few others. *Nardostachys jatamansi DC.* is one of those ornamental plants having diversity in its therapeutic actions. *Nj.Cr* was tested for antimicrobial activity along with some other 61 medicinal plants belonging to 33 different families against some microorganisms [3]. In the study screening of antimicrobial action was done by dilution of agar by 500µg/ml and 1000µg/ml and all the extracts were tested along with *Nardostachys jatamansi* DC against Saccharomyces cerevisiae, *Aspergillus niger, Candida albicans, Streptococcus faecalis, Klebsiella pneumonia, Klebsiella pneumonia, Staphylococcus epidermidis, Staphylococcus aureus, Micrococcus luteus, Bordetella bronchiseptica, Bacillus subtilis, Bacilluspumilus,*and *Bacillus cereus varmycoides*. Ciprofloxacin and Amphotericin B at a dos eof 3 µg/ml were taken as positive control against bacteria and fungi respectively while two plates were kept for negative control DMSO. Blank plates only contain Sabouraud dextrose agar (SDA) and nutrient agar (NA). Methanolic extract was used and it was concluded in this study that *Nardostachys jatamansi* DC is effective against most of the microorganisms thereby justifying its role as antimicrobial and antifungal agent. Fungistatic spectrum of NJ.Cr evaluated and the results showed that the plant is effective against *Aspergillus flavus, Aspergillus niger* and *Fusarium oxysporum*[29]. Nj.Cr has been studied for different strains of bacteria [30].

Effect on Estrogen and hair growth

Nardostachys jatamansi DC is studied for the growth of hairs due to cancer treatment [31]. In the study based on the folkloric use mentioned in traditional books, effect of Nj.Cr was investigated. The results confirmed hair growth promotion activities of the plant. In next step hair growth study was design not only to see effect of extract on hair growth but also of isolated fraction named as Nardal, Jatamansic acid, Nardin [32]

Antihyperglycemic effect

In one study [33] it was observed that effective dose for antihyperglycemic activity of Nj.Cr is 500mg/kg in diabetic rats as shown in figure 1.Hydroalcoholic extract was used on Wistar albino normal rats, glucose loaded and alloxan induced diabetes. Antidiabetic study was further confirmed by [34]) in which ethanolic extract was used to validate the traditional use of *Nj.Cr* in hyperglycemia. This study was conducted by using 400mg/kg, 800mg/kg and 1200mg/kg dose for 10 days. After induction of diabetes blood samples were collected after 10 days in both disease model and treatment model. Results depict that 1200mg/kg dose had significant antihyperglycemic effects as compared to disease model rats. Toxicity study was done as per OECD guidelines 1996. This study showed no toxicity effect even at 3000mg/kg dose. Diabetic study was also confirmed by using STZ injection [35]. Cytokines and STZ both cause damage to β cells which is protected by extract of NJ. Cr by inhibiting NF-κB activation, iNOS and NO production.

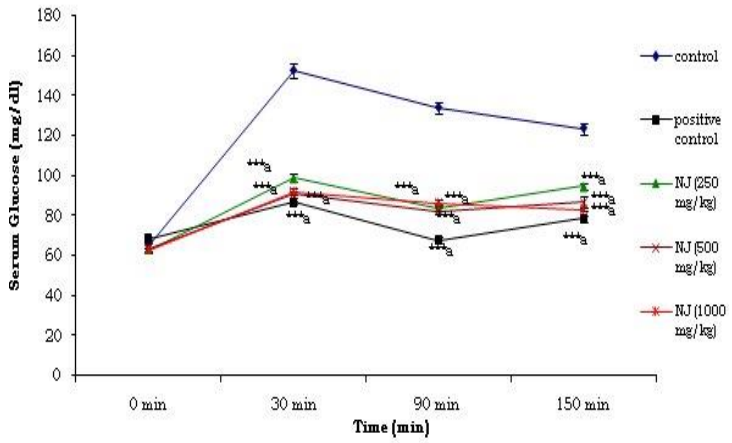

Figure No. 2

Figure No.2. Adopted from [33] to show antihyperglycemic effect of Nj.Cr in comparison with normal and control rats. In this study immunochemistry and PCR results support the above mentioned conclusion. NJ.Cr provides protection to pancreatic β cells protection.

Nervous system application

Ample quantity of scientific data supports the traditional use of *Nj.Cr* in nervous system disorder. Parkinson disease model was induced in one study by using 6-OHDA injection in Wistar rats and it was observed that the drug produced a marked decrease in biogenic amine and increase in D_2 receptors [36]. It was observed that Nj.Cr reversed the neurodegenerative loss by enhancing the biogenic amines and reducing the dopaminergic D_2 receptors in the striatum part of brain. Being an antioxidant produced significant beneficial effects on GSH, CAT, SOD and some other related enzymes and catecholamine. Previously published data also support that Nj.Cr increases the biogenic amines and inhibitory neurotransmitters in the brain [37, 38]. Inhibition of GABA and MAO has been supported by elucidating the antidepressant action of *Nj.Cr* [39]. In this study 3 doses like 100,200 and 400 mg/kg were given for 14 days and antidepressant effects were observed by using forced swim test and tail suspension methods. Antidepressant effects of ethanolic extract of *Nj.Cr* were comparable with imipramine (15mg/kg and sertraline (20mg/kg). Anticonvulsant

effects and neurotoxicity profile was reported with *Nj.Cr* [40]. Ethanolic extract of *Nj.Cr* was used at dose of 50mg/kg in combination with phenytoin 12.5,25,50 and 75 mg/kg doses. Results of study validate the existence of pharmacological synergism phenomenon between both drugs and protective Index (PI) of phenytoin increased from 3.63 to 13.18. However, extract of *Nj.Cr* was found to have no significant activity against pentylenetetrazole (PTZ) seizures, it was effective in maximum electric shock model (MES) and increased the seizures threshold. A comparative study between water and methanolic extract was conducted for acetylcholine esterase inhibition activity [41]. IC_{50} value was calculated as 47.21mμg/ml. The authors conclude that methanolic extract is more

effective in improving memory and cognition as compared to water extract. Scopolamine 0.4mg/kg i.p and diazepam 1mg/kg i.p were administered intraperitoneally to young and aged miceto induce amnesia. Three doses of methanolic extract of *Nj.Cr.* 50,100 and 200mg/kg were given for 8 days. The mice were observed for memory enhancement and learning point of view. It was observed that Nj.Cr reversed the amnesia and learning impairment induced by scopolamine and diazepam indicating that Nj.Cr could be a useful agent for restoration of memory in elderly people or in dementia.

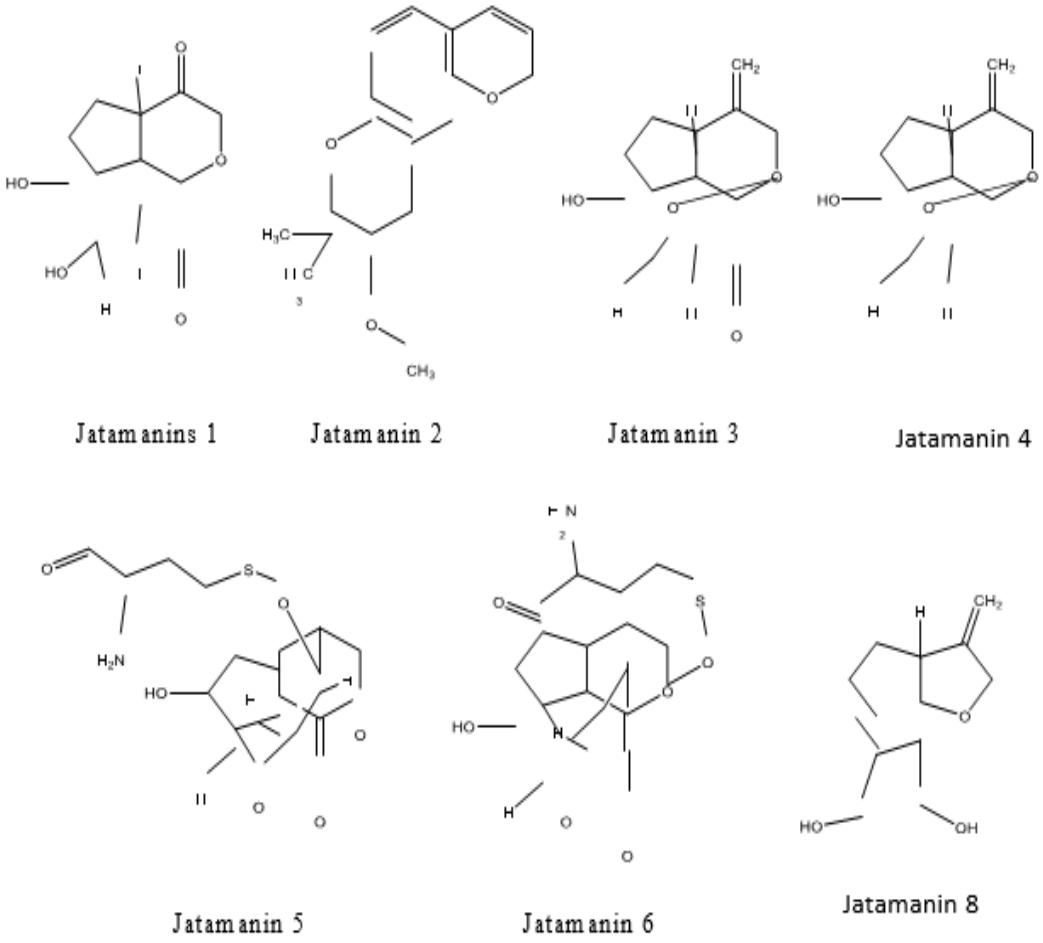

Figure No. 3 showing different types of jatamanin which are present in Nj.Cr

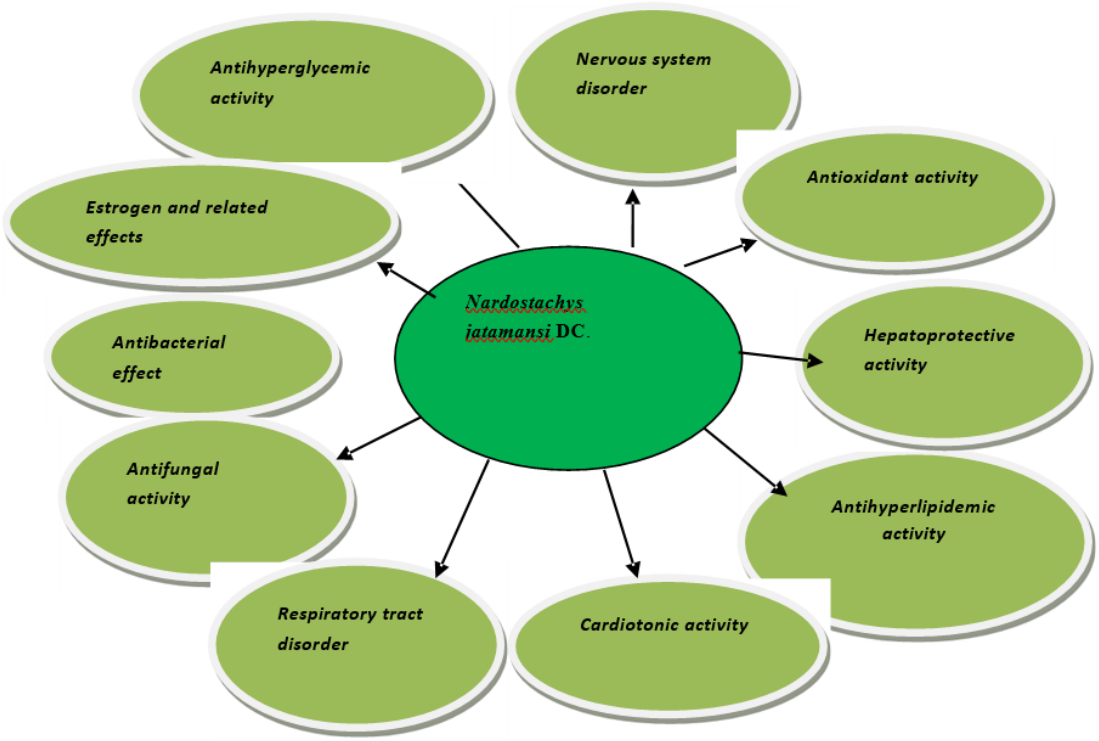

Figure No.4 showing reported activities of *Nardostachys jatamansi* DC.

Neuroprotective effect of *Nardostachys jatamansi* DC. in rats was observed by using middle cerebral artery (MCA) occlusion [38] to induce cerebral ischemia. In the study, MCA model cause reduced GSH, thiol group, catalase and Na-K ATP_{ase} activities. All the alterations done by MCA model were attenuated by pre-treatment with hydro alcoholic extract of *Nj.Cr* for 15 days. This finding was also supported by histopathological studies which show decrease in neuronal cell death following MCA and reperfusion.

Jatamansone as described in chemistry part of this review found to be most active therapeutic agent as neuroeffective drug. In some experimental models it has been observed Jatamansone increases the barbiturate induced hypnosis, increases the body temperature by decreasing reserpine activity. Toxicological studies on rats and mices for jatamansone reported greater than 3160mg/kg dose as LD_{50} [8].

Comparative studies against D-amphetamine, chlorpromazine in hyperkinetic childrens showed that Jatamansone reduces the aggressiveness, stubbornness, restlessness and insomenia [42]. Furthermore, Jatamansone showed fewer side effects as compared to D-amphetamine and chlorpromazine.

Future prospects:

Keeping in view all the data published it appears that ample work has been done on this medicinal plant. However, the areas highlighted below, and depicted by figure 5, should be given further attention First of all Activity guided isolation and identification of the components responsible for the various pharmacological properties of the plant should be done.

Secondly, the mechanisms through which the plant exerts its various pharmacological activities should be elucidated.

Thirdly, efforts should be made to compound the plant extracts into herbal drugs, after appropriate dose

regimens have been evaluated for the various pharmacological activities of the plant.

In diabetic therapeutic area, still mechanisms need to be elucidated. Efficacy is confirmed but active ingredient responsible for this action needs to be sort out. Moreover like previously reported studies [43]effect of plant on other parameters like body weight, lipid profile and histopathological studies for regeneration of beta cells should be studied Plant has previous history of flatulence and antispasmodic in classical books but at present no scientific data is available to establish its role in gastrointestinal tract as antispasmodic.

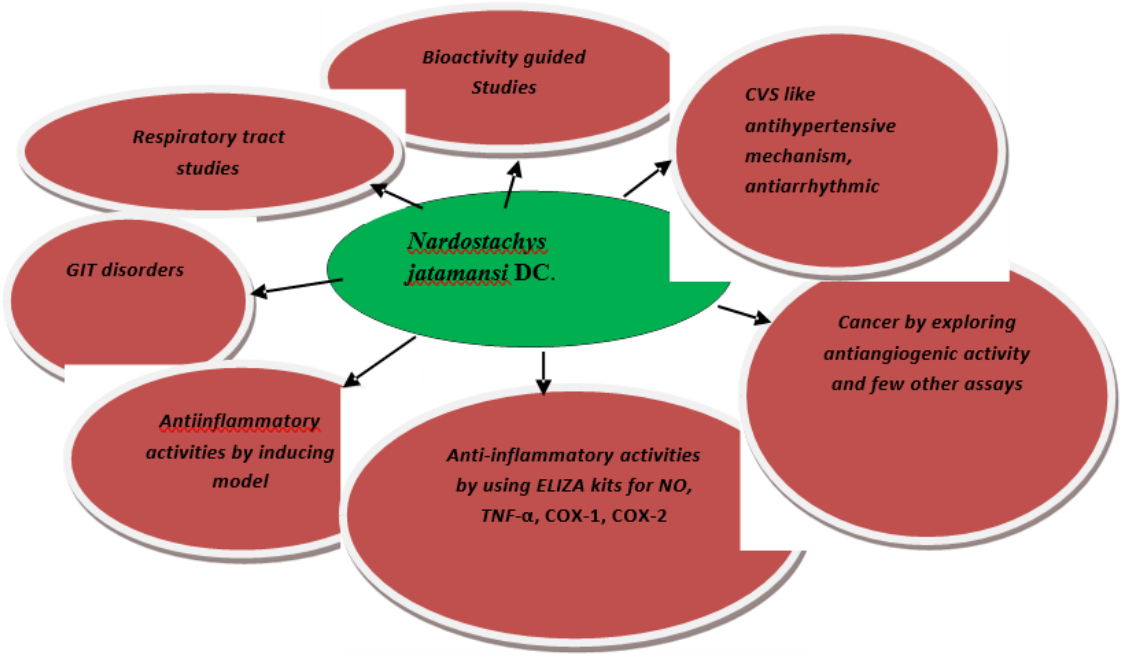

Figure No. 5 showing summary of future prospect for *Nardostachys jatamansi* DC exploration

As reported previously, plant acts on Na-K ATPase channel so plant can be used as bronchorelaxant in respiratory tract disorders and possible mechanism may be elucidated whether this relaxation is due to one mechanism or some multiple mode of actions are involved.

Cardiac therapeutic activities are reported but data published is not enough to make it conclusive for antihypertensive action or antiarrhythmic activity. So still a lot of work needs attention of researcher for this major and central compartment of the body.

Being a potential antioxidant, *Nardostachys jatamansi* DC. can be a useful therapeutic agent in inflammation. These activities can be confirmed by inducing different inflammatory model and some in vitro analysis by using NO, TNF-α, COX-1, COX-2 and some cytokines ELIZA kits.

Some antiangiogensis responses are expected under the umbrella of *Nardostachys jatamansi* DC. So cancer is a wide and broad spectrum which needs to be explored.

CONCLUSION

Summarizing all the data available, present review article is of the view that *Nardostachys jatamansi* DC. is established medicinal plant in different therapeutic areas but some areas need to be explored in

mechanistic approach and conclusive manner. However, *Nardostachys jatamansi* DC. is well established medicinal plant in nervous system disorder and needs to be included in clinical trials.

REFERENCES

[1] Issar Mrurk. *J Res Indian Med.* (**1969**),4(1):83.

[2] W.Turner; Of spikenard. In: Chapman, G.T.L., Mc-Combie, W.A. (Eds.). A New Herbal (Part II & III). Cambridge University Press, London, 1568 , (**1995**):464–6.

[3] VP Kumar; NS Chauhan; H Padh; M. Rajani, *Journal of Ethnopharmacology*,(**2006**), 107 :182-188.

[4] MB Khan; MN Hoda;S Yousuf;T Ishrat;M Ahmad;AS Ahmad, *J Ethnopharmacol.* (**2006**), 108(1):68-73.

[5] YTakaya; Y Takeuji; M Akasaka; O Nakagawasai; T Tadano; K Kisara; HS Kim; Y Wataya; M Niwa; Y Oshima, *Tetrahedron*, (**2000**),56 :7673-7678.

[6] A Chatterjee; B. Basak; U Datta; J; Banerji; A Neuman; T Prange, *Organic Chemistry Including Medicinal Chemistry*,(**2005**), (44): 430-433.

[7] H Hoerster; G Ruecker; J Tautges, *Phytochem.* (**1977**), 1:1070-1071.

[8] G Rücker; J Tautges, A;H Sieck;E Wenzl; Graf, *Arzneimittel-Forschung*, (**1978**),28:7-13.

[9] G Rücker; SK Paknikar; R Mayer; E Breitmaier; G.Will; L Wiehl, *Phytochemistr*y,(**1993**), 33 : 141-143

[10] A Bagchi; Y Oshima; H Hikino; *Planta medica*, (**1991**).57: 282-283.

[11] A Bagchi; Y Oshima; H Hikino, *Tetrahedron*, (**1990**), 46 : 1523-1530.

[12] A Chatterjee; B Basak; M Saha; U Dutta; C Mukhopadhyay; J Banerji; Y Konda; Y Harigaya, *Journal of natural products*, (**2000**), (63) :1531-1533

[13] J Zinzius. *Deutsches medizinisches Journal*, (1961), 12 :423-4.

[14] K Biswas, *Prensa méd*ica argentina, (**1963**), 50 :1021-5

[15] SR Ahemad; S Venkataraman; KN Jayaveera and Mohammed Younus Javeed. *Asian J Pharm Clin Res.* (**2012**), 5(4): 200-206.

[16] A Rasheed; S Venkataraman; K Jayaveera; AM Fazil; KYasodha; M Aleem; M Mohammed Z Khaja; B Ushasri; H Pradeep, *International journal of general medicine*, (**2010**),3:127-136.

[17] M Ahmad; S Saleem; AS Ahmad; MA Ansari; S Yousuf; MN Hoda; F Islam, *Human & experimental toxicology*, (**2005**)24:137-147.

[18] N Lyle; A Gomes; T Sur;S Munshi; S Paul; S Chatterjee; D Bhattacharyya, *Behavioural brain research*, (**2009**), 202 :285-290.

[19] NLyle; D Bhattacharyya; TK Sur; S Muns; S Paul; S Chatterjee; A Gomes, *Indian journal of biochemistry & biophysics*,(**2009**), 46 : 93-98.

[20] MA Dugaheh; F Meisami; Z Torabian; F Sharififar, *Pak. J. Pharm. Sci.* (**2013**), 26 : 53-58.

[21] H Rahman; P Muralidharan; M Anand, *International Journal of PharmTech Research*, (**2011**), 3 , 1807-1816.

[22] S Ali; KA Ansari; M Jafry; H Kabeer; G Diwakar, *Journal of ethnopharmacology*, (**2000**), 71 359-363.

[23] R Arora; P Sharma; K Kapila, *The Indian journal of medical research*, (**1985**), 46 :782-791.

[24] R Arora; K Singh; P Das; P Mistry, *Archives internationales de pharmacodynamie et de*

thé (**1958**),113:367-76. *rapie*,

[25] R Arora; B Madan, *Indian J Med Res.*, (**1956**),44:259–69.

[26] R Subashini; A Gnanapragasam; S Senthilkumar; SK Yogeeta; T Devaki, *Journal of health science*,(**2007**), 53 : 67-76.

[27] R Subashini; B Ragavendran; A Gnanapragasam; S Kumar Yogeeta; T. Devaki, *Die Pharmazie-An International Journal of Pharmaceutical Sciences*, (**2007**),62 : 382-387.

[28] V Dixit; P Jain; S Joshi, *Indian journal of physiology and pharmacology*, (**1987**), 32 :299-304.

[29] D MISHRA; R Chaturvedi; S Tripathi, *Tropical agriculture*, (**1995**), 72: 48-52.

[30] DH Tambekar;SB Dahikar, *J Chem Pharm Res* .**2010**, 2(5):494-501.

[31] SK Yadav; S Gupta; S Prabha, *IJDDHR*, (**2011**), 1 (2):52-54.

[32] VR Gottumukkala; T Annamalai; T Mukhopadhyay, *Pharmacognosy magazine*, (**2011**), 7 :146-150.

[33] M Mahesh; S Dipti; P Kaushal; V Pragnesh; D Balasaheb; D Avinash, *Nigerian Journal of Natural Products and Medicine*, (**2008**),11 : 67-70.

[34] SN Kumar, *IJAPR*, (**2011**), 2(6): 263-268

[35] MY Song; UJ Bae; BH Lee; KB Kwon; EA Seo; SJ Park; MS Kim; HJ Song; KS Kwon; JW Park, *World journal of gastroenterology: WJG*, (**2010**),16 :3249-57.

[36] M Ahmad; S Yousuf; MB Khan; MN Hoda; AS Ahmad; MA Ansari; T Ishrat; AK Agrawal; F Islam, *Pharmacology Biochemistry and Behavior*,(**2006**), 83 : 150-160.

[37] V Prabhu; KS Karanth; A Rao, *Planta medica*, (**1994**),60:114-117.

[38] S Salim; M Ahmad; KS Zafar; AS Ahmad; F Islam, *Pharmacology Biochemistry and Behavior*, (**2003**),74 : 481-486.

[39] D Dhingra; PK Goyal, *Indian journal of experimental biology*,(**2008**), 46 : 212-218.

[40] VS Rao; A Rao; KS Karanth, *Journal of ethnopharmacology*, (**2005**),102: 351-356.

[41] J Vinutha, *Ind J Pharmacol*.(**2007**), 23: 127-131.

[42] P Gupta; V Virmani, *Neurol India*,(**1968**), 6:168-73.

[43] V Gomathi; BJ R Kothai; G Ramakrishnan, *J Chem Pharm Res.*, **2010**, 2(4):266-74.