AYU

Access this article online
Website: www.ayujournal.org
DOI: 10.4103/0974-8520.85729
Quick Response Code:

Clinical Research

Clinical efficacy of *Coleus forskohlii (Willd.) Briq.* (*Makandi*) in hypertension of geriatric population

Madhavi Jagtap[1], H. M. Chandola[2], B. Ravishankar[3]

[1]Lecturer, Department of Kayachikitsa, College of Ayurveda, Nigdi, Pune, Maharashtra, [2]Professor and Head, Department of Kayachikitsa, Institute for Post Graduate Teaching and Research in Ayurveda, Gujarat Ayurved University, Jamnagar, Gujarat, [3]Director, R & D Section, SDM College of Ayurveda, Udupi, Karnataka, India

Abstract

Hypertension is the most common psychosomatic disorder affecting 972 million people worldwide. The present clinical study deals with the effect of *Makandi (Coleus forskohlii (Willd.) Briq.) Ghana vati* and tablets of its powder in hypertension found in the geriatric age group (50-80 years). A total of 49 hypertensive patients fulfilling the diagnostic criteria were registered in two groups-Group I (*Ghana vati*) and Group II (*Churna* tablet). Out of 27 enrolled patients of group I, 21 patients completed the treatment. In Group II, out of 22 registered patients, a total of 20 patients completed the treatment. The effect of the therapy was assessed on the basis of changes in the systolic and diastolic blood pressures, in both sitting and supine positions; with *Manasa Bhava Pariksha, Manasa Vibhrama Pariksha*, symptomatology, geriatric signs and symptoms, and a brief psychiatric rating scale. Analysis of the results showed that the treatment in both the groups had been found to be good. It can be stated that *Makandi,* either in *Ghana vati* form or in *churna* tablet form, is an effective remedy for the treatment of hypertension. On analyzing the overall effect, 76.19% patients in Group I and 75.00% patients in Group II were mildly improved. Comparatively the overall treatment with group I was found to be better.

Key words: *Makandi*, *Coleus forskohlii,* forskolin, *Ghana vati*, geriatric hypertension

Introduction

Hypertension is an important public-health challenge worldwide due to its associated morbidity, mortality, and economical burden on society. Worldwide, it has been seen in about 972 million people in 2000, and the prevalence has been estimated to increase by about 60% to a total of 1.56 billion by the year 2025.[1] It has been reported that hypertension prevalence in India quadrupled in the urban as well as rural populations over a 50-year period, from the early 1950s to the late 1990s.[2,3] Hypertension as such is not described in Ayurverdic literature, however, the spectrum of disease hypertension is interpreted in terms of *Raktavata*, *Raktagatavata*, and in recent years as *Vyana bala vaishymya/Vyana bala vriddhi* in Ayurvedic parlance.

The disease is associated with increased obesity and aging population. India now has the second largest aged population in the world.[4] The incidence rate of hypertension increases with age in both men and women due to age-related changes like thickening of vessel wall, arteriosclerosis, and so on, leading to a decrease in elasticity and lumen of the vessels, and hence, increase in blood pressure. Moreover feeling of insecurity, stress, and anxiety, causes a disturbance in mental health and precipitates the disease, which is frequently seen in old age. Also it is stated that *Jara Avastha* (old age) is the *Parihani Kala* having *Vata dosha* in dominancy, which is the main *dosha* involved in the pathogenesis of hypertension. It is more common in men than in women up to the age 50 years, after which blood pressure rises in women and becomes equal to that seen in males. In later life pressures are higher in women.

The treatment of hypertension in modern science is palliative in nature. Although pharmacological treatments are effective for controlling blood pressure, they have adverse side effects. Lack of information regarding the etiology of most cases of hypertension has enhanced the search for effective anti-hypertensive agents. This approach has led to a further hunt into indigenous drugs, especially after the invention of very promising results of reserpine. For preservation of the health of vital organs, the use of medicinal herbs is the need of the hour. There are a number of herbs that are used as home remedies for common ailments.

Address for correspondence: Dr. Madhavi V. Jagtap, C/o Mr. Vishwanath V. Jagtap, 'Vitthal Niwas', Hirkani Colony, Sr. No. 15/2, Near Warje Jakat Naka, Karveangar, Pune-411 052, Maharashtra, India.
E-mail: madhavi_md@rediffmail.com
Mob: +91-9970163392

Such herbs are easily available, eco-friendly, cost-effective, and toxicity-free, due to their holistic approach.

Coleus forskohlii (Willd.) Briq., [synonym C. barbatus (Andr.) Benth.], belonging to the family Labiatae, Genus-Coleus, is an ancient root drug mentioned in Ayurvedic Materia Medica,[5,6] under the Sanskrit name '*Makandi*'. It is stated to have *Agnidipana*, *Pachana*, *Pandu*, *Pliha*, *Shothhara*, and other such properties. In the recent monographs of Indian Council of Medical Research,[7] it is described by the name *Gandir*, with a Gujarati name of '*Garamar*'. It is commonly known as *Garmar* in the Saurashtra region of Gujrat, and is extensively used as pickle in almost every home during its season, around the months of March to May of each year. The species is being cultivated in Gujarat, Maharashtra, and Karnataka. The traditional uses of the plant are also reported.[8] The root tubers are used traditionally as blood purifiers, hypotensives, diuretics, and so on.

In 1974, researchers first isolated[9] the diterpene, Forskolin, having blood pressure lowering and antispasmodic effects, from the roots, making it the only plant source thus far known having this substance. The therapeutic effects of this alkaloid 'forskolin' are well-documented[10] as being a hypotensive, antispasmodic, positive inotrophic, vasodilator, smooth muscle relaxant, anti-inflammatory, with anti-platelet aggregation, a bronchodilator, anti-glaucoma agent, anti-metastatic, and so on, due to its unique ability to activate the enzyme, Adenylate cyclase, in the absence of a functional guanine nucleotide regulatory protein.

Very few clinical and experimental trials have been done on the *Churna* of the root (as a whole). No study has been reported on the effect of *Ghanavati* form of the drug using root tuber. Though many pharmacological and few clinical studies have been carried out on active principle or isolated fractions of the drug. This type of treatment is always discouraged by *Ayurveda*, as it believes in total and positive health. When a fraction is isolated it acquires a pin-pointed action and also develops the risk of creating adverse effects. The whole drug contains various fractions in balance, with the least chance of developing adverse effect. The administration of the total drug is always preferred by *Ayurveda*, so as to interfere in the least with the natural composition and action. Considering all these points, the present clinical trial was undertaken with the aim of finding efficacy of this whole root tuber, in cases of hypertension.

Aims and objectives

The aims of the study was to evaluate the efficacy of *Coleus forskohlii (Willd.) Briq.* (*Makandi*) root (tuber) *Ghana vati* and *Churna* tablet in hypertension observed in geriatric patients (age 50-80 years).

Materials and Methods

Patients: Patients attending the O.P.D and I.P.D of the Department of *Kayachikitsa* and cases referred by other departments of the Institute for Post Graduate Teaching and Research in Ayurveda hospital, Gujarat Ayurved University, Jamnagar, fulfilling the criteria of inclusion were selected for the present study. An elaborative case taking proforma, incorporating all the aspects of the disease in Ayurvedic and Modern parlance was specially designed for the purpose.

Drugs: Makandi (Coleus forskohlii (Willd.) Briq.) root (tuber) - *Ghana vati* and tablets of its powder were prepared in the pharmacy of Gujarat Ayurved University, Jamnagar.

Diagnostic criteria: The standard diagnostic criteria of the World Health Organization (WHO)/International Society of Hypertension (ISH) (2004)[11] and Joint National Committee (JNC) VI[12] for Prevention, Detection, Evaluation, and treatment of High Blood Pressure was adopted in selecting patients for the study.

Inclusion criteria: Patients above 50 years and below 80 years of age, presenting with the classical symptoms of hypertension were selected for the study. Patients having systolic blood pressure >140 mm of Hg and </ = 180 mm of Hg and diastolic blood pressure >90 mm of Hg and </ = 110 mm of Hg were selected for the study.

Exclusion criteria: Patients below 50 years and above 80 years of age with systolic blood pressure <140 mm of Hg and >180 mm of Hg and diastolic blood pressure <90 mm of Hg and >110 mm of Hg were excluded from the study. Patients having major illness like severe diabetes Mellitus (DM), tuberculosis, major endocrine disorders, malignancies, Human immunodeficiency virus (HIV) or renal accelerated and malignant hypertension and other serious systemic illness were excluded from the study.

Investigation: Hematological investigations like Hemoglobin %, Total Leucocyte Count, Differential Leucocyte Count, Erythrocyte Sedimentation Rate, Packed Cell Volume, Total Red Blood Cell count and platelet count were done, as also urine and stool for routine and microscopic examination. Biochemical investigations like FBS, complete lipid profile, blood urea, serum creatinine, uric acid, and serum calcium were done, to rule out any other pathology. Serum Apolipoprotien B-100 was investigated as a biomarker for the elderly hypertensive patients.

Study design: It was a randomized clinical study. The study design was approved by the Institutional Ethics Committee. Informed consent was taken from the patients before including them in the trial.

Management of the patients

Drug dosage, duration, and method of administration:

- *Grouping:* The selected patients were randomly divided into two groups:
- *Group-I* — Patients of this group were given *Makandi Ghana vati*-500 mg two t.d.s. after breakfast, lunch, and dinner, for two months, with lukewarm water as *anupana*. In this group, out of a total of 27 registered patients, 21 completed the treatment, and the remaining six stopped against medical advice.
- *Group-II* — Patients of this group were given *Makandi Churna* tablet-700 mg two t.d.s. after breakfast, lunch, and dinner for two months, with lukewarm water as *anupana*. In this group, a total of 22 patients were selected, out of which 20 completed the treatment and two stopped it against medical advice.

Psychological counseling was done for all patients in both the groups.

Pathya - Apathya: The patients were advised to follow correct dietary habits and avoid unhygienic, stale food, reduce intake of extra salt, avoid *papada*, *chuttneys*, *pickles*, and so on.

Mild-to-moderate exercise as per their capacity was suggested. They were consulted for modification in diet and lifestyle, to rule out the causative factors of hypertension.

Follow-up: A follow-up study was carried out for one month.

Criteria for assessment

Changes in the subjective parameters of the specific rating scales were recorded at two-week intervals. Changes in systolic and diastolic blood pressures in both sitting and supine positions were assessed weekly. A specific rating scale for geriatric signs and symptoms,[13] *Manasa Pariksha Bhava* (Mental factor examination),[14] *Manasa Vibhrama pariksha*, for symptomatology,[15] and Brief Psychiatric Rating Scale[16] were utilized to assess the effect of the therapy. The total effect of the therapy in each patient was evaluated after completion of the treatment.

Criteria for the overall assessment of therapy

The total effect of the therapy was assessed considering the overall improvement in the signs and symptoms, reduction in blood pressure, and improvement on the 'Brief Psychiatric Rating Scale'. After completion of the treatment course and in the follow-up period, the total effect was derived from the following formula:

$$\frac{\text{Total BT-Total AT}}{\text{Total BT}} \times 100$$

where BT is the mean score before treatment and
AT is mean score after treatment

The obtained results were measured according to the grades given below,

Complete remission	:	100%
Marked improvement	:	>75%-<100% Improvement
Moderately improved	:	>50%-<75% Improvement
Improved	:	>25-<50% Improvement
Unchanged	:	<25% Improvement

Statistical analysis

The information gathered on the basis of the observations was subjected to statistical analysis. The Paired '*t*' test[17] was used to check the significance of the subjective and objective criteria and to compare the effect of the therapy on the two groups. The 'χ^2'-test[18] was carried for subjective criteria and the Unpaired '*t*' test[19] for the objective criteria. The obtained results were interpreted at $P < 0.05$, $P < 0.01$, and $P < 0.001$ significant levels.

Results and Discussion

Effect of the therapies on systolic and diastolic blood pressure and pulse pressure

The effect of the therapy on systolic blood pressure (sitting position) shows 12.07 and 10.75% relief in groups I and II, respectively. The effect of the therapy on diastolic blood pressure (sitting position) shows 9.80 and 8.65% relief in groups I and II, respectively. The effect of the therapy on systolic blood pressure (supine position) shows 12.99 and 13.25% relief in groups I and II, respectively. The effect of the therapy on diastolic blood pressure (supine position) shows 10.10 and 10.75% relief in groups I and II, respectively. The effect of the therapy on pulse pressure (sitting position) shows 15.79 and 14.10% relief in groups I and II, respectively. The effect of the therapy on pulse pressure (supine position) shows 17.61 and 17.23% relief in groups I and II, respectively. Statistically in all these parameters, both groups have shown highly significant results ($P < 0.001$). On applying the unpaired '*t*' test for comparison, no significant results have been obtained.

Thus, on observing the effects on blood pressure and pulse pressure, a mild fall in systolic as well as diastolic blood pressure in both sitting and supine positions was found in both the groups, which was statistically highly significant. This finding showed the efficacy of the treatment in reducing blood pressure and proved that *Makandi* was an effective anti-hypertensive. Although the reduction was small over a treatment of two months in the geriatric population, it could be taken in order to regulate blood pressure over a long period. Comparatively, the overall reduction in blood pressure was good in the treatment of group I, that is, *Makandi Ghan Vati*. As *Ghana* is the concentrated form of the drug, with the highest potency, it obviously got better results.

Effect on chief complaints

The treatment in group I showed better improvement in *Bhrama* (67%), *Tamodarshana* (62%), *Klama* (52%), *Alpanidra* (54%), *Shwasa* (55%), *Gurugatrata* (67%), and *Alasya* (67%). Group II showed good improvement with *Shirashula* (52%), *Bhrama* (50%) *Tamodarshana* (60%), *Klama* (60%), *Alpanidra* (50%), *Santap* (53%), *Shwasa* (59%), *Shrama* (57%), *Pipasa* (50%), *Gurugatrata* (50%), and *Alasya* (75%). When the paired '*t*' test was applied, to analyze the results statistically, all the above-mentioned results were found to be highly significant, except the one in *Alpanidra* in group II, which was non-significant. On applying the Chi square test, Group I was found to be better in *Bhrama*, *Gurugatrata*, and *Krodhaprachurata* than Group II.

On analyzing the above results it is clear that the treatment in both groups I and II is good. It can be stated that *Makandi*, either in the *Ghana vati* form or in the *churna* tablet form is an effective treatment remedy for the treatment of hypertension.

Effect on geriatric signs and symptoms and body mass index

No significant or remarkable change was observed in any sign of aging in the studied geriatric population. The finding supported the fact that after the age of 50 years, the natural aging changes that occurred in various systems of the body could not be reversed. What Ayurvedic or any treatment modality could achieve was to prevent further degenerative changes and improve the quality of life. These objectives were fulfilled by the present treatment modality.

Group I had shown 2.60% while Group II had shown 2.38% of reduction in body mass index (BMI). Statistically both the results were found highly significant (P value < 0.001). Obesity has been widely claimed for its role in the manifestation of HT. The increase in body weight in the population is a critical factor in the increase in the prevalence of hypertension. Weight loss in overweight or obese persons can prevent or delay the onset of hypertension.[20] The *Meda dushti* in case of obesity may be the cause for the obstruction of *Vyana vata*, leading to hypertension. The obtained results can be due to

the *Tikta*, *Katu rasa*, and *Ushna Virya* of the trial drug. *Tikta rasa* causes *kleda*, *meda*, *vasa*, and *mutra upashoshana*, having properties of *Deepana*, *Pachana*, *Shodhana*, and *Lekhana*, which are helpful for removing the obstruction from the *Srotasa*, and thus, responsible for *Srotoshodhana*. The *Ushna Virya* by removing the underlying obstruction helps to regain the normal functioning of *Vata*.

Effect on *Manasa Pariksha Bhava* and *Manasa Vibhrama Pariksha*

Among the *Manasa Bhava*, mild improvement in *Moha* (13.33%), *Shoka* (22.22%), *Harsha* (17.64%), and *Bhaya* (14.28%) was observed in the treatment with Group I. It also showed improvement in *Buddhi Vibhrama* (75%). Group II failed to show any remarkable effect on these parameters. The psychology is obviously disturbed in the geriatric population and they need more supportive psychotherapy through social and familial support, rather than medicine, to satisfy the inner instincts and to adapt to the physical and psychological changes occurring in the body and mind. Medicine can play a limited role in changing the psychological parameters.

Effect on brief psychiatry rating scale

In brief, the psychiatry rating scale of Group II showed better improvement in somatic concern, anxiety, guilt feeling, and depressed mood (50% each). Group I showed better improvement in tension (50%). All other symptoms were seen mildly improved in both the groups. It was clearly seen that Group II showed better results in the symptoms on the brief psychiatry rating scale.

Effects on the hematological and biochemical parameters

When the effects on the hematological and biochemical parameters were observed, no remarkable changes were observed in any of the parameters in both the groups. Group I had shown 11.81% increase in serum HDL, which was found statistically highly significant ($P < 0.01$). Group II showed 8% increase in serum HDL. The treatment in Group I had also shown a 13.69% decrease in blood urea and a 7% decrease in serum creatinine, with statistically significant ($P < 0.05$) and highly significant ($P < 0.01$) results, respectively. In both these parameters Group II had shown 10 and 1% increase, respectively. In the serum cholesterol, Group II had shown a 4% decrease, while Group I showed a 3% increase. Statistically Group II showed highly significant ($P < 0.01$) and Group I showed an insignificant result. In case of the investigation of a biomarker, serum Apolipoprotein-B 100, neither percentage wise nor a significant remarkable change was observed in any of the groups. In all other investigations, both the groups showed statistically non-significant results.

On comparison by unpaired '*t*' test, Group I showed significantly better results in decreasing serum creatinine and increasing serum HDL level than Group II, whereas, Group II was found to be significantly better in reducing the serum cholesterol than Group I.

All the changes were within normal physiological limits. The findings on these hematological and biochemical profiles proved the safety and efficacy of the drugs under trial.

Overall effect of therapy

On analyzing the overall effect, it was observed that Group I, that is, treatment with *Makandi Ghan Vati*, showed comparatively better results than Group II [Figure 1]. The probable mode of action and the reason behind this is as discussed below.

Probable mode of action of *Coleus Forskohlii (Willd.) Briq. (Makandi)*

According to Vagbhata, the drug acts by its *Rasa*, *Vipaka*, *Virya*, *Guna*, and *Prabhava*.[21] Normally the effect of *Rasa* is less than that of *Vipaka*. The effect of *Vipaka* is less than that of *Virya*, which further is less than the effect of *Prabhava*, provided all are present in equal proportions.[22]

Rasapanchaka[23]

- *Rasa*: *Tikta*, *katu*, *Madhura*
- *Guna*: *Tikshna*, *Vikasi*
- *Veerya*: *Ushna*
- *Vipaka*: *Kanda-Madhura vipaka*

The probable effects of *Makandi* produced by its various properties are summarized below:

Tikta Rasa: (bitter taste)

Tikta rasa[24] itself is not delicious, but when added with other things it promotes deliciousness. It is having *Deepana*, *Pachana*, *Shodhana*, *Lekhana*, and *Shleshmopashoshana* properties, which show that it promotes proper digestion, purification of the body, and depletion of *Kapha*, which can cause obstruction in the pathways of *Vyana Vata*. It has the properties[25] of *kleda*, *meda*, *vasa*, and *mutra upashoshana*, which are also helpful in the treatment of hypertension. *Kleda* and *Meda* are the factors that are involved in the pathophysiology of hypertension. Among the six Rasas, *Tikta rasa* is mentioned as '*Laghutama*',[26] the property that is against the *ama guna* which is *Guru* in nature. Thus, by counteracting *ama*, it again helps to alleviate the disturbed pathophysiology in hypertension. Also because of this basic structure of *Mahabhuta* with *Akasha* and *Vayu*, it is supposed to have highest penetrating capacity and reach the subtlest level of the channels and the mind. *Tikta* can cause *Pralhada* (delightfulness).[27] Thus, it is very helpful in the treatment, as it is the remover of obstruction, in the case of hypertension. The *Rasa* is *Pitta Shamaka*, the second dominant *dosha* in geriatric hypertension.

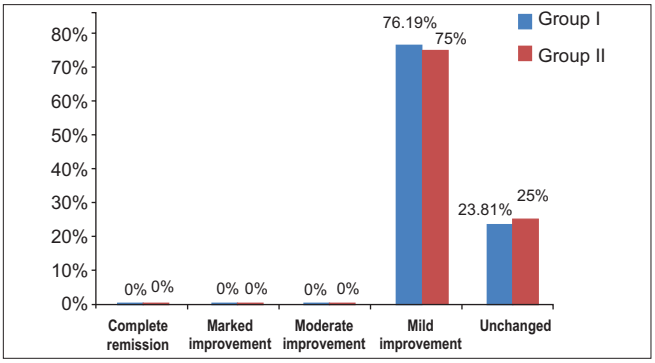

Figure 1: Overall effect of therapy

Madhura Vipaka

Makandi Kanda possesses *Madhura Vipaka*, which is the finally converted *Rasa* after metabolism by *Agni*.[28] *Madhura Vipaka* alleviates the *Vata dosha*, stimulates the production of normal *Kapha*, promotes semen, and helps in the proper elimination of stool and urine.[29] *Madhura* also can cause *Aalhada*, that is, soothening and delightfulness.[30] Sushruta states that *Madhura* can produce *Soumanasya* (sense of well-being), *Bala* (power), *Utsaha* (enthusiasm), *Harshana* (pleasure), and *Sukham* (happiness).[31] These are important qualities to alleviate the disturbed physio-psychopathology in hypertension.

Ushna Virya

Ushna Virya is again helpful in stimulating *Agni* and *Amapachana*, alleviating the vitiated *Vata* by removing the obstruction, and dominating its *sheeta* property. It helps in the dilatation of channels, thus providing a sufficient space to flow.

Guna

Makandi possesses important properties like *Tikshna* and *Vikasi*. By the virtue of the *Tikshna gunas* it can penetrate at a subtler level of channels, to remove the obstruction and by virtue of *Vikasi guna*, it can spread all over the body within a short time span, which is useful in the treatment of hypertension.

Other actions and uses

As per the classics, *Makandi* possesses *Deepana*, *Ruchi Vardhaka*, *Pathya*, *Jathara Roga Nashaka*, *Agni Dipaka*, *Ruchya*, and *Balakaraka* properties, which are also synergistic in the treatment of hypertension. It can destroy the diseases of the *Pleeha*, *Vata*, and *Kapha Vikaras*. It also cures *Gulma*, *Udara*, *Anaaha*, and *Sheeta Jwara*. Its *Kanda* (root tuber) is useful in *Pandu*; it is *Shopha Nashaka*, *Krimi*, *Pleeha*, *Pandu*, *Gulma*, *Samgrahani*, *Udara*, and *Arsha Roga Nashaka*.

Difference between the pharmacological action of *Ghana vati Kalpana* and *Churna Kalpana*

Properties of the drug also depend on the form of the administered drug, because the particular changes are created at all the physical, chemical, and metaphysical levels according to that particular procedure of the preparation (type of *Kalpana*). The same drug can have different properties (*Gunantarani*) according to the different types of the preparations (*Kalpanavisheshena*).[32] The study has proved this quotation.

The main procedural difference between the two forms is *Agni Samskar*. When preparing the *Ghana vati*, first the decoction of the drug is prepared and the filtered decoction is again heated, so that it concentrates to a solid form. In this method, the active ingredients of the drug have been under abundant heat for a prolonged time, which may increase or decrease the potency of the drug. Generally it is advised to prepare the *Ghana vati* of those drugs only, the active ingredients of which remain stable on heating and still the potency increases so as to increase the therapeutic efficacy of the drug. The advantage of *Ghana vati* is a more therapeutic efficacy with a lower dose, with a high level of palatability.

In the second group, tablets prepared from the powder of the drug were administered to the patients. In this form, the drug does not undergo any direct heating mode. It is the form made, so the drug is easy to take and is palatable. In this trial, therefore, it was decided to work critically on both forms of the drug *Makandi*.

After preparing the *Makandi Ghan vati* and *Makandi* powder, the estimation of the active ingredient 'forskolin' was done by using the HPLC quantitative analysis method.[33] It was observed that forskolin was present, 2.40 mg/500 mg in *Ghana vati*, and 2.31 mg/700 mg in the *churna* tablet. Thus, it was evident that the active ingredient was more in the *Ghana vati* form than in the *churna* tablet form.

Pharmacological actions of *Coleus forskohlii (Willd.) Briq. (Makandi)*

Forskolin is the extract from the tubers of the *Coleus forskohlii (Willd.) Briq.* plant, which has been proven to have blood pressure lowering and antispasmodic effects. It was first described as an activator of adenylate cyclase in rabbit heart menbranes, in 1981 (Metzer and Linder, 1981).[34] The unique ability of forskolin to activate the enzyme Adenylate cyclase in the absence of a functional guanine nucleotide regulatory protein, strongly suggested that forskolin was a unique agent, capable of activating the catalytic protein directly (Seamon and Daly, 1981).[35] Also, in the textbook of modern science[36] it is mentioned that adenylate cyclase can be stimulated directly by the administration of forskolin, which bypasses both the beta receptor and G protein.

The hypotensive effects of forskolin are observed in deafferented as well as in the spinal transected cat, and suggested that lowering of blood pressure is not mediated by the central effects of forskolin, but is rather due to the direct peripheral vasodilatory actions, through its smooth muscle relaxation property.[37] Activation of adenylate cyclase further increases the amount of cyclic adenosine monophosphate (cAMP) in the cells. cAMP is the most important cyto-regulatory compound. This activation of Adenylate cyclase in the smooth muscles of the blood vessels by forskolin, resulting in an increase of cyclic AMP levels, may be a mediating factor for the relaxation of smooth muscles, which further results in vasodilatation, hence leading to a decrease in blood pressure.

It also had a spectrum of other actions like positive ionotropic, anti-glaucoma, anti-inflammatory, anti-platelet aggregation, anti-metastatic, bronchospasmolytic;[37] body weight reduction by increasing lean body mass,[38] and so on, all of which attributed to its ability to increase the amount of cAMP in the cells.

Lukewarm water was taken as an *anupana*. Its various properties like *Dipana*, *Pachana*, *Vatanulomana*, and so on, are mentioned in the classics. Some role of these actions, in the outcome of the therapy, can also be considered. It can be suggested to carry out further extensive studies on various permutations and combinations of different forms and doses of the drug. This study can be referred for the baseline idea.

Conclusion

The study has revealed the efficacy of the treatment in reducing BP, and has proved that *Makandi* is an effective anti-hypertensive. On analyzing the overall effect, Group I has shown better results than Group II. The reason behind this may be that in the *Ghana* preparation the drug is in a more concentrated form, with the highest potency in a lower

dose than in the *Churna* tablet form. Group I has also shown encouraging results on renal function by lowering the blood urea and serum creatinine level with improvement in HDL — good cholesterol, while Group II has shown better improvement in serum cholesterol. The results have also shown that the same drug can have different properties according to the type of the preparation. It can be stated that *Makandi* either in the *Ghana vati* form or in the *Churna* tablet form is an effective treatment remedy for the treatment of hypertension. The study has provided enough scope to future research workers interested in *Makandi* vis-a-vis hypertension, to have a large sample study for a longer duration. If patients are administered *Makandi* on the early detection of hypertension then the unnecessary use of powerful synthetic drugs, causing a number of adverse effects, can be effectively avoided.

References

1. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: Analysis of worldwide data. Lancet 2005;365:21723. Available from: http://www.sld.cu/galerias/pdf/servicios/hta/global_burden_of_hypertension.pdf [Last assessed on 2010 Apr 23].
2. Gupta R, Al-Odat NA, Gupta VP. Hypertension epidemiology in India: Meta-analysis of 50 year prevalence rates and blood pressure trends. J Hum Hypertens 1996;10:465-72.
3 Gupta R. Major coronary risk factors and coronary heart disease epidemic in India. South Asian J Prev Cardiol 2003;7:11-40. quoted in article-'Increased variance in blood pressure distribution and changing hypertension prevalence in an urban Indian population' downloaded from http://www.nature.com/jhh/journal/v17/n8/pdf/1001588a.pdf on 23/4/2010.
4. Indias older population quadruple by 2050, pg-1. Available from: http://www.indianexpress.com [Last accessed on 2010 Mar 20].
5. Shaligram Nighantu- Bhushnam, Lala-Shaligramji- vaishya virachita, sanskaran. Parishishta Bhaga, pg-931, Khemaraj Shrikrushnadasa prakashana; Mumbai, 1993.
6. Nighantu Ratnakara – a compendium of system of Hindu medicine, edited by Bhishagvarya Late Krishna Shastri R. Navre collated with spacious notes by Vasudev Laxman Shastri Pansikar and Krishnaji Vitthal Soman, Part I. Gunadosha prakarana, pg-152. Nirnayasagar press, Mumbai, 1993.
7. Reviews on Indian Medicinal Plants, Vol-VII, chapter- 25, Coleus Lour. (Lamiaceae), Indian Council of Medical Research, New dehli-110 029, 2004, pg-357-89.
8. Reviews on Indian Medicinal Plants. Vol. 7. Chapter 25. Coleus Lour. (Lamiaceae). New Delhi: Indian Council of Medical Research; 2004. p. 367
9. Ammon HP, Axel B. Muller- Forskolin: From an Ayurvedic Remedy to Modern Agent. Article published in; Planta Medica, Journal of Medicinal Plant and Natural Product Research; Issue-6, volume-51: 473-477, Thieme Medical Publishers, Germany, Dec-1985, assessed at https://www.thieme-connect.de/ejournals/abstract/plantamedica/doi/10.1055/s-2007-969566, on dt 12/07/2011.
10. Handa SS, Kaul MK. Supplement to cultivation and utilization of Medicinal plants. Regional research laboratory. Jammu-Tawi: Council of scientific and Industrial Research; 2006. p. 407
11. The Updated World Health Organization (WHO)/International Society of Hypertension (ISH) Hypertension Guidelines 2004. Available from: http://www.medscape.com/viewarticle/471863. [Last assessed on 2008 Jan 31].
12. The Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure. Arch Intern Med 1997;157:2413-42. Available from: http://archinte.ama-assn.org/cgi/reprint/157/21/2413 [Last accessed on 2010 Mar 28].
13. Shukla D, Chandola HM, Ravishankar B. The role of Manasika Bhava in Akalaja Jara (Ageing) and comparative study of its management with Guduchyadi and Bhringarajadi Rasayana. - M.D. (Ayu.) thesis. Jamnagar, India: IPGT & RA, GAU; 2007.
14. Deole Y, Chandola HM, Ravishankar B. Clinico experimental study on effect of Brahmi Ghtita on Depressive illness, M.D. (Ayu.) thesis. Jamnagar, India: IPGT & RA, GAU; 2008.
15. Kale Atul. The Clinical Study on Ayurvedic Samprapti of Essential Hypertension and its Management with Sarpagandhadi Vati, M.D. (Ayu) thesis. Jamnagar, India: Gujarat Ayurved University; 2005.
16. Overall JE, Gorham DR. The Brief Psychiatric Rating Scale (BPRS): A comprehensive review. J Operat Psychiatry 1991;148:472. Hamilton M: A rating scale for depression. J Neurol Neurosurg Psychiatry 1960;28:56.
17. Mahajan BK. Methods in Biostatistics for medical students and research workers. 6th ed. New Delhi, India: J P Brothers medical publishers (P0 limited; 2006. p. 147-50.
18. Mahajan BK. Methods in Biostatistics for medical students and research workers. 6th ed. New Delhi: J P Brothers medical publishers (P0 limited; 2006. p. 168-85.
19. Mahajan BK. Methods in Biostatistics for medical students and research workers. 6th ed. New Delhi: J P Brothers medical publishers (P0 limited; 2006. p. 142-7.
20. He J, Whelton PK, Appel LJ, Charleston J, Klag MJ. Long-term effects of weight loss and dietary sodium reduction on incidence of hypertension. Hypertension 2000;35:544-9. Available in article 'The Hypertension Paradox — More Uncontrolled Disease despite Improved Therapy'. Available from: http://content.nejm.org/cgi/reprint/361/9/878.pdf [Last accessed on 2010 Apr 23].
21. Vagbhata, Ashtanga Hridayam, with the commentaries, 'Sarvangasundara' of Arunadatta and 'Ayurvedarasayana' of Hemadri Annotated by Dr. Anna Moreshvara Kunte, and Krishna Ramachandra Shastri Navre, edited by Pt. Harishastri Paradakar Bhishgacharya. Reprint 2002, Sutra Sthana 9/21-22. Varanasi, India: Chaukhmba surbharati prakashana; 2002. p. 170.
22. Ibid Ashtang Hridaya Sutra Sthana 9/25. p.171.
23. Ibid Shaligram nighantu, p. 931.
24. Agnivesha, 'Charaka Samhita' Text with English Translation and Critical Exposition Based on Chakrapanidatta's 'Ayurveda Dipika', by Dr. Ram Karan Sharma and Vaidya Bhagvan Dash. 7th ed. Chowkhamba Sanskrit Series Office, P. box. 1008, Varanasi -221 001, (India), 2002 Sutra Sthana 26/41(5). Varanasi, India; 2002. p. 468-9.
25. Ibid Ashtanga Hridaya Sutra Sthana 11/15. p. 176.
26. Ibid Ashtanga Hridaya Sutra Sthana 11/39. p. 178.
27. Ibid Charaka Samhita Sutra Sthana 26/78. p. 480.
28. Ibid Ashtanga Hridaya Sutra Sthana. 9/20. p.169.
29. Sharma RK, Bhagwan Dash. Charaka Samhita (text with English translation & Critical exposition based on Chakrapanidatta's Ayurveda Dipika). Vol. 1. Chaukhambha Sanskrit Series Office. Sutra Sthana 26/61. Varanasi: Chaukhambha Sanskrit Series Office; 2002. p. 473.
30. Ibid Charaka Samhita Sutra Sthana 26/74. p. 480.
31. Sushruta, 'Sushruta Samhita' with 'Nibandha Sangrha 'commentary by Dallhanacharya, edited by Vaidya Jadavaji Trikamaji Acharya and Narayana Rama Aachrya. 8th ed. Chaukhamba Orientalia, post box. no. 1032, Gopal Mandir Lane, Varanasi -221 001, India. Sutra Sthana 46/481. Varanasi, India: Chaukhamba Orientalia: 2005. p. 249.
32. Ibid Chakrapani commentary on Charaka Samhita Vimana Sthana 1/10. p. 232.
33. Jagtap Madhavi, M.D. Ayu. Thesis, A survey of hypertension in geriatric population and its management with *Makandi* (*Coleus forskohlii (Willd.) Briq.*), Drug review/Analytical study. Jamnagar, India: I.P.G.T. & R.A., G.A.U.; 2010.
34. Metzer H, Linder E. 1981a, IRCH Med. Sci. 9, 99. available at Proceedings of the international symposium, on FORSKOLIN. In: Rupp RH, De Souza NJ, Dhohadwalla AN, editors. Its chemical, biological and medical potential, organized by Hoechst centre for Basic Research, Bombay on 28th and 29th Jan. India: Horchst india Limited. 1985. p. 51,64
35. Seamon KB, Daly JW, 'Activation of Adenylate Cyclase by the Diterpene Forskolin Does Not Require the Guanine Nucleotide Regulatory Protein', J Biol. Chem., Vol.256, no.19, Issue of October 10, pp 9799-9801, U.S.A., 1981, assessed at http://www.jbc.org/content/256/19/9799.long on 13/7/2011.
36. Harrison's Principles of Internal Medicine, International Edition, Vol. 1. 14th ed. Chapter 232- Normal and Abnormal myocardial Infarction. New York: Mcgraw-hill Companies; 1998. p.1286.

37. Ammon HP, Axel B. Muller- Forskolin: From an Ayurvedic Remedy to Modern Agent. Article published in; Planta Medica, Journal of Medicinal Plant and Natural Product Research; Issue-6, volume-51: 476, Thieme Medical Publishers, Germany, Dec-1985, assessed at https://www.thieme-connect.de/ejournals/abstract/plantamedica/doi/10.1055/s-2007-969566, on dt 12/07/2011.
38. Badmaev V, Majeed M, Conte A, Parker JE. Diterpene forskolin: a possible new compound for reduction of body weight by increasing lean body mass, Townsend Letter 2001;June: 115, the Examiner of Alternative Medicine, consolidated Press Seattle, Washington, assessed at http://findarticles.com/p/articles/mi_m0FDN/is_1_11/ai_n16126568/pg_4/?tag=mantle_skin;content and http://townsendletter.master.com/texis/master/search/?q=forskolin&s=SS on 9/7/2011.