

Use of Punarnava (*Boerhavia diffusa*) as a Potential Herb for the Management of Diabetes by Ayurvedic Practitioners

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Introduction: India is the 'diabetes capital of the world' and statistics show that the country now has 101 million diabetics, with a further 136 million pre-diabetic individuals in need of prevention. As per Ayurveda, there exists a huge collection of plants with antidiabetic potential. The research work primarily done in animal model systems shows that Punarnava possesses beneficial medicinal properties. The objective of the study was to validate the findings from the available literature regarding Punarnava (*Boerhavia diffusa*) and to understand the safety and effective dosage, side effects/toxicity if any and forms in which it can be prescribed to diabetics from the perspective of the doctors who use the herb in their routine practice.

Materials and Methods: A questionnaire-based online survey was conducted on 101 Ayurvedic practitioners. The questionnaire consisted of 24 questions with respect to the utility, form/dose determination, safety, bioavailability and procurement of Punarnava.

Results: Around 71%, 66%, 55% and 33% doctors reported that Punarnava possessed anti-inflammatory, diuretic, hepatoprotective and anti-diabetic properties respectively. Around 78% of them preferred to prescribe Punarnava in the form of pills/tablets whereas other forms like powder (63%), decoction (48%), juice (42%) were also suggested. Eighty three percent of the doctors agreed that the consumption of Punarnava does not have any side effects on the patients and 81% of them felt that it is totally safe for long term consumption.

Discussion: The safety, utility and use of Punarnava has been documented in several research papers, review articles and ancient Ayurveda literature. With the available data from the present study, further clinical trials can be done in order to understand the importance of Punarnava in the management of diabetes.

Keywords: Punarnava, *Boerhavia diffusa*, Diabetes, Inflammation, Ayurveda

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Introduction

According to the National Family Health Survey 5 data, Diabetes mellitus continues to be a major health issue across the country with the highest prevalence in Kerala (males: 27% and females: 24.8%), followed by Goa (males: 24.1% and females: 20.8%), West Bengal (males: 21.3% and females: 17.7%) and other states like Gujarat (males: 16.9% and females: 15.8%) and it still continues to rise exponentially in the country.[1]

Diabetes mellitus (DM) is a group of metabolic diseases which is identified by chronic hyperglycemia. Impaired insulin secretion, insulin action, or a combination of the two factors may be the reason behind chronic hyperglycemia in patients.[2] Diabetes has a variety of complications associated with it including the macrovascular and microvascular complications like neuropathy, retinopathy and nephropathy caused by the accumulation of advanced glycation end products (AGEs), pro-inflammatory molecules which lead to oxidative stress and thereby aggravate the deterioration of the patients' condition. The macrovascular complications commonly include atherosclerosis.[3]

The corresponding term for diabetes mellitus in Ayurveda is *madhumeha* (*madhu* means "sweetness" and *Meha* means "excessive urination").[4] Ayurveda is a traditional form of medicine which primarily emphasizes the use of herbal supplements for the treatment of type 2 diabetes. However, exercise, weight management, and various supplemental procedures are included in Ayurvedic practices. The goal of Ayurvedic practices on the treatment of type 2 diabetes like in Western medicine focuses on bringing the hemoglobin A1c (HbA1c) value into a therapeutic range. The ability of medicinal plants to stimulate insulin secretion or inhibit the absorption of glucose by the intestinal tract is the primary mechanism by which they restore pancreatic function and exhibit anti-diabetic activity. Plants primarily contain polyphenols, flavonoids, terpenoids, carotenoids, and coumarins as their active ingredients.[5]

In India, since ancient times, the traditional healers have been using around 3000-3500 of medicinal plants[5] and it has been observed that there are about 800 plants which have been reported to show antidiabetic potential.[6]

Underutilized herbs need to be identified and analyzed in order to isolate new effective, active, environment friendly and non-toxic compounds. *Punarnava* (*Boerhavia diffusa*) has been used to cure many diseases since ancient times.

In Ayurveda, the *Punarnava* herb is considered a "*Rasayana*," meaning it rejuvenates the body by flushing toxins from body tissues, and helps nourish cells and it promotes all around balance in the vital organs for internal harmony and wellness.

Growing in tropical locations including the Antille Islands, South America, India and Africa, this perennial herbaceous plant is recognized by a few names: *RaktaPunarnava* (Red *Punarnava*), *Shothaghni* (Inflammation killer), *Kathillaka* (Small leaf/small shrub), *Kshudra* (Small/minor), *Varshabhu* (Rain-borne/born of the rainy season), *Raktapushpa* (Red flower) and *Varshaketu* (Flag of the rainy season).

According to Ujowundu and colleagues, the roots are a major source of a variety of bioactive compounds. *Punarnava* is found throughout the warmer parts of India, in the Himalayan region growing up to an altitude of 2000 m and reaches up to 70 centimeters in height.[7] Out of the 40 species, 6 species of this genus are found in India. It has a large root system and produces yellow and white flowers. It can be found in many tropical and warm-climate countries.[8]

Although, all the parts (stem, leaves and root) of *Punarnava* are utilized and have been documented, the root of *Punarnava* possesses immense potential in treating various conditions like gynecological disorders, anemia, asthma, jaundice, inflammation and it provides relief from their symptoms. It has been used extensively across the globe in different forms. In Cholistan desert, Pakistan, the root decoction has been used for managing conditions like kidney failure, hematuria as it works as an excellent diuretic agent.[9]

A combination of *Punarnava* root along with ginger and pepper was used to cure asthma and jaundice by people living in certain parts of Haryana.[10] The tribal people of Madhya Pradesh utilize the roots of the plant to treat renal and heart problems, dropsy, and gonorrhea.[11] The Jaintia tribe of Meghalaya uses cooked leaves of *Punarnava* to treat low blood pressure and to treat jaundice and asthma.[12]

Aim and Objectives

Aim: The present study was conducted with aim to elicit information on use of *Punarnava* by Ayurvedic Practitioners across India in their daily practice.

Primary objective: To document the safety, bioavailability, adverse effects, the form in which *Punarnava* is generally prescribed.

Secondary objective: To get deeper understanding on use of herb and its parts in management of diabetes, appropriate dose and duration for which it is prescribed and its probable mechanism of action on diabetes and its associated complications.

Materials and Methods

A questionnaire-based online survey was conducted on 101 Ayurvedic practitioners. The questionnaire was validated by 6 experts from different disciplines viz. Department of Dravyaguna, Pharmacy and Foods and Nutrition. Approximately 1372 Ayurvedic practitioners across India were approached through emails and by personally contacting them (Table 1). Of those, 101 Ayurvedic practitioners (with a response rate of 7%) gave their consent to be a part of the study. The questionnaire consisted of 24 questions which focused on utility, form/dose determination, safety, bioavailability and procurement of *Punarnava*. The study has been approved by the Institutional Ethics Committee for Human Research (No.: IECHR/FCSc/PhD/2021/123).

Observations and Results

Domain 1: Utility

A majority of the doctors mentioned that *Punarnava* is predominantly used for treating kidney disorders (87%) followed by oedema (82%), inflammation (61%), anemia (60%), liver disorders (57%) and diabetes (54%) and others as shown in figure 1(a).

Around 57% of the practitioners stated that *Punarnava* should not be prescribed in case of dehydration, diarrhea (49%) or electrolyte imbalance (38%) (Figure 1 (b)).

As shown in figure 2, 71% of the doctors stated that *Punarnava* possesses anti-inflammatory, diuretic (66%), nephroprotective (61%), hepatoprotective (55%), rejuvenating (51%), antioxidant (49%), antidiabetic (33%) and other properties.

Figure 3 depicts description or mention of *Punarnava* in ancient literature like the *Bhavprakash Nighantu*, *Charaka*, *Shushruta Samhita*, *Pandu Chikitsa*, *Ashtanga Hridayam* or others like (*Shothagna*, *Swedopaga*, *Anuvasanopaga*, *Kasahara* and *Vayasthapana Mahakashaya*, *Bhaishajya Ratnavali*, *Siddha Yoga Sangraha*, *Nighantu*, *Vidarigandhadi Gana*, *Adarsh Nighantu*, *Raj Nighantu*, *Sharangdhara Samhita*, Basic *Brhatrayi* (3 major texts), *Laghutrayi* (The lesser triad), *Nighantu dravya* collection, *Rasashastra*, *Rasayana Prakarana*, *Sahasrayoga*, *Chikitsamanjari*, *Ayurveda Sara Sangraha*, *Sahasrayoga*, *Chikitsamanjari*, various *Nighantu* like *Raj*, *Kaiyadeva*, *Dhanvantari*.

Many positive responses were received from the doctors when asked about the historical mention of *Punarnava* and its uses since ancient times along with some unusual stories or cultural practices of the herb.

It was mentioned that *Punarnava* literally means 'bring back to life' or 'renewer' ('*Punah punah jivitam iti Punarnava*') and as per *Charaka Samhita*, it has been used as a vegetable since a very long time by the tribals and can be used as a leafy vegetable as a part of our regular diet. *Punarnava* helps to generate new cells or tissues in body and by intake of *Punarnava*, as the name of drug itself suggests, '*Punar*' means again and '*Nava*' means new. It is very useful in chronic kidney disease, skin, urinary and liver disorders and to reduce inflammation. The white variety of *Punarnava* root has been effective in patients with renal failure according to one of the doctors while it is also very helpful in patients who have urinary tract infection and painful urination (*Mutrakriccha*). *Punarnava Mandoor* can be given for pregnancy induced anemia and the *Punarnava swaras* can be used in rejuvenation therapy.

Domain 2: Form/Dose Determination

The herb is prescribed generally in the form of Powder (63%), Tablet/Pill (78%), Juice (42%), Extract (48%), Fresh form (39%) and tea (14%) as shown in figure 4. A majority of the doctors (82%) prescribed *Punarnava* looking at the severity of the patient's condition or after prakriti analysis (54.5%) of the patient (Figure 5 (a)). Around 80% of the doctors stated that they keep in mind the *Prakriti* of patient while prescribing *Punarnava* formulations (Figure 5 (b)).

As shown in figure 6 (a), according to 43% of doctors, appropriate duration of supplementation of *Punarnava* formulations to study its positive impact on health and disease is 1 month to 3 months whereas 62% doctors felt that it depends on the condition of the patient. Fifty three percent of the respondents felt that *Punarnava* is effective in the form of decoction (53%), plant juice (swaras) (47%), mandur (34%), powder (18%), churna (16%) and other forms as depicted in figure 6 (b).

Sixty one percent of the doctors said that the form of *Punarnava* is modified according to the disorders which meant that it is used in powder or decoction form for certain conditions like urinary tract disorders or stones whereas for others it is used in the form of paste and in case of anemia, it is used in a combination with calcined iron and honey. In case of inflammation, it can be given in the form of a tablet or decoction and generally it is given to children along with honey since it is less palatable to consume alone. It was also mentioned that if the digestive capacity of the patient is good, it can be given in the form of juice, otherwise it can be given as a tablet or powder form.

Domain 3: Safety/Toxicity/Side Effects

Approximately 44% of the doctors suggested that *Punarnava* can be given in the form of a tablet with the composition of 1000 mg [in a divided dose of 500mg twice per day (2 tablets)], while in the form of decoction it can be given upto 30ml per day and powder form upto 5g per day, according to 53% of the doctors (Figure 7).

A majority of the doctors stated that *Punarnava* does not have any side effects (83%) and it does not have any adverse drug reactions (91%) and 81% of them mentioned that it is safe for long term consumption (Figure 8 (a), (b) and (c)). When asked about the dietary restrictions that need to be kept in mind along with the consumption of *Punarnava*, a majority of the doctors stated that a light diet with less salt and spices can be consumed. Patients should avoid foods that can cause excessive gas production and avoid sour foods, pickles, lemon in case of swelling. It is usually advised to avoid heavy and fried food as it may provoke *Pitta Dosha* which may in turn reduce efficiency of drug. They also recommended that one should consume more electrolytes (sodium rich foods) & water intake should also be increased in order to avoid dehydration.

Domain 4: Bioavailability

When asked regarding the use of any other bioenhancers to in addition to the herb alone, for its better absorption and enhanced action, the doctors suggested that it may be given with milk (11%), citrus fruit juice (7%), honey (29%), curd (2%) and other mixed with calcined iron (Mandoor Bhasma) or ghee or with other herbs. Majority of them suggested that it could be consumed simply with lukewarm water (80%) (Figure 9 (a) and 9 (b)).

As mentioned in the ancient Ayurvedic texts, the whole plant is considered to be effective in disease management which was also agreed upon by the doctors (46%). However, around 41% of the doctors revealed that the root of the herb is more effective as compared to the leaves (8%) and stem (5%) (Figure 10).

Domain 5: *Punarnava* in Diabetes

Approximately 53% of the doctors preferred prescribing *Punarnava* in the form of tablet/powder and decoction while 36% of them prescribed it as *Churna* (polyherbal formulations) and around 31% of them prescribed it in the form of *Arishta* (decoction of herbs in boiling water) or *Asava* (fermenting fresh herbal juices), *Shaka* (vegetable) and so on (Figure 11). As per figure 12, the safe limit consumption of *Punarnava* formulations prescribed for diabetes patients, in the form of juice was around 30-60 ml/twice/day, while around 32% of the doctors stated that up to 3-5g/day in its powder form can be prescribed.

Around 74% of the doctors stated the probable mechanism of action could be as follows:

- Rejuvenation/ enhancement of the function of β Cells of the pancreas thereby improving insulin secretion and maintains the blood sugar levels by reduction of swelling on pancreas (16%).
- The fluid and toxins which are present in the body may be washed out after the consumption of *Punarnava* (diuretic property) and it may also rejuvenate the tissues which can help for formation of new cells and protect the remnant cells (16%).
- For diabetic patients, *Punarnava* is useful to correct kidney function of the patient and hence it is found to be useful in treating diabetes (especially type 2 diabetes) (7%).

- *Punarnava*'s main action is to improve efficacy of drugs combined together and helps to work better on any disease. Along with its property of rejuvenation, it helps to reverse the disease by helping liver cells to regenerate better (7%).

Most of the doctors procured *Punarnava* formulations from the local pharmacy shops (83%) while some of them got it from Sasoi dam garden from Pipali in Jamnagar and from South India, from gardens/fields, wastelands or from farmers (17%).

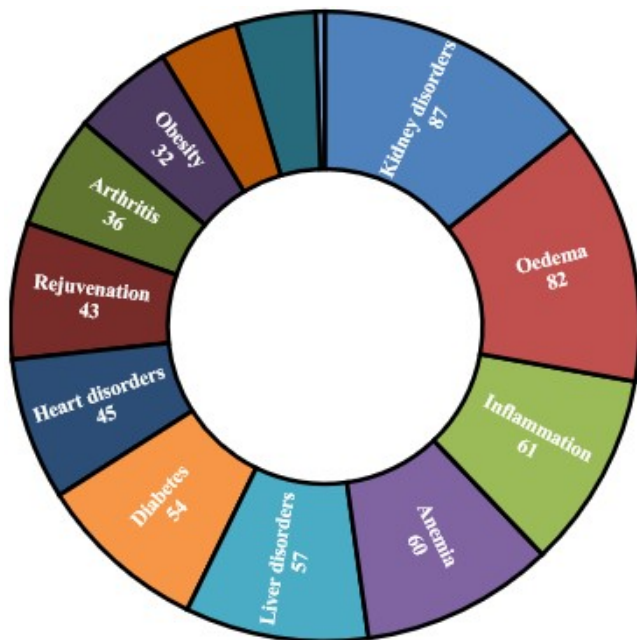


Figure 1 (a): Medical Conditions/disorders for which *Punarnava* is Generally Prescribed*

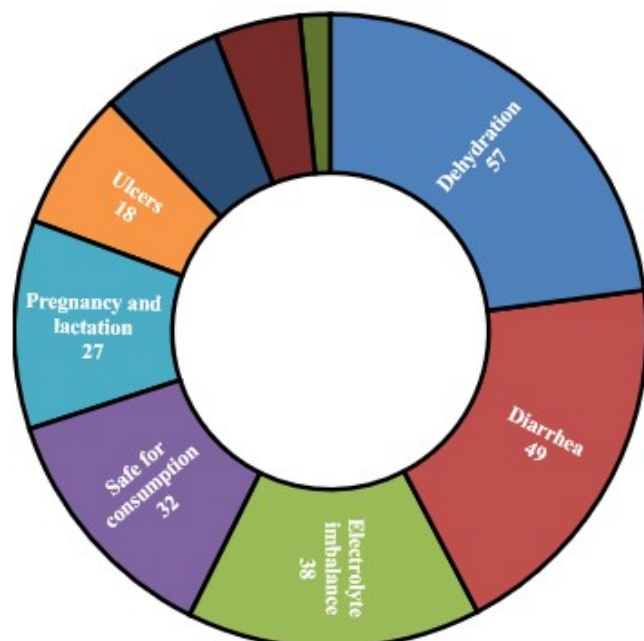


Figure 1 (b): Medical Conditions/disorders for which *Punarnava* is not Prescribed*

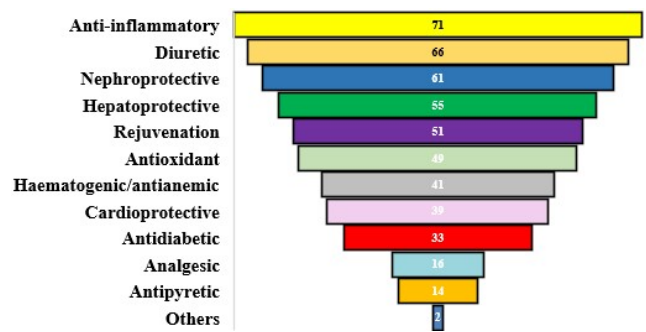


Figure 2: Medicinal Properties of *Punarnava**

*Multiple Responses

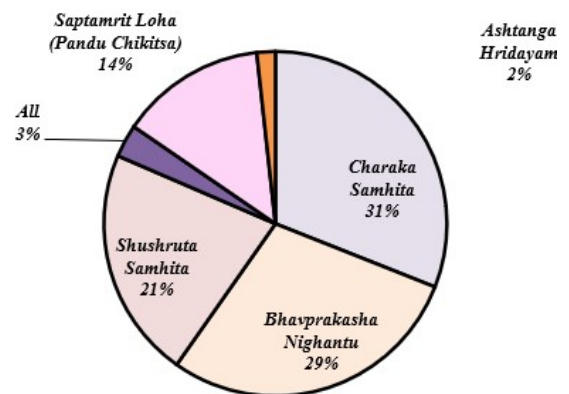


Figure 3: Reference in Ayurvedic Literature*

*Multiple Responses

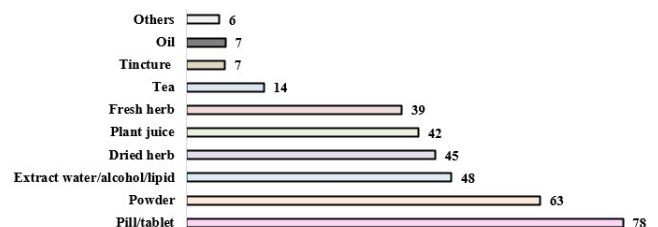
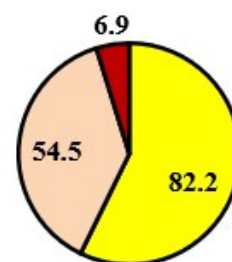


Figure 4: Form in which the Herb is Prescribed*



- Depends on the severity of the condition of the patient
- After prakruti analysis
- Others

Figure 5 (a): Determination of Dose and Duration for the Consumption of *Punarnava**

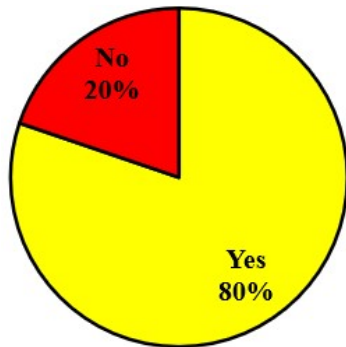


Figure 5 (b): Whether the Prakriti of the Patient kept in Mind while Prescribing *Punarnava*

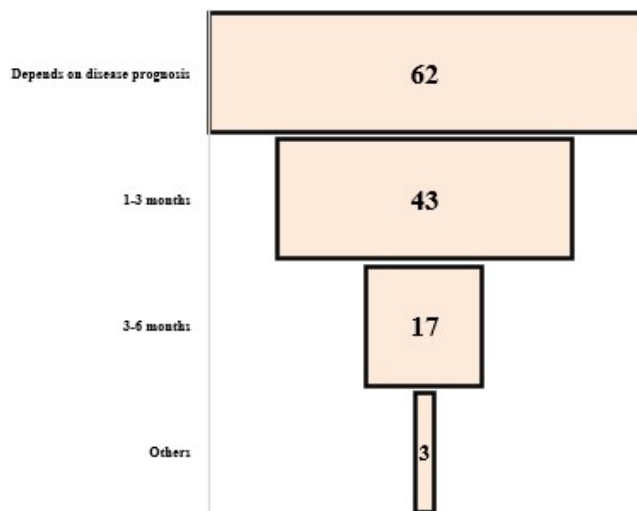


Figure 6 (a): Appropriate Duration of Supplementation of *Punarnava* Formulations*

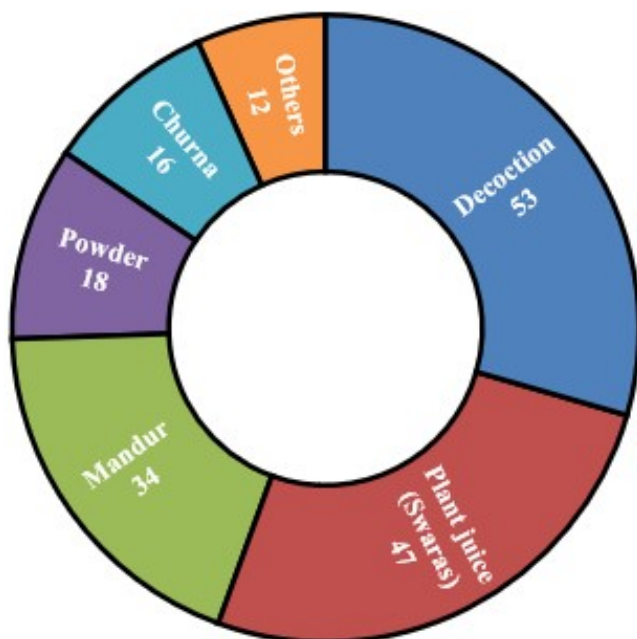


Figure 6 (b): Form of *Punarnava* with Highest Efficacy*

*Multiple Responses

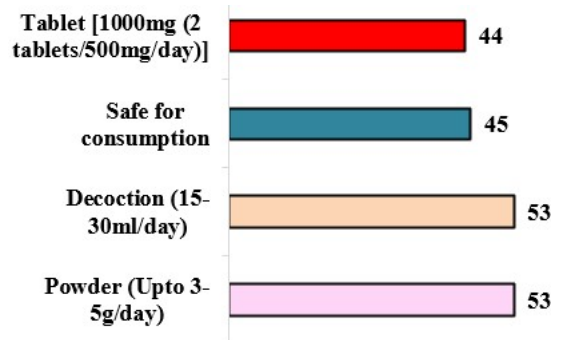


Figure 7: Safe Limit Set for the Consumption of *Punarnava* in Each Form Prescribed*

*Multiple Responses



Figure 8 (a): Does *Punarnava* Have Any Side Effects?



Figure 8 (b): Is *Punarnava* Safe for Long-term Consumption?

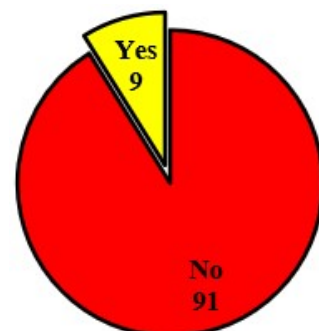


Figure 8 (c): Is any adverse drug reaction reported in literature or you find in your practice?

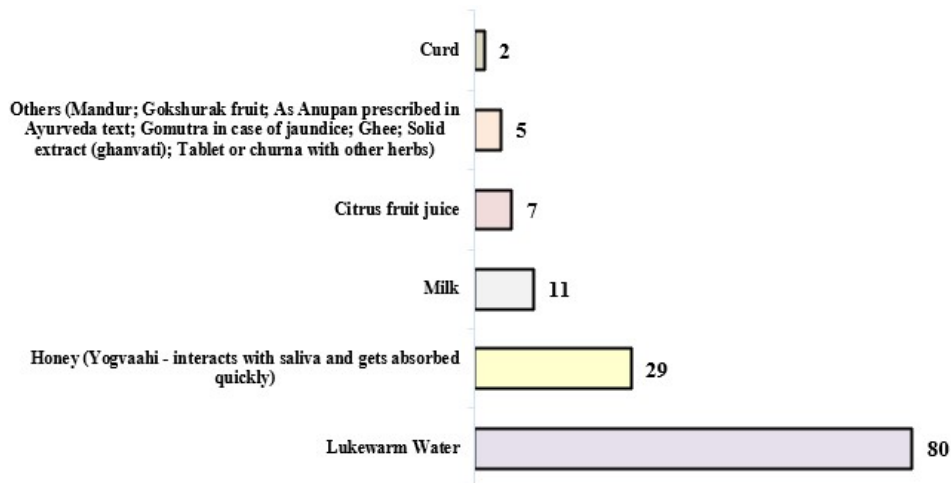


Figure 9 (a): Suitable Vehicle for *Punarnava* Supplementation for Better Absorption*

*Multiple Responses

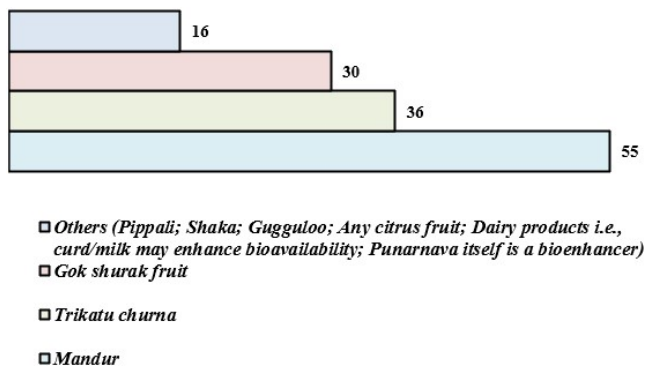


Figure 9 (b): Bioenhancers Recommended along with *Punarnava* to Increase its Bioavailability*

*Multiple Responses

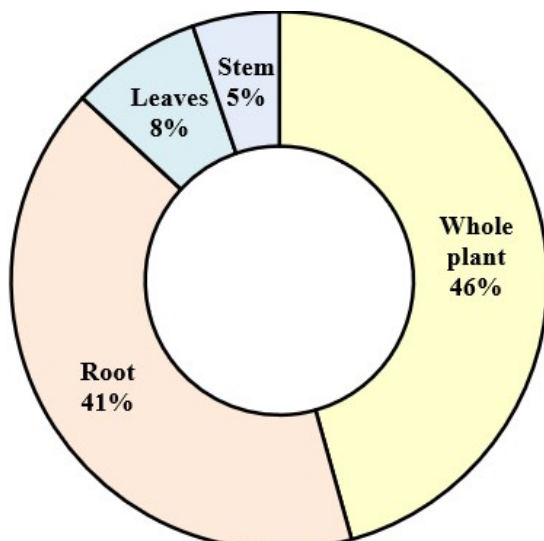


Figure 10: Part of the Plant is Most Effective and Commonly Used for Preparation of Medicines*

*Multiple Responses

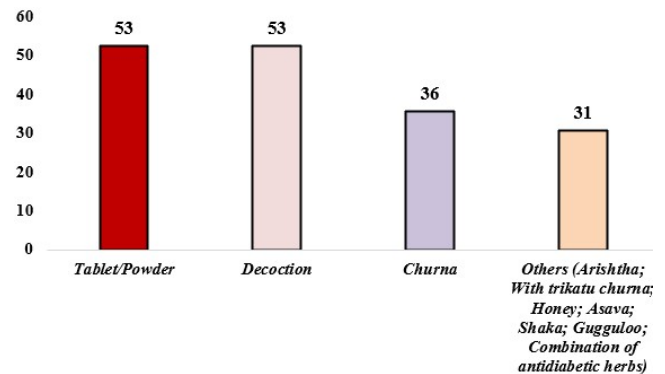


Figure 11: Advisable form in which *Punarnava* can be prescribed to Diabetics*

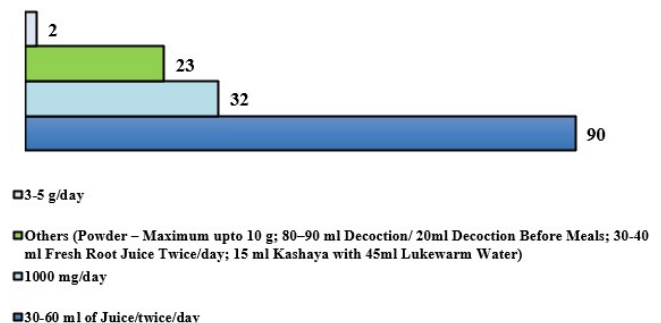


Figure 12: Safe Limit of Consumption of *Punarnava* Formulations Prescribed for Diabetes Patients*

*Multiple Responses

Discussion

Studies suggest that *Punarnava* (*Boerhaavia diffusa*) is a very well-known medicinal herb used to treat large number of human ailments as mentioned in Ayurveda, *Charaka Samhita*, and *Sushruta Samhita*.

The safety, utility and use of *Punarnava* has been documented in several research papers, review articles and ancient Ayurveda literature.[13] The presence of phenolic compounds[14] & polyphenolic compounds like flavonoids[15] present in vegetables, herbs and fruits have the potential to act as free radical scavengers which in turn slow down the ageing process and have been reported to provide anti-cancer, anti-inflammatory effects which may be helpful in minimizing the risk of developing diseases like diabetes or cardiovascular diseases.

The whole plant has medical benefits especially the roots which is in conjunction with our findings. In Ayurveda, *Punarnava* herb is most widely used in treatment of renal problems and urinary tract infections.[16] According to Tayade and colleagues, *Punarnava* has been used in different forms to treat multiple conditions like in patients with weak eyesight, it is given in the form of a paste or the decoction is used for swelling in legs, urinary disorders and skin disorders.[17] The root decoction, plant infusion leaf extract is useful to manage jaundice, asthma, bronchitis and eye problems.[18] The whole plant has been found to be extremely useful to manage conditions like asthma, urinary disorders, piles, anemia, cardiac and stomach disorders.[5]

In a study conducted by Hiruma-Lima *et al.* (2000) on the acute oral toxicity of a crude extract obtained from a lyophilized decoction and from the juice of fresh leaves of *Punarnava*, it was observed that there were no signs of toxicity up to the dose of 5000 mg/kg in mice.[19] Thus, this result probably indicates that the plant extract has no toxicologic effect and the analgesic property of aqueous extracts obtained mainly from the leaf juice of the plant was seen. Another study revealed that the whole plant extract does not show any signs of toxicity up to an oral dose of 2 g/kg in mice.[20]

The Ethanolic extract when administered daily (250 mg/kg) to pregnant albino female rats during the entire period of gestation showed no teratogenic or mutagenic effects.[21] Also, as per the FSSAI Nutraceuticals Regulations, the permitted range for usage of different parts of *Punarnava* (aerial part and root) safe for consumption by adults is 1-3g/day (as powder) while 20-30g (for decoction) which is in line with our findings from the responses received from the Ayurvedic practitioners.[22]

Studies on folk drugs or ethnomedicines reveal that the active constituents of many herbs interact in complex ways to produce the therapeutic effect remedy as a whole and tribal medicine men prioritize the whole herb/plant than the sum total of its parts.[23]

Punarnava can be utilized by the community for the control and management of various disorders like diabetes, renal disorders, liver disorders their associated complications. Various Ayurvedic formulations like *Punarnavadi Kwath*, *Punarnavarishtha* and *Punarnavadi Mandura* have been used extensively for kidney or liver disorders due to its diuretic and anti-inflammatory properties.[24]

Review of literature suggests that the herb *Punarnava* (*Boerhavia diffusa*) has benefits in terms of antidiabetic, antioxidant and hepatoprotective activities and it is extensively used as a remedy among the various tribal groups, ayurvedic and traditional practitioners for treatment of various conditions.

It is widely used in management of kidney, liver, lung, skin, eye and stomach disorders and is used across the world as an excellent anti-inflammatory agent, heart tonic, kidney tonic, used in jaundice, general fever, obesity and a lot of other conditions.

Conclusion

Various mono/poly herbal formulations made from *Punarnava* in various forms have been marketed by various pharmaceutical companies which also proves that it is safe for human consumption and a majority of the doctors also consider it safe. However, there is scarcity of data with respect to the clinical studies on the effects of consumption of *Punarnava* in humans. Being an easily available and an economical Ayurvedic resource, having immense potential, *Punarnava* can be utilized by the community for the control and management of inflammation and diabetes mellitus and its associated complications.

However, a lack of clarity of the doctors with respect to the probable mechanism of action of *Punarnava* on inflammation and diabetes merits attention and needs to be studied further. With the available data from the present study, further clinical trials can be done in order to understand the importance of *Punarnava* in the management of diabetes.

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