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## Cover story

### *Heen Binthal*

***Curculigo orchioides* Gaertn**
**Family: AMARILLIDACEAE**
**Vernacular names: Sinhala:** *Heen Binthal*; **Sanskrit:** *Bhuthali;*
**English:** Golden eye-grass; **Tamil:** *Wolappanai*

The term *Bhuthali* implies different varieties of *Binthal* namely i) White verity (*Sudu Binthal*) ii) Black verity (*Kalu Binthal*), which is sub classified into i) *Ma binthal* (*Curculigo Finlaysoniana* Wall.) and ii) *Heen binthal* (*Curculigo orchioides* Gaertn) [1]. Currently this plant is named under the family HYPOXIDACEAE[2], which is an endangered flowering plant species in the genus Curculigo known as "*Rasayana*" (rejuvenate) herb. The plant is also used as an herbal medicine in Kampo and Chinese medicines [3].

The ecology of this plant is believed that originated in the shady forests of Asia in plains and shows prostrate growth on moist fertile soil. It is also distributed in Sri Lanka, India, Japan, Malaysia and Australia. This is a small herbaceous plant with an elongated tuberous rootstock and lateral roots; rootstock elongate, 5-25 cm, vertical; Leaves (5-20 x 0.8-1.5 cm), very much variable, narrowly linear to lanceolate, acute, plicate or flat, crowded on the short stem with sheathing leaf bases; Petiole short to 3 cm, often absent; Flowers throughout the year, light yellow, bisexual, sessile, regular, 1.2 cm [3].

The rhizome, presence alkaloids, carbohydrates, saponins, flavonoids, tannins, glycosides and steroids. It also possesses hypoglycaemic, spasmolytic, anticancer and antioxidant properties also with uterine stimulant, phagocytic, hepatoprotective, antimicrobial and immune-modulatory activities [4]. Cut pieces of rhizome the main use part of this is used as raw material for drug preparations. Some of the commercial formulations containing *C. orchioides* are available in form of capsules and syrups which are claimed to be rejuvenating, energizers or aphrodisiac pharmaceutical products [5].

An experimental study vis-à-vis the *C. orchioides* is published on page 554.

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***Cover story by Dr. A.P.A. Jayasiri***
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***Cover page designed by Mr. K.K.P.R.K. Kohombakanda***

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## Contents

# Management of diabetic wound using a Siddha Ayurveda treatment approach including *Manjal karasealai* (corrosive gauze) - A case study

**Anpuchelvy S.[1], Sritharan G.[2*], Ganesan S. [3]**

## Abstract

Chronic diabetic wounds are encountered as a major health problem and produced the complications of trauma. It causes long-term agony to the patients and as recurrences and post-operative complications. Consequently '*Karam (Kshara)'*- Traditional wound healing takes good hope in diabetic wound healing. This study was formulated to perceive wound healing sequels of "*Manjal karasealai"* (yellow corrosive gauze) on diabetic wound management. A diabetic female patient aged 65 years with having a chronic wound on the right foot was selected for this study. This lesion started six months ago and surgical wound management was done. Subsequently, the patient experienced mild symptomatic relief but it relapses repeatedly. The patient resorted to Siddha Ayurveda treatment. At first, the wound was cleaned with *Tripala* decoction and the fistula was identified. '*Kshara*' technique was applied to treat this fistula as *"Manjal karasealai"* and inserted into the fistula by using the probe. Internal medication was given to maintain random blood sugar level below 200mg/dl. *Manjal Karasealai* was inserted in every other day. Size of the wound was measured for healing along with photographic images. In the end, the wound showed features of complete healing. This case study disclosed an effective wound debridement action of *Manjal karasealai* on a chronic diabetic wound.

**Keywords**: Diabetic wound, *Manjal karasealai* (corrosive gauze), wound tunneling

## Introduction

Diabetic ulcers most commonly occur on the plantar surface of the foot underneath the pressure point. An epidemiologically most common cause of diabetic patients getting hospitalized with diabetic foot ulcers. As many as 15% of people with diabetes have foot ulceration and its related complications[1] and 3% have a lower limb amputation[2]. Non–healing diabetic wounds has become a major challenge in managing due to the distant concern of it possesses. Increased Sugar in diabetes may cause slight injury to the glucose-laden tissue infection and ulcer formation. Increased sugar favors the propensity of bacteria to multiply and cause severe spreading infections. Diabetic micro- angiopathic ulceration may be precipitated by ischemia due to diabetic atherosclerosis, as a result of which blood supply to the tissues is grossly compromised. In diabetic neuropathy, the peripheral nerves are affected as diminished or no sensations, so the result the patient experiences no pain and sustains injuries. For the confirmation of diagnosis certain other conditions causing delayed healing are considered like atherosclerosis, chronic venous insufficiency, vasculitic neuro- pathies, metabolic neuropathies, autonomic neuropathy, and radiculopathy. All diabetic patients need a thorough foot examination around nail beds and between webs of fingers to check for any swelling, rash, cut or any underlying fungal infection is mandatory. A persistent treatment modality is essential for the evolvement in the management.

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Diabetic wound management is a significant and growing health burden on the community[3]. Delayed wound healing and wound infection place a substantial financial burden on health care systems, as a result of increased dependency and increased admissions and hospital stays. Chronic wounds also have a very large social and quality of life impact on individuals and curers[4]. After the injury, healing is a natural phenomenon and continues in a sequential manner until the formation of a healthy scar. Usually, the defense mechanisms of the body take complete care in order to keep the scar clean. But at times, when the infection is massive, surface area of the wound is very large and slough or necrotic tissue is too much, this auto cleansing mechanism becomes inadequate [5]. The objective of this study was to perceive wound healing sequels of "*Manjal karasealai"* (yellow corrosive gauze - herbo mineral Siddha formula) on diabetic wound management and internal medicine is enhancing the wound healing process.

Ingredients of *Manjal karam* (Reference Akathiyar rana nool -1975)

- *Curcuma longa* Powder
- Yellow oxide of Arsenic (synthetic)
- Yellow Arsenic Trisulphide
- Galena Sulphide (Lead ore)
- Limestonene
- Sulphate of zinc
- Resin of *Shorea robusta*

  each of the same amount

All ingredients total weight amount of white cloth mixed and grinding as powder forms and mixed sterile water or Glycerin and mixed semisolid liquid form (Figure 01).

**Fig: 01: Gauze preparation of yellow corrosive oil**

***Case Report***

A female patient aged 65 years presented with complaints of ulceration right side of the foot, blackish discoloration, and oozing of serous fluid with a foul smell for the last three months. The lesion started six months before with bluish discoloration on the dorsum of the foot then it gets reddish with a blister, then the pus oozes from the wound and it gradually spread over the foot skin with itching, serious watery foul smell secretion. The patient obtained surgical management at an allopathic hospital. Thereafter patient got mild symptomatic relief but it relapses repeatedly. Consequently, the patient seeks Siddha Ayurveda treatment and her health problem was diagnosed as a chronic diabetic wound.

***On physical examination***

The general condition of the patient was good; her pulse was 82/ min, regular; BP was 120 / 70 mm Hg, respiratory rate was 20 /min regular, with a history of diabetes mellitus with a Random Blood Sugar level of 123mg/dl.

***Wound management***

At first, the wound was cleaned with *Tripala* decoction (herbal antiseptic lotion) to prevent the growth of harmful microorganisms and a fistula was identified. A special traditional wound healing '*Kshara'* technique was employed to treat this wound fistula and Medicated thread known as "*Manjal karasealai*" (corrosive gauze) was used (Figures 02 and 03). *Manjal karasealai* is prepared by repeatedly soaking sterilized gauze in a solution of *Manjal karam* (medicated alkaline mixture) "*Manjal karam*" also applied over the adjoining wound and bandaging is done.

***Post-wound management***

The wound was cleaned and *Manjal karasealai* was changed every other day. Random blood sugar levels were also monitored and maintained below 150mg/dl.

***Details of oral drugs***

Initially, oral medication was given for 7 days to the patient for *Pachana. Panchatheppakni churnam* 3g with hot water morning and evening. *Kaishoor Guggulu* 2 tablets (500 mg each tablet) tds, 1 h after

food, *Arogyavardhani vati* 2 tablet (250mg each tablet) tds, *Thripala churnam* 4 g bd with hot water.

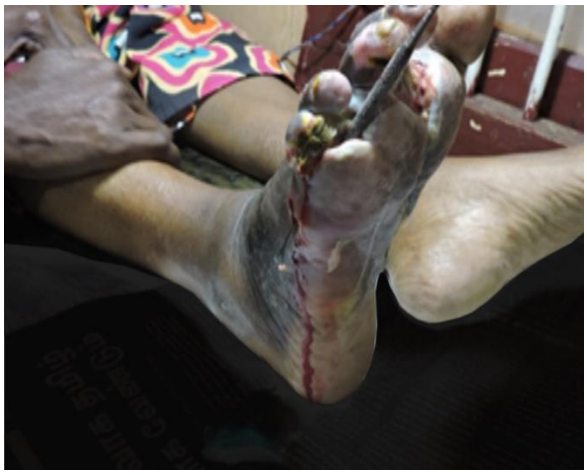

**Fig. 02: Probing into the wound fistula**

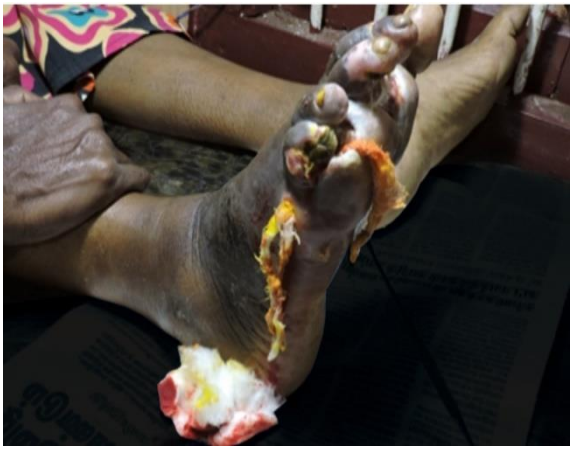

**Fig. 03: Application of *Manjal karasealai* through the Fistula of the wound**

***In the second week***

Continued with initial medication with wound healing *Churnam* 3g bd with hot water. *Sutharsana*, tab 2 bd, with hot water, *Seenthil kudineer* 60 ml bd 1 hour before food, and *Kadukai chunam* 3g with hot water at bedtime. All these medications were continued for two months. The patient was advised to continue the allopathic treatment (diabetic) and dietary advice to maintain a random blood sugar level below 150 mg/dl.

After the 10th day of treatment, foul smelling and profuse discharge was completely stopped and the wound showed more necrotic features than expected. So, the procedure was repeated on every visit. Clinical features and size of the wound were measured during different stages of healing along with photographic images. At the end of the treatment wound showed features of complete healing (Figures 04 and 04).

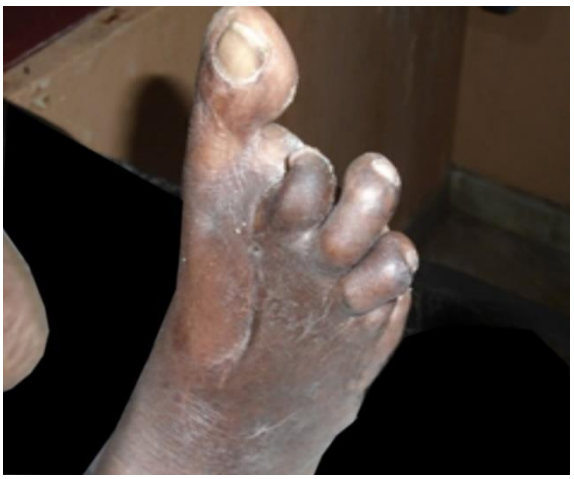

**Fig. 04: At the end of the treatment**

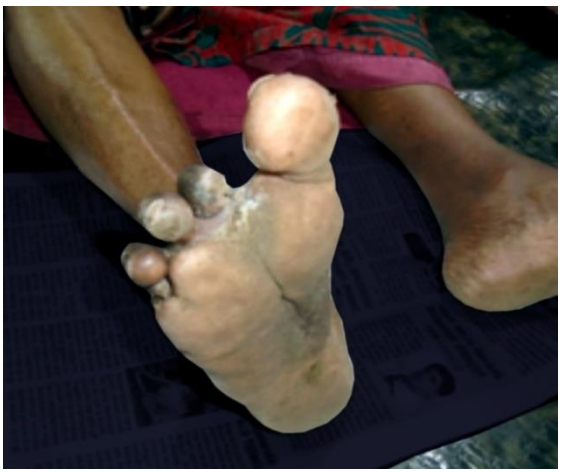

**Fig. 05: At the end of the treatment**

**Result and Discussion**

The diabetic wound is one of the types of chronic wound with complications and is difficult to treat. Agasthiyar described treatment modalities to treat different types of wounds and mentioned *"Karam*" is *Thrithosam* (three functional elements of the body) hence a single drug, which acts all the three doshas. The great Siddha surgeon "Akasthiyar" narrated *Kara* techniques and the use of kara for the different types of wounds[6]. Several corrosive gauzes are named based on their colour. Thus, it is named as green, yellow, black and blue corrosive plasters in Siddha medicine. Similarly, corrosive liquids are named by their colour to clean ulcers. All of them

are indicated for external use in chronic ulcers. So far there is no research report regarding their use in actual practice[7]. The application of corrosive drugs (*Karam*) to heal chronic ulcers is one, of the 32 forms of external drugs in Siddha medicine. Agathiyar Rana Vaithiyam and Agathiyar Rana Nool are some of the ancient texts of wound treatments in Siddha medicine, giving details of the preparation of corrosive gauzes[8].

***Traditional wound management***

To achieve effective wound management, it is necessary to practice *Manjal kara* therapy, having knowledge and experience of such preparation and the specific procedures. The surgical intervention like fistula wound management, fistulectomy and so on proved idle due to high recurrence and post-operative complications. Under these circumstances, *Manjal karam* therapy offers a good way of hope in wound management. It is gradual but sustained chemical action that removed the debris from the site of the fistula and thus it helps in the formation of healthy granulation tissue inducing a long healing pattern in the depth of the tissue. *Manjal karam* also dissolves through fibrous tissue and ultimately drains exudates and creating a healthy base for healing. Further, it enhances the contraction of the fistula and sinuses of the wound.

According to Sushruta the irresponsible person who mistakes a suppurated inflammation for an unripe one ignores a suppurated one, or when a patient allows a lot of pus to accumulate in an ulcer, then that pus having entered into his aforesaid tissues (i.e. skin, subcutaneous tissue, muscle), penetrates inside[6]. According to Acharya Sushruta, a surgeon should excise a sinus by means of a sutra (thread) impregnated with caustic (alkali) material (*Kshar-sutra*) occurring in the emaciated, the weak and the timid, and those (sinuses) which occur at the vulnerable areas[7]. *Kshara* is a caustic material obtained after processing from the ashes of various medicinal plants. The *Kshara* is superior to sharp instruments because of their capability to perform excision, incision and scraping and their power to alleviate all the three dosas[8]. These caustic materials are called as *Kshara* due to its capability of melting and destroying the lesion[9]. So, *Kshara* are not only cause the destruction (lysis) of unhealthy tissue but also helps in their debridement. Hence this is an ideal procedure to be adopted for the management of sinus track as it not only destroys the fibrous wall of the track but also helps in its curettage. There is simultaneous cutting and healing of the tract and no pocket of pus is allowed to stay back[10]. Thus it provides an environment for healthy granulation tissue to develop providing a venue for *Nadivrana* (sinuses) to heal completely. *Karam* dissolves the tough fibrous tissue and chemically corrects all the infections[12]. This therapy allows the fistulous tract to collapse and heal. *Karam* keeps the whole track open and facilitates the drainage of all the infections from the wound area thus it reduces the formation of pus and prevents the further spread of fistula within the wound. *Karam* has antibacterial properties therefore it does not allow the bacteria to multiply[13]. Wound healing is a normal physiological event that outsets immediately after injury till the formation of a healthy scar. "*Manjal karam"* regenerative properties are also useful for healing wounds and promoting the growth of healthy cells[14]. *Curcuma longa* has been studied for many years due to its bio-functional properties, especially antioxidant, radical scavenger, antimicrobial and anti-inflammatory activities, which play a crucial role in the wound healing process. Moreover, curcumin stimulated the production of the growth factors involved in the wound healing process, and so curcumin also accelerated the management of wound restoration. *Thiripala* decoction (herbal antiseptic lotion), *Termilnalia chebula*. *Phyllanthus emblica*. *Terminallia bellirica*. Prepared by adding an equal part of medicinal herbal powder and boiled with water to get decoction. *Tripala* removes the slough from the suppurated wound along with the foul smell. It also helps in the reduction of swelling and pain[15].

## Conclusion

This case study showed effective wound debridement action of *Manjal karasealai* on the chronic diabetic wound. Therefore, a lot of scope for further research in this field to standardize the preparation and application of *Manjal karasealai* on the diabetic wound for the betterment of patients and their wellbeing

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# *In vitro* screening of antioxidant and anti-inflammatory capacities of plant extract *Curculigo orchioides* Gaertn

**Wijesekara M. A.,[1*] Soysa P.[1], Jayasena S.[1], Kottahachchi D.U.[2], Perera D.[3], Jayasiri A.P.A.[4], Gooneratne, L.V.[1]**

## Abstract

*Curculigo orchioides* Gaertn is a medicinal herb belonging to Amaryllidaceae family and is recognized as a potent source of biologically active compounds with many biological properties. The rhizome of the plant was used to prepare aqueous extracts in order to screen antioxidant and anti-inflammatory capacity. Total Phenolic Content (TPC) and Total Flavonoid Content (TFC) were evaluated to determine the phytochemical composition of the extracts. Antioxidant activity was screened using different assays, DPPH, total antioxidant activity, inhibition of protein oxidation, lipid peroxidation and deoxyribose oxidation and ferric ion reducing power. Anti-inflammatory activity was screened using human red blood cell membrane stability test and inhibition of protein denaturation assays. The TPC and TFC were 101.2±1.3 mg GA/g (Gallic Acid /g) and 178.4±2.4 mg EGCG/g (epigallocatechin gallate/g) respectively. The values of $EC_{50}$ for DPPH, inhibition of deoxyribose oxidation, inhibition of lipid peroxidation, inhibition of protein oxidation and inhibition of BSA denaturation assays were 25.6±1.6, 10.1±1.0, 29.0±0.7, 82.6±3.9 and 32.9±3.5 µg/mL respectively. Further, RCO extract showed less ferric ion reducing ability. CO demonstrated comparable values for $EC_{50}$ with Diclofenac sodium standard on membrane stabilizing activity (49.7±1.4 and 49.7±1.4 µg/mL respectively). Result of the study suggests that CO exerts antioxidant as well as anti-inflammatory activities by stabilizing biological membranes.

**Keywords**: *Curculigo orchioides*, protein oxidation, lipid peroxidation, deoxyribose oxidation, human red blood cell membrane stability

## Introduction

The therapeutic potential of plants has been well explored over years in traditional practices including Chinese traditional, Ayurveda, and Unani medicine[1]. An antioxidant is a substance that delays or inhibits oxidative damage to a target molecule[2]. The main characteristic of an antioxidant is its ability to trap free radicals. Natural antioxidants in plants are chemical constituents that occur in all parts of the plant, very effective to prevent cellular oxidative stress. Polyphenols (phenolic acids, flavonoids, anthocyanins, lignans and stilbenes), carotenoids (xanthophylls and carotenes) and vitamins (vitamin E and C) are the major natural antioxidants compounds present in plants [3,4]. Oxidative stress is caused by excessive production of reactive oxygen species (ROS) and reactive nitrogen species (RNS) results in cellular damage leading to degenerative diseases such as cancer, cardiovascular diseases and inflammatory disorders.

Plant origins with anti-inflammatory activities are considered to be an important source for the development of new therapeutic agents. Chronic inflammatory diseases are still one of the main health problems of the world's population[5].

Although several modern drugs are used to treat these types of disorders, however, prolonged use may cause several adverse side effects.

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Consequently, there is a need to develop new anti-inflammatory agents with minimum side effects. Several plants are being used in traditional medical systems for treating these disorders which are inflammatory like rheumatism and arthritis. Flavonoid, polyphenols, proanthocyanidin, alkaloid, terpenoid and steroid compounds in plants are usually responsible for the anti-inflammatory activities [6].

*Curculigo orchioides* Gaertn belongs to Amaryllidaceae family and are distributed in Asia, Europe and North Africa[7]. In Sri Lanka, it is commonly known as *Heen Binthal*. *Curculigo* plants are perennial herbs, often with tuberous rhizomes 7. The rhizomes of this plant possess medicinal properties which can be used to treat skin diseases, asthma, bronchitis and jaundice etc[8]. In addition to that, the rhizome also possesses immune simulative[9] hepatoprotective, anticancer and antioxidant properties[10]. Water extracts of *C. orchioides* are used for many herbal preparations in Sri Lanka. However, there is no compressive scientific report available in Sri Lanka. Thus, the present study has been directed to investigate the antioxidant and anti-inflammatory activity of *C. orchioides* water extract.

## Materials and Methods

### *Preparation of extract*

The plant was obtained from "*Weda waththa*" (6.801746, 79.977027) located in Maththegoda of Colombo district area from August to September 2021, in Sri Lanka. The plant was identified by a senior lecturer, at the Institute of indigenous medicine, University of Colombo. Rhizome of the plant was used for the study. Rhizome was washed with tap water followed by distilled water and de-ionized water and dried in a freeze drier to avoid oxidation of endogenous substances. Rhizome was cut into small pieces and ground to a fine powder using a clean kitchen blender. Fine powder biomass, 60 g was boiled with 1920 mL of deionized water until the total volume was reduced to 240 mL (1/8th of the original volume) using a glass beaker. The plant extract was filtered through a cotton wool plug followed by filter paper (Whatman No.1). The filtrate was centrifuged at 2000 rpm for 10 min. The supernatant was freeze-dried. The freeze-dried sample was weighed and stored at -20$^0$ C in sterile glass tubes until further use.

### *Removal of polyphenols*

Removal of polyphenols was carried out using Polyvinylpolypyrrolidone (PVVP) column according to the method described by Ranatunge *et al* 2017[11]. The antioxidant activity of the polyphenol-free water extract was determined using a DPPH assay.

### *Total Phenolic Content (TPC) and Total Flavonoid Content (TFC)*

The total phenolic content was estimated by the Folin – Ciocalteu method[12] and the total flavonoid content (TFC) was determined using the aluminum chloride (AlCl3) method described by Zhishen et al., 1999[13]. TPC and TFC were expressed as gallic acid equivalents (mg Gallic Acid /g) and epigallocatechin gallate (EGCG) equivalents per gram of dried sample respectively.

### *DPPH radical scavenging activity assay*

The free radical scavenging activity of the plant extract was measured by 2,2,0- diphenyl-1-picrylhydrazyl (DPPH) assay according to the method described by Blois1958[14] with modifications. The capacity to scavenge the DPPH radical was calculated using the following equation:

% DPPH scavenging effect = (AC – AS)/ AC ×100

Where, AC and AS are the absorbance of the control and sample respectively.

$EC_{50}$ value was calculated using a graph constructed with different concentrations vs % DPPH scavenging effect.

### *Total antioxidant capacity*

The total antioxidant activity of the plant extract was evaluated by the phosphomolybdenum reduction assay method according to the procedure described by Prieto *et al* 1999[15]. Ascorbic acid was used as the positive standard. The total antioxidant capacity was expressed as milligrams of ascorbic acid equivalents per gram of dried sample.

***Ferric reducing power assay***

The reducing power was evaluated by determining the ability to convert ferric ions to ferrous ions by plant extract as previously described with slight modifications[16]. In briefly different concentrations (7.81-250 µg/mL) of CO (100 µL) was mixed with phosphate buffer (0.2 M, pH 6.6, 250 µL) and potassium ferricyanide (1% w/v, 250 µL). The reaction mixture was incubated at 50º C for 20 minutes and trichloroacetic acid (10% w/v, 250 µL) was added and samples were centrifuged at 6500 rpm for 10 minutes. The supernatant was mixed with deionized water and ferric chloride (0.1% w/v) at a ratio of 1:1:2 respectively. L- Ascorbic acid was used as the positive control. Absorbance was measured at 700 nm wavelength.

***Inhibition of protein oxidation***

The effect of CO on protein oxidation was carried out according to the slightly modified method of Wang and co-workers 2006[17]. Bovine serum albumin (BSA) was oxidized by a Fenton-type reaction. Different concentrations of CO (0.5 mL) were mixed with reaction mixture (1.5 mL), containing potassium phosphate buffer (20 mM, pH 7.4, 300 µL), BSA (4 mg $mL^{-1}$), $FeSO_4$ (2 mM, 300 µL), $H_2O_2$ (30%, 400 µL) and was incubated for 30 min at 37º C. For the determination of protein carbonyl content in the samples, 1.0 mL of 10 mM 2,4-dinitrophenylhydrazine (DNPH) in 2 M HCl was added to the reaction mixture. Samples were incubated for 30 min at room temperature. Then, 1.0 mL of cold TCA (10%, w/v) was added to the mixture and centrifuged at 3000 rpm for 10 min. The protein pellet was washed three times with 2.0 mL of ethanol/ethyl acetate (1:1, v/v) and dissolved in 1.0 mL of guanidine hydrochloride (6 M, pH 2.3). L- Ascorbic acid was used as the positive control. The absorbances of the samples were measured at 370 nm wavelength. The percentage inhibition of protein oxidation was calculated by the following equation.

% inhibition = (AC – AS)/AC× 100

Where, AC and AS are the absorbance of the control and sample respectively.

$EC_{50}$ value was calculated using a graph constructed with different concentrations vs % inhibition.

***Inhibition of lipid peroxidation***

The inhibition of lipid peroxidation was carried out according to the slightly modified method of Dhar et al. 2013[18]. Lipid peroxides formed in the egg yolk was used as the lipid-rich source. Briefly, fresh egg yolk emulsion was diluted to 10% v/v with 1.15% w/v KCl. Egg yolk emulsion (50 µL), different concentrations (7.81-1000 µg/mL) of CO, aqueous trichloroacetic acid (20%, 150µL) and 0.67% w/v thiobarbituric acid (150µL) were added respectively. The reaction mixture was then vortexed thoroughly and incubated at 95° C in the water bath for 1 hour. The mixture was cooled and centrifuged at 3000 rpm for 10 min. L- Ascorbic acid was used as the positive control. The absorbance of the upper layer was measured at 532 nm wavelength and percentage inhibition was calculated with the following formula.

% Inhibition = (AC- AS) /AC X 100

Where, AC and AS are the absorbance of the control and sample respectively.

$EC_{50}$ value was calculated using a graph constructed with different concentrations vs % inhibition.

***Inhibition of deoxyribose oxidation***

The inhibition of deoxyribose oxidation was measured according to the modified method of Halliwell 1987[19]. Gallic acid was used as the positive control. The absorbance was measured at 532 nm wavelength. Percentage inhibition of deoxyribose oxidation was calculated with the following formula.

% inhibition= (AC –AS)/AC) X 100

Where, AC and AS are the absorbance of the control and sample respectively.

$EC_{50}$ value was calculated using a graph constructed with different concentrations vs % inhibition.

***Assessment of in vitro anti-inflammatory activity***

***Inhibition of albumin denaturation***

The anti-inflammatory activity of plant extract was studied by using inhibition of albumin denaturation according to the method published by Leelaprakash and Mohan Dass 2011[20] with minor modifications. Different concentrations (7.81-1000 µg/mL) of CO

(0.05 mL) mixed with 0.45 mL bovine albumin (5%). pH of the reaction mixture was adjusted to 6.3 using 1N HCl. The resulting mixture was incubated at 37º C for 20 min and then heated to 51º C for 20 min. After cooling the mixture, the turbidity was measured at 660 nm wavelength. Diclofenac sodium was used as a positive control. The percentage inhibition of protein denaturation was calculated as follows.

% inhibition = (AC –AS) / AC X 100

Where, AC and AS are the absorbance of the control and sample respectively.

$EC_{50}$ value was calculated using a graph constructed with different concentrations vs % inhibition.

***Human red blood cell membrane stability assay***

The human red blood cell (HRBC) membrane stabilization method was carried out according to the method described by Stability and Azam 2013[21]. The blood sample was collected from a health volunteer. The collected blood was mixed with sterilized alsever solution (2% dextrose, 0.8% sodium citrate, 0.05% citric acid and 0.42% sodium chloride dissolved in distilled water). The blood sample was centrifuged at 3000 rpm and packed cells were washed with isosaline and a 10% (V/V) suspension. Different concentrations (7.81-1000 µg/mL) of CO (l mL) mixed with phosphate buffer (1mL), hyposaline (2 mL) and HRBC suspension (0.5 mL). Diclofenac sodium was used as a positive control and instead of hyposaline 2 mL water was used as the negative control. The hemoglobin content in the supernatant was calculated using a spectrophotometer at 560 nm wavelength. The result was estimated by the following equations.

% Hemolysis = ODS/ODCX 100

Where, ODS and ODC are the optical density of the sample and control respectively.

The percentage of membrane protection was calculated by the following equation

% Membrane protection=100- the percentage of hemolysis

$EC_{50}$ value was calculated using a graph constructed with different concentrations vs % Membrane protection.

***Statistical analysis***

All the results were expressed as the mean ± standard deviation (Mean ± SD) of at least three independent experiments. Calibration curves were considered linear if $R^2 > 0.99$. The EC50 values were calculated from linear dose-response curves where $R^2 > 0.95$. A student t-test was carried out for the statistical calculations using Microsoft Excel (2010).

**Results**

Extraction yield, polyphenolic and flavonoid content of *C. orchioides* extract is mentioned in Table 01. The extraction yield of the CO was 10.5 ±0.5%.

**Table 01: Extraction yield, polyphenolic and flavonoid content of *C. orchioides* extract.**

| Sample/ Control | Extraction yield % | Total polyphenolic content (TPC) (mg GAE/g) | Total Flavonoid content (TFC)(mg EGCG/g ) |
|---|---|---|---|
| CO | 10.5 ±0.5 (n=2) | 101.2±1.3 (n=6) | 178.4±2.4 (n=6) |

Figure 01 shows the comparison of the total antioxidant capacity of CO with ascorbic acid. Total antioxidant capacity increases with the concentration and is comparable with ascorbic acid at a lower concentration (< 25 µg/mL).

All experiments were repeated independently at least three times, and data (n=3 for each concentration) are expressed as the mean ± SD; **p <.05 and ***p<.001 or ****p< .0001 in comparison to the positive control (Ascorbic acid); paired t test.

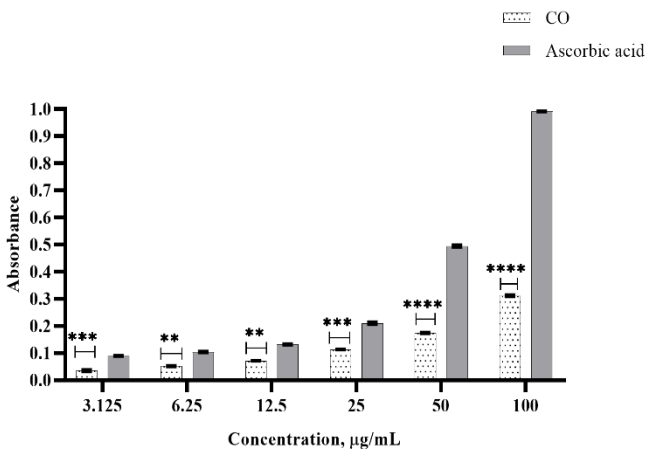


**Fig. 01: Total antioxidant capacity of CO water extract**

$EC_{50}$ values for inhibition of lipid peroxidation, inhibition of protein oxidation, and inhibition of deoxyribose oxidation is mentioned in Table 02.

**Table 02: $EC_{50}$ values for inhibition of lipid peroxidation, inhibition of protein oxidation, and inhibition of deoxyribose oxidation.**

| Sample/ Control | $EC_{50}$(µg/mL) | | |
|---|---|---|---|
| | Inhibition lipid peroxidation | Inhibition protein oxidation | Inhibition deoxyribose oxidation |
| CO | 29.0±0.7* | 82.6±3.9* | 10.1±1.0 |
| Ascorbic acid | 58.4 ± 2.2 | 51.2±0.1 | NA |
| Gallic acid | NA | NA | 8.7±0.6 |

NA- Not Applicable
(*P<0.05 when compared with positive control)

Table 02 shows the inhibition of lipid peroxidation of the CO water extract showed significantly higher activity compared with the standard ascorbic acid (P<0.05). However, CO exhibited moderate inhibition of protein oxidation compared with ascorbic acid (P<0.05). There was no significant difference observed between CO and gallic acid in protective activity against the oxidation of deoxyribose.

The effect of polyphenols on DPPH radical scavenging activities shows in Table 03.

**Table 03: The effect of polyphenols on DPPH radical scavenging**

| Sample/ Control | $EC_{50}$(µg/mL) | |
|---|---|---|
| | Before removal of polyphenols (PP) | After removal of polyphenol |
| CO | 25.6±1.6 *** (n=6) | 704.1±4.6 (n=3) |
| Gallic acid | 4.5±0.2 (n=3) | NA |

$EC_{50}$ values confirm that polyphenol present in the CO extract contributes significantly to scavenging free radicals (Table 03). (***P<0.001 between PP and PP free extracts)

Anti-inflammatory potential of plant extract (Human red blood cell membrane stability and inhibition of BSA denaturation assay) is shown in Table 04.

**Table 04: Anti-inflammatory potential of plant extract (Human red blood cell membrane stability and inhibition of BSA denaturation assay)**

| Sample/ Control | $EC_{50}$(µg/mL) | |
|---|---|---|
| | Human Red blood cell membrane stability | Inhibition of BSA denaturation |
| RCO | 49.7±1.4 | 32.9±3.5 |
| Diclofenac Sodium | 47.8±2.1 | 23.8±3.6 |

This was only preliminary testing and higher red blood cell membrane protection was observed in CO compare with the anti-inflammatory drug diclofenac Sodium (p>0.05). Further inhibition of BSA denaturation confirms that higher anti-inflammatory properties of CO compared with Diclofenac sodium (p >0.05).

Figure 02 shows the comparison of the reducing potential of CO with ascorbic acid. Ascorbic acid was used as a positive control and CO showed poor reducing potential when compared with the ascorbic acid. The reducing potential of CO slowly increases with the concentration.

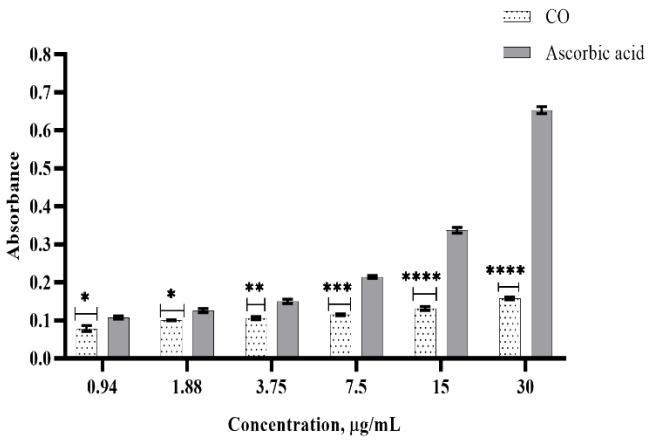


**Fig. 02: Ferric iron-reducing potential of CO extract and positive control**

All experiments were repeated independently at least three times, and data (n=3 for each concentration) are expressed as the mean ± SD; *p < .01 **p < .05 and ***p < .001 or ****p < .0001 in comparison to the Positive control (Ascorbic acid) ; paired t test.

**Discussion**

Among the medicinal plants of the genus Curculigo, *C. orchioides* is the most commonly used herbal medicine in Sri Lanka. The rhizome of the *C. orchioides* is used in traditional and folk medicine to treat diseases such as urinary and skin diseases, asthma, bronchitis, and jaundice etc[8]. The water extract which is prepared according to Sri Lanka traditional medicine was used in the present study to explore the antioxidant activity of the water extract and polyphenol free extract of *C. orchioides.*

Antioxidants are substance which is capable of reducing or preventing cellular damage[2]. The main characteristic of an antioxidant is its ability to trap free radicals. Polyphenols (phenolic acids, flavonoids, anthocyanins, lignans, and stilbenes), carotenoids (xanthophylls and carotenes), and vitamins (vitamin E and C) are the major natural antioxidants present in plants[3,4]. Herbal plants are considered good antioxidants. Therefore, different *in vitro* antioxidant assays were carried out to screen the antioxidant capacity of the CO based on different mechanisms involved. Total phenolic content and total flavonoid content were used to quantify the phenolic compounds of the extracts. Free radical scavenging capacity was screened using a DPPH radical scavenging assay, inhibition of lipid peroxidation, inhibition of protein oxidation and inhibition of deoxyribose oxidation. Reducing power assay and total antioxidant capacity were used to measure the ability of the antioxidant to produce a reduction of metal ions.

Plant polyphenols are secondary metabolites; frequently involve as defensive agents against abiotic and biotic stress conditions. They also play numerous roles in biological systems such as antioxidants, antimicrobial and anticancer agents[22]. The TPC of CO was 101.2±1.3 mg GA/g (Gallic Acid /g) (Table 01). The study of Hejazi et al., 2018 showed that the TPC of water extract is 83.95±0.02 mg GA/g [23]. The review of Wang *et al* 2021[8] is revealed that phenolic compounds are the main metabolites present in the plants of the Genus Curculigo. Nie *et al.,* 2013 has reported that total of 31 phenols and phenolic glycosides have been isolated from the Curculigo species[7]. Further, it describes that these compounds are characterized mainly as benzyl benzoate glucosides, followed by phenol glycosides and simple phenol[7]. In the case of total phenol content determination, the results strongly suggest that phenolics are important components of the CO. Previous studies report that the antioxidant activity of plant extract is mainly associated with the presence of phenolic compounds [24], which may exert antioxidant effects as free radical scavengers, as hydrogen donating sources or as singlet oxygen quenchers and metal ion chelators[25]. Qiong *et al*., 2005 also reported that phenolic compounds are major contributors to the antioxidant activity of *C. orchioides*[26]. There is a highly positive relationship between total phenols and antioxidant activity [27].

Flavonoids are another subset of polyphenols. They involve in regulatory mechanisms in cell proliferation and differentiation to protect eukaryotic cells from oxidative stress by regulating the activity of different protein kinases[28]. The antioxidant properties of flavonoids are due to their ability to scavenge free radicals and also serve to chelate metals. According to the present study, the higher contents of flavonoids (178.4±2.4 mg EGCG/g, Table 01) in CO explain its higher radical scavenging activity.

DPPH is the most extensively used assay to determine the antiradical and/or antioxidant power of biological extracts and/or purified compounds. The violet colour of the DPPH solution converts into the yellow colour due to the presence of a substance that can donate hydrogen depending on the antioxidant activity. It is a relatively stable free radical that, upon reduction by an antioxidant loses its absorption (517 nm) [29]. The present study showed that the CO contains a potent scavenger of DPPH free radical and has an $EC_{50}$ value of 25.6±1.6 µg/mL (Table 03). Previous studies also showed a moderate DPPH radical scavenging capacity of *C. curculigo*[23]. The methanol extract of *C. orchioides* rhizomes was found to be moderately effective in scavenging DPPH radicals [30]. The study of Hejazi et al., 2018 revealed that the DPPH radical scavenging capacity of aqueous extract of *C. orchioides* was $EC_{50}$ 104.8±0.6 [23]. Literature indicates that variation of plant secondary metabolites occur due to geographic location and connected environmental factors like temperature, rainfall, soil type, and composition [31]. The higher DPPH radical scavenging capacity of the plant extract may be due to the presence of the polyphenol. Therefore, experiment was carried out to investigate the polyphenol contribution for DPPH radical scavenging capacity. The polyphenol of the CO was removed using polyphenol adsorbant PVPP. PVPP is a highly cross-linked polymer that has a high affinity toward polyphenols [32,33].

Interestingly CO showed poor DPPH radical scavenging capacity after the removal of polyphenol (Table 03). The $EC_{50}$ ratios with the absence and presence of polyphenols are over 100-fold extracts. These results indicate that polyphenols are the main factor that contributed to DPPH radical scavenging activity and the involvement of non-polyphenols in the antioxidant activity is negligible. Total antioxidant activity is another standard assay used to evaluate the antioxidant potential of plant extract. The total antioxidant capacity assay is based on the reduction of molybdenum (VI) to molybdenum (V) which forms a green chromophore with phosphate in the acidic medium[34]. CO exhibits moderate total antioxidant capacity. The evidence further confirms the CO was with higher antioxidant potential (Figure 02).

Lipid peroxidation is the process where the reaction between unsaturated lipids and reactive oxygen species[35]. Malondialdehyde (MDA) is one of the final yields of polyunsaturated acids peroxidation in the cells[36]. MDA level is commonly recognized as a marker of oxidative stress and overproduction of MDA due to an increase of free radicals [37]. The thiobarbituric acid (TBA) is a common method is used to determine the degree of malondialdehyde (MDA) compound in biological solution[38].

The mechanism of the assay is MDA reacts with TBA and produces a pink colour which read at 532 nm. A higher reduction of lipid peroxidation is observed in CO extract ($EC_{50}$, 29.0±0.7 µg/mL) compare with the positive control (Ascorbic acid $EC_{50}$ 58.4±2.2 µg/mL) (Table 02). Molecules present in the CO extract may have a high contribution to the inhibition of lipid peroxides. Results suggest that plant extracts are capable of reducing cell membrane damage by scavenging lipid peroxides. The previous study of Bafna and Mishra, 2005 showed that methanol extract exhibit potent inhibition of lipid peroxidation induced by Iron/ADP/Ascorbate complex in rat liver homogenate, $EC_{50}$ value was 94.7µg/mL [30].

Reactive species also damage proteins due to oxidation of the protein. Superoxide ($O2•–$) hydroxyl (•OH), peroxyl($RO_2$•), alkoxyl (RO•), hydroperoxyl ($HO_2$•), and non-radical species such as hydrogenperoxide ($H_2O_2$), hypochlorous acid (HOCl), ozone ($O_3$), singlet oxygen ($O_2$), and

peroxy- nitrite ($ONOO^-$) are the ROS leading to protein oxidation [39].

The direct attack of oxidants damages the backbone of a protein to cause fragmentation and conformational changes in the secondary and tertiary structure of the protein [40]. The generation of carbonyls is the most common damage for oxidized proteins[40]. DNPH derivation method has been developed as a convenient and regular method to quantify the levels of protein oxidation in the food system [41]. In this method, DNPH reacts with the carbonyl groups of proteins to generate hydrazones and the absorbance is read at 370 nm wavelength[42]. In the present study, inhibition of protein oxidation by CO was tested. The results revealed that CO contains the moderate potential to prevent protein oxidation ($EC_{50,}$ 82.6±3.9 µg/mL, Table 02). Ascorbic acid (Positive control) was $EC_{50}$ 51.2±0.1 µg/mL. Therefore, CO is highly applicable for a disease that arises due to increased levels of protein carbonyls such as neurodegenerative diseases (amyotrophic lateral sclerosis, Alzheimer's, Parkinson's, and Huntington's diseases), cataractogenesis, systemic amyloidosis, muscular dystrophy, progeria, Werner's syndrome, rheumatoid arthritis, and respiratory distress syndrome [43].

DNA damage is one of the major effects of ROS [44]. DNA is the cell's genetic material and OH- radicals react with all purine and pyrimidine bases also the deoxyribose backbone results in changes in the encoded proteins, which may lead to malfunctions or complete inactivation of the encoded proteins. Further, changes in the nucleotides of one strand can result in mismatches with the nucleotides in the other strand, yielding subsequent mutations[45]. Accordingly, inhibition of DNA oxidation power of RCO was evaluated in the present study. The hydroxyl radical formed in the reaction between iron (III)-EDTA and $H_2O_2$ in the presence of ascorbic acid. The attacked pentose sugar 2-deoxyribose is on heating with thiobarbituric acid at low pH, yielding a pink chromogen that can be measured by its absorbance at 532 nm wavelength[46]. Interestingly higher inhibition of deoxyribose oxidation was observed in RCO ($EC_{50,}$ 10.1±1.0 µg/mL, Table 02) compared with the positive control (Ascorbic acid, $EC_{50,}$ 8.7±0.6 µg/mL).

Reducing power is associated with antioxidant activity and may serve as a significant reflection of the antioxidant activity[47]. Compounds with reducing power indicate that they are electron donors and can reduce the oxidized intermediates of lipid peroxidation processes so that they can act as primary and secondary antioxidants [48]. Present study CO showed less reducing power potential compared with ascorbic acid (Figure 02). The antioxidant potential of plants is directly linked to their anticancer potential [49].

Inflammation is a complex process and it is a protective reaction to tissue damage caused by physical injury and harmful chemicals[50]. The most commonly used drug for the management of inflammatory conditions is the non-steroidal anti-inflammatory drugs (NSAIDs). But there are many various adverse effects, especially gastric irritation, leading to the formation of gastric ulcers are associated with the above synthetic drugs [51]. Secondary metabolite of plant acts as a potent anti-inflammatory drug with the minimum side effect. Inhibit the function of cycloxygenase (COX) enzyme that is responsible for conversion of arachidonic acid to prostaglandin (PG is the major function of the anti-inflammatory agents[21]. The anti-inflammatory capacity of plant extract can be evaluated *in vitro* and *in vivo*. Red blood cell membrane stability and inhibition of protein denaturation are *in vitro* methods frequently used for screening the anti-inflammatory activity. Since the erythrocyte membrane is analogous to the. lysosomal membrane, the prevention of hypotonicity-induced HRBC membrane lysis has been used as a measure for estimating the anti-inflammatory property of extracts [52, 53].

Stabilization of the lysosomal membrane is important in limiting the inflammatory response by preventing the release of lysosomal constituents of activated neutrophils, such as bacterial enzymes and proteases, which causes further tissue inflammation and damage upon extracellular release[53]. The lysosomal enzymes released during inflammation

produce various disorders. Therefore non-steroidal drugs act either by inhibiting these lysosomal enzymes or by stabilizing the lysosomal membrane [54]. Interestingly RCO water extract showed high red blood cell membrane stability ($EC_{50}$ 49.7±1.4 µg/mL, Table 04) compare with the commercially available non-steroid drug Diclofenac sodium ($EC_{50}$47.8±2.1 µg/mL). The study of Asif and kumara 2016 revealed that root tubers methanolic extract obtained from the plant *Curculigo orchioides* at a dose of 200 mg/kg and 400 mg/kg have significant anti-inflammatory activity[55].

Application of external stress or compound, such as strong acid or base, a concentrated inorganic salt, an organic solvent or heats are the factors that cause protein denaturation[56]. Denaturation of proteins is a well-documented cause of inflammation. Accordingly, the ability of plant extract to inhibit protein denaturation was studied as part of the investigation of the anti-inflammatory activity. It was effective in inhibiting heat-induced albumin denaturation ($EC_{50,}$ 32.9±3.5 µg/mL, Table 04) compare with the positive control (Diclofenac sodium, $EC_{50}$ 23.8±3.6 µg/mL).

## Conclusion

The results of this study demonstrate the antioxidant and anti-inflammatory capacity of the rhizome CO. The finding explains that bioactive molecules present in water extract act as potential antioxidant agents with different mechanisms. The present study confirms that polyphenol contributes to the antioxidant potential. Furthermore, water extract exerts high in vitro anti-inflammatory capacity. Hence, the present study indicates that bioactive molecules present in the plant extract can be used as a prototype for the development of new drugs and/or as a source of antioxidants and anti-inflammatory pharmaceutical raw material.

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## Disclosure

The authors declare that there is no conflict of interest regarding the publication of this paper.

The author reports no conflicts of interest in this work.

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# Review on antimicrobial activity of commonly used Ayurvedic preparations

**Arachchi K.R.A.,* Molligoda S.P., Rajapaksha R.A.J.W.**

**Abstract**

Ayurveda is one of the oldest healing sciences with a vast number of medicines for curing diseases and for protecting the healthiness of healthy people. Relevant medicines possess potent *Jwaraghna*, *Rasayana*, etc. pharmacological activities. Hitherto, antimicrobial activity is given less attention. Nevertheless, microbes were synonymously referred as "*Yathudana*", "*Rakshasa*", "*Pishacha*", "*Asura*", "*Gandharva*" and "*Krimi*" in *Samhita*. These terms resulted in this research to study the antimicrobial activity of some commonly used Ayurveda medicines. A total of thirteen Ayurveda medicines, including *Churna, Arishta, Avaleha, Vati* and *Rasaushadha*, were tested for antimicrobial activity by using agar well diffusion method and by disc diffusion method under strict aseptic conditions and following standard laboratory guidelines. The findings of this study were very encouraging as all 13 Ayurveda medicines exhibited potent antimicrobial activity in general. *Rasamanikya* and *Shwasakuthara rasa* were shown to be effective against *Staphylococcus aureus*. *Chyawana prashavalehaya* and *Chandraprabha vati* exhibited antimicrobial activity against *Escherichia coli*. *Sudarshana* and *Thrikatu churna* were found to have the strongest antimicrobial activity against *S. aureus* and *E. coli*. *Amrtarishta* was effective in eradicating *Staphylococcus aureus*, *Escherichia coli* and *Salmonella typhi*. *Draksharishtaya* was found to have antimicrobial activity against *Staphylococcus aureus, Escherichia coli, Salmonella typhi* and *Bacillus subtilis*, *Dashamularishtaya* was effective against *Shigella flexneri, Aspergillus niger* and *Pseudomonas auriginosa*. Only *Thalisadi churna* exhibited antifungal activity against *Candida albicans*. Exhibit results clearly established the potent antimicrobial activity of all thirteen Ayurveda medicines against common human pathogens and might offer new hopes for controlling infectious diseases and preventing the emergence of resistant variants.

**Keywords**: Antimicrobial activity, Ayurvedic preparations, Inhibition zone, Extracts

## Introduction

Ayurveda sciences have smartly approached to cure of infectious diseases in numerous ways. Moreover, the antimicrobial properties of Ayurvedic herbs and preparations are essentially important and play a vital role in present Ayurveda medicine[1]. Many traditional and Ayurveda remedies are rich in chemical compounds which responsible for antimicrobial activity. Multiple research studies have been carried out in order to determine the antimicrobial activity of various Ayurveda preparations.

According to allopathic medicine antimicrobial effect contributes greatly to curing infectious diseases caused by pathogenic bacteria, virus and fungi. Antimicrobial activity can further be defined as a collective term for all active principles (agents) that inhibit the growth of bacteria, prevent the formation of microbial colonies, and may destroy microorganisms. There are a number of methods that use to evaluate the antimicrobial activity of herbal preparation[2].

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The major aim of this review seeks to find commonly used Ayurveda preparations which enriched with antimicrobial properties (antibacterial, antifungal, antiviral) including *Churna, Arishta, Avaleha, Vati* and *Rasa* preparations and find out commonly used methods in assessing the antimicrobial activity of selected preparations and identify common human pathogens who can be killed by selected herbal preparations. After summarizing the gathered information on the basis of the assessing methods and activity of each preparation against specific microbes.

## Methodology

The first phase of the study has been focused on the study of antimicrobial activity and testing methods to assess antimicrobial activity via reading relevant research articles. Research articles, review articles and authentic books which explain the antimicrobial activity of common Ayurvedic preparations have been studied. Among the available several herbal preparations Thirteen number of Ayurveda preparation have been selected to conduct a deep analysis (*Sudarshana churna, Thalisadi churna, Thrikatu churna, Samasharkara churna, Amrtarishta, Dashamularishtaya, Draksharishtaya, Chyawanprashavaleha, Chandraprabha vati, Arogyavardhini vati, Manikyarasa, Rasaka bhashma, Swasakutararasa*). Then for the clear understanding thirteen herbal preparations were divided into five major sections as *Churna, Arishta, Avaleha, Vati* and *Rasa* preparations. The study was separately carried out covering all the five sections with appropriate examples by collecting the necessary information on their antimicrobial activity from several appropriate research findings[2,3,4]. Moreover, the evaluation procedure relevant to antimicrobial activity was further studied focusing on relevant research articles. Furthermore, specific microbial species which can be killed by each preparation were identified. For example, *Sudarshana churna* has specific antimicrobial activity on *Staphylococcus aureus* (*S. aureus*) and *Escherichia coli* (*E. coli*)[1]. Also, the antimicrobial activity of other preparations was analyzed separately focusing to apposite references. Finally, the collected data were further summarized by using tables and bar charts**.** Table 01 has shown the selected Ayurveda preparations of the study.

**Table 01: Selected Ayurveda preparations**

| ***Churna*** | ***Arishta*** | ***Avaleha*** | ***Vati*** | ***Rasa*** |
|---|---|---|---|---|
| *Sudar shana* | *Amurtha rishta* | *Chywana Prasha waleha* | *Chandra prabha vati* | *Rasa manikya* |
| *Thalisadi* | *Dasha Mula rishta* | | *Arogyaa vardhini Vati* | *Swasa kutara rasa* |
| *Thrikatu* | *Drakshari shta* | | | *Rasaka bhashma* |
| *Samasharka ra* | | | | |

### *Churna preparations*

In Ayurveda, "*Churna*" is the most commonly prescribed dosage form which consists of herbal, mineral or herbo-mineral materials in fine powder form.

### *Assessing the antimicrobial activity of Sudarshana churna*

"*Sudarshana churna*" is a very effective Ayurveda preparation which composed of 42 medicinal plants. Ancient physicians used "*Sudarshana churna*" to cure all types of fever due to various reasons as well as a rejuvenate medicine and diuretic. *Swetia chirata* a potent antiviral herb included in *Sudarshana Churna* [3].

Antimicrobial activity of *Sudarshana Churna* has been tested against gram-positive bacteria like *S. aureus*, gram-negative bacteria like *Klebsiella pneumoniae* (*K. pneumoniae*) and *E. coli*. Agar disc diffusion method has used in this study. The result of the above study shows that the aqueous extract of *Sudarshana Churna* possesses significant antimicrobial activity. The active effect against gram-positive bacterial strain like *S. aureus* and gram-negative bacteria like *K. pneumoneae* and *E. coli* whereas less effective against gram-positive bacteria *Staphylococcus epidermidis* (*S. epidermidis*) and *Bacillus subtilis* (*B. subtilis*)[4].

***Assessing the antimicrobial activity of Thalisadi Churna***

*Thalisadi churna* is beneficial for cough, cold, asthma, diarrhea, bloating, vomiting, side and chest aches, anemia, and spleen diseases. It controls wheezing due to asthma or allergy[5].

The agar disk diffusing method is used to find out the antimicrobial effect of *Thalisadi churna. Candida albicans, is* one of the medically important fungal strains that is used to determine the zone of inhibition which use to prove the antimicrobial effect of *Thalisadi churna*. The result shows that the incredible inhibition of the fungal growth was shown against the tested organism as exhibited in Figure 01.

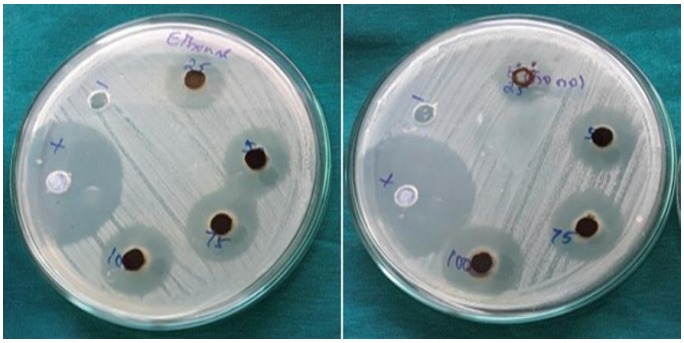

**Fig. 01: Antifungal activity of *Thalisadi churna* against *Candida albicans***

***Assessing the antimicrobial activity of Thrikatu churna***

*Thrikatu churna* is polyherbal preparation which improve digestive power and promotes appetite. *Thrikatu churna* is an absolute remedy for liver disorders (hepatitis, jaundice), infections, bronchitis, common cold, cardiovascular diseases such as heart attack, atherosclerosis, blood clots and is beneficial in weight reducing treatments.

Ethanolic extract of *Thrikatu churna* and individual components have been tested for antimicrobial activity against certain clinical and fungal isolates. Agar well diffusion method has been used for assessing the antimicrobial property of *Thrikatu churna*. The result verified that the *Thrikatu churna* and its individual ingredients perform potent antimicrobial activity[6].

***Assessing antimicrobial effect of Samasharkara churna***

*Samasharkara churna* is used in the treatment of piles, cough, cold, asthma, anorexia, indigestion, throat pain and infections.

Disc diffusion method and serial dilution method have been used to evaluate the antimicrobial property of *Samasharkara churna*[7]. *S. aureus and S. epidermedis* as Gram-positive bacteria, *Klebisiella* and *E. coli* as Gram-negative bacteria and *Candida albicans* (*C. albicans*), *Aspergillus niger* (*A. niger*) as fungus have been used [7]. The results exhibit that, *Samasharkara churna* has an immense antimicrobial effect against gram-negative bacteria, gram-positive bacteria as well as fungi[7].

***Arishta preparation***

*Arista* and *Asawa* are liquid Ayurvedic preparations or self-generated herbal fermentations. *Asawa* has prepared with the use of fresh herbal juice or herbs which are soaked in water. *Arista* is prepared with a decoction of herbs in boiling water. Both have a sweet taste and an alcoholic smell.

***Assessing the antimicrobial activity of Amrtarishta***

*Amrtarishta* is a polyherbal, common Ayurvedic liquid preparation which helps to cure chronic fever, cough, cold, boosting immunity and blood purification.

A modified disc diffusion assay method has been used for assessing the antimicrobial activity of *Amrtarishta*. The result verified that the *Amrtarishta* possesses a great antimicrobial effect. Especially *Amrtarishta* holds immense antimicrobial activity against *S. aureus, Salmonella typhi, E. coli, B. subtilis* which are commonly presence as a human pathogen[8].

***Antimicrobial effect of Dashamularishta***

*Dashamularishta* is an Ayurvedic preparation composed of ten precious medicinal herbs. It is another self-generated alcohol preparation that acts as a pain killer, immunity booster, strength promoter and also helps to get rid of backache, digestive disorders, mental stress and fever. *Dashamularishta* has a promising effect of speed recovery for new mothers. It contains 3-7% of alcohol which forms by fermentation of herbal materials.

***Assessing antimicrobial effect of Dashamula arishta***

Antimicrobial activity of *Dashamularishta* have been tested against *Pseudomonas aeruginosa* (*P. aeruginosa*), *S. aureus, K. pneumoniae, S. typhi, Shigella flexneri* (*S. flexneri*), *Proteus vulgaris* (*P. vulgaris*), *Enterobactor aerogenes* (*E. aerogenes*) and as a fungi *C.albicans, A. niger, Trichophyton rubrum* (*T. rubrum*)[9].

The bactericidal *in vitro* disc diffusion method has been used to evaluate the antimicrobial effect of *Dashamularishta*. The results proved that the ingredients of *Dashamularishta* have immense antimicrobial activity against *S. flexneri, P. aeruginosa* and *A.s niger* with highest inhibition zone[9]. Figure 02 shows the zone of inhibition of *Dashamularishta* against *A. niger* and *S. flexneri*.

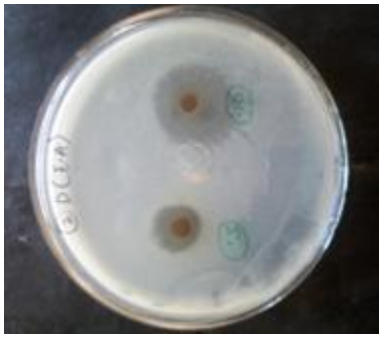

**Fig. 02: *Ethyl acetate* extract of *Dashamularishta* against *A. niger* and *S. flexneri***

***Assessing antimicrobial effect of Draksharishtaya***

*Draksharishtaya* improves immunity, digestion and outstanding remedy for constipation, cough, asthma, common cold, insomnia, anorexia and physical weakness. Generally, *Draksharishta* use as tonic and nutritional supplement.

Disc Diffusion Assay method have been used to assess antimicrobial effect of *Draksharishta*. Zone of growth inhibition have been measured to assess the antimicrobial activity of *Draksharishta*. *Draksharishta* exhibit immense antimicrobial activity against common human pathogens such as *S. typhi, B. subtilis, E. coli, S. aureus*[10].

***Avaleha preparations***

*Avaleha* is a semisolid secondary preparation which is utilized in various diseases. *Avaleha kalpana* reach high popularity because of its palatability, easy administration and long shelf life[11]. Different kinds of decoction or *Swarasa* along with sweetening agents such as sugar, jaggery or sugar candy are used to utilize *Avaleha*. These preparations consider as an *Upa kalpana* of *Kwatha kalpana* and *Leha, Lehya, Raskriya* are the synonyms of *Avaleha*.

***Assessing antimicrobial activity of Chyawanprasha valeha***

*Chyawanprashavaleha is* rich in many potent herbs which promote rejuvenation and longevity. This remedy can use to treat any lung and breathing disorders, aid digestion, enhance cardiac functioning as well as expand brain function. The magical content of *Chyawanprashavaleha* provides useful nutrients such as anti-oxidant, protein, dietary fibers and alkaloids[12].

The study has been focused on the antimicrobial effect of a chloroform extract ($CHCl_3$) of *Chyawanprasha valeha* and hydrolyzed *Chyawanprashavaleha* against *E. coli* and *S. aureus* on nutrient agar medium[13]. The cup plate method has been used to evaluate the antimicrobial property of *Chyawanprashavaleha*. After the incubation period zone of inhibition have been measured to assess the antimicrobial activity of *Chyawanprashavaleha* against the *E. coli* and *S. aureus*[13]. The exhibited inhibition zone diameter showed that, both chloroform extract of *Chyawanprashavaleha* and hydrolyzed $CHCl_3$ extracts of *Chyawanprasha valeha* are rich with excellent antimicrobial activity against *E. coli* according to the concentration[13].

***Vati preparations***

*Vati kalpana* is one of the commonly used Ayurvedic preparations which is a derivative of the *Xalka kalpana*. Among the Ayurvedic classics, *Sharangadara samhitha* give large explanation and made an individual chapter for *Vati kalpana. Vati* (tablets), *Gutika* (pills), *Modaka* (large size pills)

and *Varthi* (dragges) are the synonyms that *Acharya Sharagadara* suggested for *Vati*[14].

***Assessing antimicrobial effect of Chandraprabha vati***

*Chndraprabha vati* is a *Vati* preparation which has commonly use in treatments of diabetes, men's infertility, prostate enlargement, nephritic syndrome, kidney stones, proteinuria, glycosuria, heel pain, constipation, anxiety, mental depression and painful menstruation. It contains a large number of ingredients which provide multiple healing effects with their significant properties[15].

The antibacterial activity of *Chandraprabha vati* have been evaluated by tube dilution method using a varying concentration of the drug, which have been added to Luria Bertani broth. The tubes have been incubated at $37^0$C for 24hrs. The results have been studied with growth curve analysis[15] and this study found *Chandraprabha vati* has antimicrobial action against the *E. coli*.

***Assessing antimicrobial effect of Arogyavardhini vati***

*Arogyavardhini vati* is a miraculous Ayurvedic remedy which is commonly practiced in diseases such as liver, skin, stomach, heart and gallbladder. Agar well diffusion method with Mullar Hinton Agar have been used to evaluate antimicrobial property of *Arogyavardhini vati*[16]. *P. aeruginosa, E. coli, S. aureus, Candida albicans* have been utilized to evaluate antimicrobial property of *Arogyavardhini vati*[16]. The results have proved that the *Arogyavardhini vati* possess incredible antimicrobial activity against *P. aeruginosa, S. aureus* and no considerable antimicrobial activity against *C. albicans*[16]. Figure 03 has shown the antimicrobial activity against *S. aureus* with agar well diffusion method of *Arogyavardhini vati*.

***Rasa preparations***

The ancient Indian Ayurvedic science rich with various medicinal concepts. *Rasa shasthra* is one of the outstanding concepts which build up on mercury (*Parada*) majorly while other minerals (*Hingula (HgS), Swarna makshika ($CuFeS_2$), Palmanikkam ($CuSO_4$),* metals (*Swarna, Vanga, Lauha*) along with non-metal compound such as *Gandaka* (S)[17].

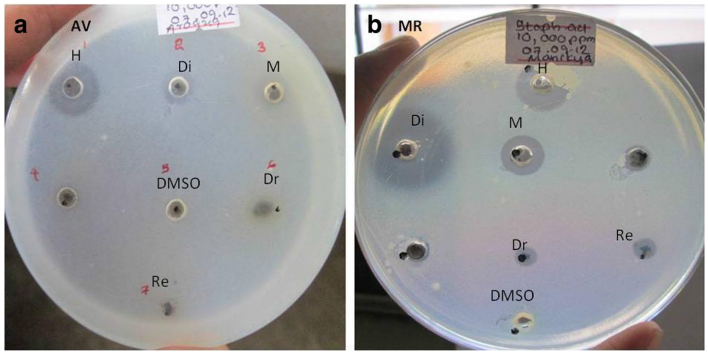


**Fig. 03: Antimicrobial activity against *S. aureus* with agar well diffusion method of *Arogyavardhini vati***

***Assessing antimicrobial activity of Manikyarasa***

*Manikyarasa* is a really popular rasa drug among Ayurvedic physicians which is made up with *Harithala* as the major ingredient. It is commonly used in conditions of bronchial asthma, bronchitis, fistula (*Bagandara*), skin diseases such as leprosy, dryness of skin, rashes social diseases such as, syphilis and nervous diseases too.

Eleven human pathogenic microbes have been used to evaluate the antimicrobial activity of *Manikyarasa* [18]. According to the result, *Manikyarasa* shows unbelievable antimicrobial activity against *S. aureus*. Figure 04 shows zone inhibition of *Manikya rasa* against *S. aureus.*

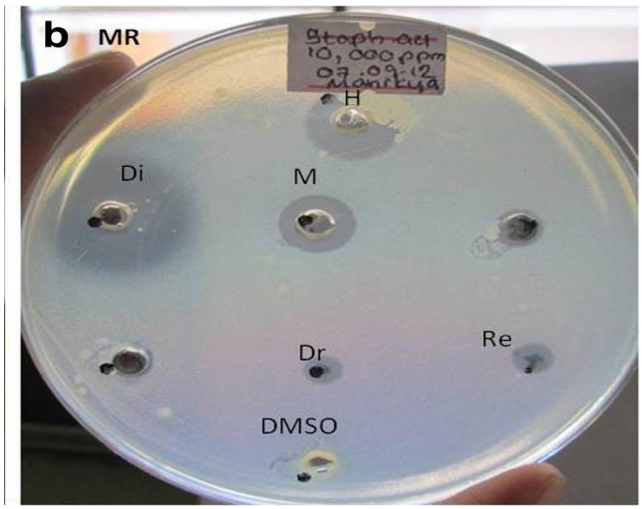


**Fig. 04**: **Antimicrobial activity of *Manikya rasa* against *S. aureus***

***Assessing antimicrobial activity of Raska bhashma***

A *Bhasma* means an ash obtained through incineration, the starter material undergoes an elaborate process of purification and this process is followed by the reaction phase, which involves the incorporation of some other minerals or herbal extract.

*Rasaka* (Zinc), which classified under the *Maharasa* is a mineral containing zinc. It is a zinc combination with carbonate, sulfide and oxide. *Kharpara*, *Thamra ranjaka* and *Nethra rogari* are the synonyms of *Rasaka* [19].

Agar disc diffusion method have been used to study the antimicrobial activity of *Rasaka bhashma* against gram positive and gram-negative bacteria. *S. pneumonia*, *S. aureus* and *S. pyogenes* have been used as gram-positive bacteria and *K.pneumonia* have been used as gram-negative bacteria. Finally, results have evaluated the antimicrobial activity of *Rasaka bashma*. Both $ZnCO_3$ and ZnO showed great antimicrobial activity against *Streptococcus* compared to other organisms. But, comparing to ZnO, $ZnCO_3$ showed better activity against selected organisms[19].

***Assessing antimicrobial activity of Swasakutara rasa***

*Shwasakutara rasa* is an outstanding Ayurvedic preparation which has commonly been applied on conditions of respiratory disorders, in tablet or powder form. This herbo-minaral preparation shows the amazing curative effect on diseases such as, common cold, asthma, anorexia, chronic bronchitis, dyspnea and indigestion[20].

The Agar disc diffusion method has been used to evaluate the in-vitro antimicrobial activity of *Swasakutara rasa*[21]. *S. aureus* has been used as a major microbe and it has been grown on mullar hinton agar. According to the result, *Shwasakutara rasa* shows antimicrobial activity against *S. aureus*.

Table 02 shows the selected herbal preparations against the specific microbes along with the assessing method.

**Table 02: Selected herbal preparations against the specific microbes along with the assessing method.**

| Name of the preparation | Microbes which kill by selected preparations | Assessing method |
|---|---|---|
| *Sudarshana churna* | *S. aureus*, *E. coli* | Agar disc diffusion method |
| *Thalisadi churna* | *C. albicans* | Agar well diffusion method |
| *Thrikatu churna* | *S. aureus*, *E. coli* | Agar well diffusion method |
| *Samasharkara churna* | *S. aureus*, *E. coli*, *S. epidermidis* | Agar disc diffusion method |
| *Amrtarishta* | *S. aureus*, *E. coli*, *S. typhi* | Agar disc diffusion method |
| *Dashamula rishta* | *S. flexneri*, *A. niger*, *P. auriginosa* | Agar disc diffusion method |
| *Draksha rishta* | *S. typhi*, *S. aureus*, *E. coli*, *B. subtilis* | Agar disc diffusion method |
| *Chyawana prashavaleha* | *E. coli* | Agar disc diffusion method |
| *Chandraprabha vati* | *E. coli* | Tube dilution method |
| *Arogyavardhini vati* | *P. aeruginosa*, *S. aureus* | Agar well diffusion method |
| *Rasamanikya* | *S. aureus* | Agar well diffusion method |
| *Rasaka bhashma* | *S. aureus*, *S. pyogenes* | Agar disc diffusion method |
| *Shwasakutara rasa* | *S. aureus* | Agar disc diffusion method |

Figure 05 shows the methods which use to evaluate antimicrobial activity against a number of preparations.

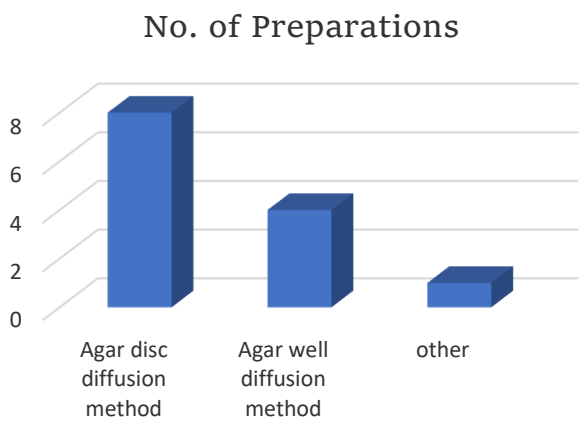


**Fig. 05: Methods which use to evaluate antimicrobial activity against number of preparations.**

Figure 06 depicts the different methods which used to evaluate antimicrobial activity together with a number of preparations which are assessed by each method.

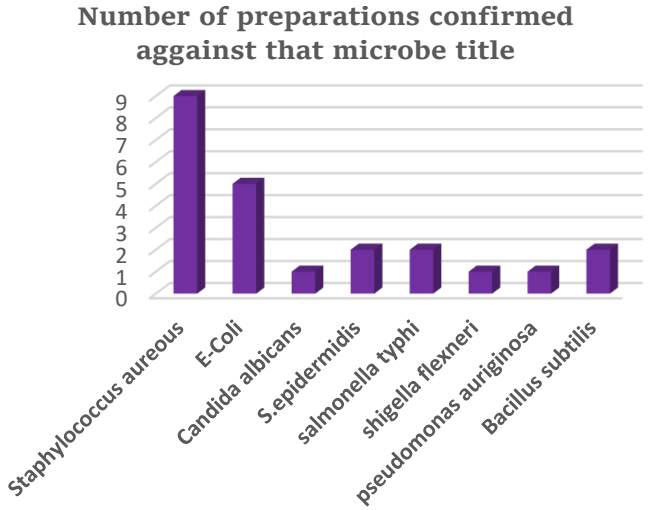


**Fig. 06: Microbes which kills by selected preparations against a number of preparations.**

The highest number of preparations have been tested with the agar disc diffusion method and four preparations have been tested with the agar well diffusion method. Figure 6 shows the microbes which can kill by selected herbal preparations. Eight number of preparations have an antimicrobial effect on *S. aureus*, six preparations have an inhibitory reaction against *E. coli* and two preparations can destroy Salmonella typhi among the selected preparations.

**Discussion**

Present review study has revealed antimicrobial activity of commonly used Ayurvedic preparation via a number of research studies which associate with laboratory experiments. There are several methods which use to evaluate antimicrobial activity as, the Agar disk diffusion method, antimicrobial gradient method, Agar well diffusion method, Agar plugs diffusion method, Cross streak method, and Agar dilution method are some of them. Among them, agar disc diffusion method and agar well diffusion method has used commonly in the studies of assessing the antimicrobial activity of Ayurvedic preparations. The agar mediums play a major role in the above laboratory findings. Blood agar, nutrient agar, MacConkey Agar and mullar hinton agar are the agar plates which commonly used in laboratory experiments, associate with the antimicrobial activity of Ayurvedic preparations. Five to ten percent of blood of sheep or horses have used to prepare blood agar plates and it is utilized to spot organism such as *Neisseria gonorrhoeae* and *Haemophilus influenza* [22].

According to the present review study, some species of microbes are commonly killed by selected Ayurvedic preparations. Gram-positive bacteria, *Staphylococcus aureus* have been destructed by well-known Ayurvedic preparations such as, *Sudarshana churna, Thrikatu churna, Amurtharishta, Draksharishta, Arogyavardhini vati, Rasamanikya* and *Rasaka bashma. S. aureus* is a common human pathogen which majorly involve in skin infections (abscess) and sometime respiratory diseases (pneumonia), endocarditis, and osteomyelitis. Above drugs which exhibit antimicrobial activity against *S. aureus* also have been prescribed in the same conditions. As an example, *Sudarshana churna* and *Thrikatu churna* has amazing action in *shwasa*, *kasa* conditions. *Manikyarasa* indicates for both skin diseases and

respiratory tract diseases which are mainly origin due to the action of *S. aureus.*

**Conclusion**

The present study has been conducted to investigate the antimicrobial activity of the commonly used thirteen Ayurveda medicines against the common human bacterial and fungal pathogens using the agar well diffusion method and by disc diffusion method under strict aseptic conditions and following standard laboratory guidelines.

The findings of this study were very encouraging as all 13 Ayurveda medicines exhibited potent antimicrobial activity in general. Particularly, *Rasamanikya* and *Shwasakutara rasa* were shown to be effective against *S. aureus*. Next, *Chyawanaprashava leha* and *Chandraprabha vati* exhibited antimicrobial activity against *E. coli*. Then, *Sudarshana Churna* and *Thrikatu churna* were found to have the strongest antimicrobial activity against *S. aureus* and *E. coli*. *Amrtarishta* was effective in eradicating *S. aureus*, *E. coli* and *S. typhi*. Then, *Draksharishta* was found to have antimicrobial activity against *S. aureus*, *E. coli*, *S. typhi* and *B. subtilis*, apart from that, *Dashamularishta* was found to be effective against *S. flexneri*, *A. niger* and *P. auriginosa*. Only *Thalisadi churna* exhibited good antifungal activity against *C. albicans*.

The results of this study clearly established either the potent antimicrobial activity or inhibitory action of all thirteen Ayurveda medicines against the common human bacterial and fungal pathogens and might offer new hopes for controlling infectious diseases and preventing the emergence of resistant variants.

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# Concept and management of *Warm e Meda* (Gastritis) in Unani perspective: A review

**Naleefa U.L.*, Muthalib A.M.**

**Abstract**

*Warm e Meda* (Gastritis) is a common Gastro Intestinal disorder affecting the world's population. According to the Unani concept *Warm e Meda* occurs mainly due to *Soo e Mizaj* of *Meda* (imbalanced temperament of the stomach) and accumulation of *Ghair Tabayee Akhlath* (bad humours) in the stomach. According to Unani concept, there were many preventive and treatment modalities found to treat and manage *Warm e Meda*. In the preventive method, *Asbab e sitta e zarooriya* (six essential factors) should be maintained viz *Hawae e Muheet* (fresh air), *Makhool wa Mashroob* (food and drink), *Harkath wa Sukoone badani* (body movement and response), *Harkath wa Sukoone Nafsaniya* (mental movement and response), *Naum vo Yakzah* (sleep and wakefulness) and *Ehthibaas wa Istifaraagh* (retention and evacuation). *Ilaj bil Ghiza* (dietotherapy) and *Ilaj bil Dawa* (pharmacotherapy) are the treatment modalities used to treat *Warm e Meda*.

**Keywords**: *Warm e meda, Soo e mizaj, Ghair Tabayee Akhlath, Asbab e sitta e zarooriya, Mufrad vo Murakkab Dawa*, Gastritis

## Introduction

*Warm e Meda* (gastritis) is a commonly found disease condition in now a day. It affects all age groups; specially adolescents and both sexes. In modern, the word "gastritis" refers to the inflammation, irritation or erosion of the lining of the gastric mucosa and it may occur suddenly (acute) or gradually (chronic)[1]. Epigastric and retrosternal burning, abdominal discomfort, nausea, and vomiting are some peculiar symptoms of *Warm e Meda*. According to Unani Classical texts, the terminology "*Warm*" means inflammation and "*Meda*" means stomach. Hence *Warm e Meda* refers to inflammation in the stomach. As per Unani scholars, *Sozish e Meda, Hurqat e Meda* and *Iltehab e Meda* are commonly used names for *Warm e Meda* in the Unani medical system[2]. *Warm e Meda* (gastritis) occurs mainly due to *Soo e Mizaj* of *Meda* (imbalanced temperament of the stomach) and accumulation of *Ghair Tabayee Akhlath* (morbid humours) in the stomach. Apart from the above some other causes are also noticed in the development of *Warm e Meda* viz alcohol consumption, excessive drinking of certain beverages like carbonated drinks and coffee, taking some medication, inadequate sleep at night, stress, excessive worries, some occupation etc.

In the book "Canon of Medicine" Ibn Sina describes the diseases of internal organs, in particular to the detailed description of symptoms of gastritis and gastric ulcer close to modern description[3,4]. He also provides data on diseases of the stomach and intestines as a reaction of the organism to changing environmental conditions and violation of specific forms of adaptability of the organism[4]. In the Unani system of medicine, many effective *Mufrad dawas* (single drugs) and *Murakkab dawa* (compound drugs) that are derived from plants, animals and minerals sources are being used for the treatment of *Warm e Meda*. These drugs act both locally and systemically. Further Unani physicians have recommended different medicines in different seasons according to the different *Mizaj* (temperaments) of the patients.

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***Classification***

Unani physicians have described *Warm e Meda* under four headings according to various factors. They are clinical features, causative factors and humours, duration of the disease and gross pathological changes.

Based on the clinical features *Warm e Meda* is classified into *Warm e Meda Harr* (hot type of gastritis) *Warm e Meda Baarid* (cold type of gastritis). Based on the *Warm e Meda Harr* (hot type of gastritis) further, it is divided into *Damavi* (sanguineous) type of *Warm e Meda* and *Safravi* (billious) type of *Warm e Meda*. Moreover, *Warm e Meda Baarid* (cold type of gastritis) is further divided into *Balghami* (phlegmatic) type of *Warm e Meda* and *Saudavi* (melancholic) type of *Warm e Meda*[3,4].

According to the type of humours accumulated in the stomach, *Warm e Meda* is further divided as *Warm e Meda Damavi* (sanguine type of gastritis), *Warm e Meda Balghami* (phlegmatic type of gastritis), *Warm e Meda Safravi* (billious type of gastritis) and *Warm e Meda Saudavi* (melancholic type of gastritis)[3].

Based on the duration of the disease, Unani Scholars have described *Warm e Meda* into *Warm e Meda Falghamuni*, *Warm e Meda Hamrath e meda*, *Warm e Meda Rakhw* and *Warm e Meda Sulb*[4]. Further Unani scholars have classified *Warm e Meda* into *Warm e Meda Haad* (acute gastritis) and *Warm e Meda Muzmin* (chronic gastritis) on the basis of gross pathological changes[3,4]. If *Warm e Meda Haad* (acute gastritis) is left untreated, this will lead to *Warm e Meda Muzmin* (chronic gastritis)[3].

**Methodology**

This review was done from 2000 to 2021 using search engines like pub med and Google scholar databases, Unani classical textbooks and Scientific Journals.

**Results and Discussion**

***Asbab***

*Warm e Meda* is caused mainly due to *Soo e Mizaj* (derangement of temperament) of the stomach and accumulation of *Fasid Akhlath* (morbid humours) in the stomach[8]. Besides some other causes also impact in the development of *Warm e Meda*. They are *Ghiza e Ghaleez Kham* (diet that is partially cooked and hard to digest), pouring of irritants, sour black bile and bilious fluid in the stomach, taking foods that don't match body constitution, consuming extremely spicy and sour foods and beverages, wheat flour products, products made from white sugar and fatty acids, smoking, prolonged exposure to alcohol, eating large meals or lying down specially on your back after a meal, being overweight or obese, taking snacks at bedtime, excessive intake of chocolates, etc.[3,4]

***Clinical features***

Clinical features may vary according to the type of *Akhlath* (humors) involved in the causation of the disease. These clinical features are very important in diagnosing the causative factor of the disease conditions. In the case of *Warm e Meda Harr* (hot type of gastritis) there will be abdominal heaviness and distention, *Humma* (fever), *Qai* (vomiting), *Shiddat -e-piyas* (excessive thirst), restlessness and decreased appetite. In case of *Warm e Meda Baarid* (cold type of gastritis) which is caused by *Balghami Khilth*, there will be *Humma-e- layyinah* (mild fever), excessive appetite, decreased appetite, distended stomach, whitish tongue and puffiness of face. While in case of hard consistency caused by *Saudavi Khilth* (black bile), there will be hardness on palpation, but no history of fever. Apart from the above there are some clinical features are noticed such as heart and chest burn, sometimes chest pain, nausea, throat burn, sour and bitter belching, regurgitation of food, or vomiting of sour substances, heaviness and pain in the abdomen, Indigestion, Aversion of food, Headache, foul-smelling loose motion, bad breath, thirst, mouth ulcer, fatigue (specially in legs), tiredness, severe burning sensation over the hands and feet, itching all over the body, fainting, giddiness etc.[3,4]

***Management***

According to the Unani Medical system, some basic principles of treatments are practiced in treating the *Warm e Meda*. They are

- Maintaining the equilibrium of *Asbab e Sith e Zarooriya* (six essential factors)
- *Ilaj bil Ghiza* (dietotherapy)
- *Ilaj bil Dawa* (pharmacotherapy)

***Asbab e sith e zarooriya***

According to the Unani system of medicine, *Asbab - e -Sith- e- Zarooriya* is known to be six essential factors which is needed for the healthy state of humans. Prevention of diseases could be gained through maintaining the balance in *Asbab-e-Sitta-e-Zarooriya* which have a direct influence on health. Imbalance in these factors will cause the alteration in *Mizaj* which in turns leads to disease conditions. Therefore, *Warm e Meda* could be prevented by maintaining the equilibrium of the following six essential factors[5].

*Asbab-e-Sitta -e-Zarooriyah* includes six essential factors which are as follows:

- *Hawa-e-Muheet* (atmospheric air)
- *Makool wa Mashroob* (food and drinks)
- *Harkat wa Sukoon-e-Badani* (physical activity and response)
- *Harkat wa Sukoon-e-Nafsani* (mental activity and response)
- *Naum wa Yaqza* (sleep and wakefulness)
- *Ehtibas wa Istifragh* (retention and elimination).

***Hawa-e-Muheet***

Air is one of the main essential factors for living. According to Unani scholars it is mentioned to be a vital element of *rooh* in one's human body. According to that inhaling pure clean air will help to reduce many diseases. Air could be subjected to abnormal variations like pollution. Inhalation of polluted air will lead to mal temperament of *rooh* which causes number of diseases. Further it will lead to *soo e mizaj* of the stomach which in turns cause gastritis. So, it could be prevented by staying at well ventilated place by inhaling fresh pure air [4,5].

***Makool wa Mashroob***

Food and drink are placed to be a second factor next to air. Improper diet will lead to many diseases. The quality and quantity of the food and drink will impact in one's health. Imbalance in the quality and quantity of the food will cause some health problems. So, the diet we intake should be clean and fresh as well as the quantity should be taken according to our body's need. Consumption of bad quality foods will produce putrefaction of humors in the stomach. As regards of quantity, an excess produces indigestion, obstruction and then putrefaction of *Akhlath*[5,6]. Consequently, the quality and quantity of one's food and drink is believed to ensure physical fitness by strengthening "*Tabiat*". According to Jalinoos; time of the food, type of the food, the quantity of the food and the temperament of the food should be taken into consideration while consuming the diet[6]. Thus, maintaining the equilibrium by practicing good dietary habits will improve and get rid of many diseases including *Warm e Meda*.

***Harkat wa Sukoon-e-Badani***

The body needs exercise as well as rest for a good physique. Ibn Sina said that "exercise is the cause of good health if it is done at the right time and in moderate quantity"[5]. Moreover, he has stated that physical activity is needed for the activation of *Hararath e Ghareezi* (innate energy) and to excrete the waste products produced from the body while rest is needed to help in digestion, to relieve the fatigue and to decrease the body temperature. Imbalance of the above factor may cause disturbances in *Hararath e Ghareezi* (innate energy) and the indigestion will lead to cause immature *Akhlath* in the stomach that will be accumulated and cause erosion in the stomach. Accordingly, maintaining the regular exercise as well as proper rest in equilibrium will help in good health[4,5, 6].

***Harkat wa Sukoon-e-Nafsani***

Psychological factors play a significant role in the wellbeing of an individual. Emotional disturbances like stress, excessive worries, anger, grief etc. will cause many diseases. Many research articles described that, there is a close relationship between

gastritis and mental disturbances among both sexes. Especially it has been reported that the relationship of emotional stress to abnormalities of the gastric mucosa was considered in a review of 788 consecutive upper gastrointestinal endoscopies[7]. Therefore, maintaining the equilibrium of psychological factors will help to preserve or restore health.

***Naum wa Yaqza***

Normal sleep and wakefulness are much important for a person's health. Inadequate sleep will cause many digestive problems like indigestion, mental weakness and loss of energies[5]. Excessive sleep causes more coldness in the body while excessive wakefulness produces indigestion. So sufficient amount of sleep and wakefulness should be needed for the healthy life. The Unani scholar Ibn Nafees described that all functions of the body happen in wakeful state, but excess of awakening will produce impaired digestion, dissolution of *rooh* and weakness in the brain[6]. Majoosi said that "*Tabiat*" is maintained by the proper and adequate sleep which gives mental and physical rest and the digestion and concoction of *Akhlath.* Subsequently, any indigestion and accumulation of *Ghair Tabayee Akhlath* will lead to develop gastritis. Moreover, in one of the research articles it has been reviewed that the sleep disturbances will cause gastritis and peptic ulcer diseases[5]. Therefore, it is essential to maintain the equilibrium on sleep and wakefulness.

***Ehtibas wa Istifragh***

The waste products produced from the body should be evacuated at regular interval to maintain the "*Tabiat"*. Any retention of harmful products or excessive elimination will cause some health problems in the human body. Retention of waste products will produce putrefaction while excessive elimination will cause coldness in the body which in turns leads to impaired digestion. Immature *Akhlath* will be produced due to indigestion[6]. Accumulation of putrefied humors and immature *Akhlath* in the stomach will cause some erosion and inflammatory conditions in the gastric mucosa. Therefore, it is very important to evacuate morbid humors at the correct time in proper way[5].

***Ilaj bil Ghiza* (Dietotherapy)**

A specialized form of treatment, *Ilaj bil Ghiza* (dietotherapy) has been practiced from the period of Unani scholars like Avicenna, Galen to treat several diseases. They were completely aware about the importance of *Ilaj bil Ghiza*. It plays a key role in the treatment and prevention of many diseases. A well-balanced diet with adequate intake of all nutrients, is necessary for good nutrition as well as for maintaining health and preventing diseases[8]. Unani physicians recommend a suitable diet for a diseased person before the initiation of drug therapy. They believed to be that some disease could be cured by dietotherapy alone or adjuvant with pharmacotherapy. In addition to nutritional property, the food we consume have pharmacological actions too. More over in Unani medical system a person is recommended to consume foods which is opposite *Mizaj* to the *Mizaj* of the disease condition to restore the health. Therefore, correct suitable *Mizaj* diet should be selected according to the temperament of the stomach of each individual in treating *Warm e Meda*. Moreover, it is recommended to take easily digestible diets like *Talbina*, soup, *Ma us shaeer*, *Ma ul jubun* that will help to relieve strain on a person digestive system and reduce symptoms of *Warm e Meda.* Pomegranate juice, *sikanjabeen, Aabkama, Murabba, Gulqand, Hasarmiya, Zeerba, Mazeera, Masleeya, Faluda, Maibah, Cydonia oblonga* mixed with wheat bread, fruits having cold temperament will help to relieve symptoms of *Warm e Meda*[8]. Oily diets, spicy foods, chilled water should be avoided[4].

***Ilajbil Dawa (Pharmacotherapy)***

*Ilajbil Dawa* is the most used mode of treatment modality in the treatment of all diseases with less side effects. The drugs used for the treatment are crude drugs prepared from plant, animal and mineral sources. They might be *Mufrad Dawa* (single drugs) or *Murakkab Dawa* (compound formulation of crude drugs). Unani medicine pre supposes that drug also have their own temperament. Appropriate drugs should be selected when treating the all diseases including *Warm e Meda* by considering the *Mizaj* of

the stomach of an individual and *Mizaj* of the drug. The following *Mufrad* and *Murakkab Dawa* are helpful in the effective treatment of *Warm e Meda* (Table 01).

**Table 01: *Mufrad* and *Murakkab Dawa*, which are helpful in the effective treatment of *Warm e Meda***

| Single drug | Pharmacological actions |
|---|---|
| *Althaea officinalis* Linn (*Khatmi*). | Anti-inflammatory, Demulcent, Emollient, Mucilaginous [9,10,11] |
| *Alpinia galanga* (Linn.) Willd (*Khulanjan*) | Anti-Ulcer, Stomachic[4,14] |
| *Aloe barbadensis* Mill. (*Elva*) | Anti-inflammatory, Anti-oxidant, Anti-microbial[4,14,15] |
| *Onosmabracteatum* (*Gaozaban*) | Anti-inflammatory, Anti-microbial, Anti-Ulcer [4,15,16] |
| *Glycyrrhiza glabra* Linn. (*Asl-us-soos*) | Anti-inflammatory, Astringent, Anti-Ulcer, Demulcent[17] |
| *Withania somnifera* (Linn.) Dun. (*Asgand*) | Anti-bacterial, Astringent, Anti-oxidant[18] |
| *Zingiber officinale* Roscoe (*Adrak*) | Anti-inflammatory, Anti-oxidant[4,19] |
| *Phyllanthus emblica* Linn. / *Emblica officinalis* Gaertn. (*Amla*) | Anti-inflammatory, Anti-oxidant[20] |
| *Curcuma longa* (*Haldi*) | Anti-inflammatory, Anti-oxidant[21,22] |
| *Asparagus racemosus* Willd (*Satawar*) | Anti-ulcer[4,26] |
| *Acacia arabica/nillotica* Willd (*Samagh-e-arabi*) | Anti-oxidant, Astringent, Demulcent[27] |
| *Myristica fragrans* Houtt (*Jaiphal*) | Anti-oxidant, Anti-microbial, Anti-stress[28] |
| *Bambusa arundinacea* (Retz.) Roxb. Syn.: *B. bambos Voss* (*Tabasheer*) | Cooling, Anti-ulcer, Anti-inflammatory, Anti-oxidant[29] |
| *Pistacia lentiscus* Linn. (*Mastagi*) | Anti-inflammatory, Stomachic[4] |
| *Coriander sativum* (*Kashneez*) | Anti-inflammatory, Analgesic, Astringent[30] |
| *Santalum album* (*Sandal e Sufaid*) | Cooling, Analgesic[4,23] |
| *Rosa damascene* (*Gul e Surkh*) | Cooling, Anti-inflammatory, Analgesic [23] |
| *Nigella sativa* Linn. (*Kalonji*) | Anti-inflammatory, Anti-oxidant, Anti-bacterial, Analgesic[24] |
| *Androgrphis panniculata* Wall (*Bhui neem*) | Anti-inflammatory, Anti-microbial[4,25] |

Further there are several *Murakkab Dawa* (compound drugs) are used in the treatment of *Warm e Meda*. They are; *Murabba Zanjabeel, Jawarish Kamooni, Jawarish Mastagi, Jawarish Ood-e- Shirin, Jawarish Ood-e- Tursh, Habb-e-Tursh, Safoof Hazim, Jawarish Anarain, Sharbat Anar, Majoon Dabidul Ward, Habb-e- Hilteet, Majoon Zanjbil, Qurs Satawari, Itrifal Aftimoon, Sharbat Unnab, Khammeera Sandal,* and *Mufarreh Ahmadhi*[3,4].

## Conclusion

*Warm-e-Meda* is one of the commonest problem among the community. In Unani system of Medicine, the diseases related to *Meda* are well described and well understood. Unani scholars have contributed towards the information of strength and ailment of *Meda.* There are several treatment modalities are mentioned by Unani scholars to treat *Warm e Meda*. It could be prevented by maintaining the equilibrium of *Asbab-e-Sith-e-Zarooriya* with effective *Ilaj bil Ghiza* and *Ilaj bil Dawa.* This study validated the concept, aetiopathogenesis and management of *Warm e Meda* (gastritis) clearly.

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# Traditional medicinal benefits of *Caryota urens:* A review article

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## Abstract

*Caryota urens* which belongs to the Palmae family is used as a food, beverage, fiber, timber and for ornamental purposes in Sri Lanka. Jaggery and treacle made out from *Caryota. urens* is very abundantly used in the Sri Lankan communities since a long ago. Even though its usage as a food article has been broadly described in many instances, its medicinal usage has not been mentioned clearly with regard to Traditional Medicinal aspects of Sri Lanka. The aim of this paper was to review the relevant literature from authentic texts in Traditional Medicine such as Ayurveda pharmacopoeia, *"Deshiya chikitsa samgrahaya"* and *"Osuthuru wisithuru"* as well as published research articles in the data bases such as Science direct, PubMed and Google scholar to provide a summary on potential medicinal benefits of *Caryota urens*. The results revealed that the used parts of this plant are leaves, bark, root bark, flowers as well as toddy and starch. It gives beneficial health effects such as anti-microbial, anti-oxidant, anti-inflammatory, anti-parasitic, anti-cancer and analgesic properties. The most common herbal preparations made out from this plant were herbal gruel and *"Basna"* (A nutritional preparation specific to Sri Lankan traditional medicine). Apart from that, the use of *Caryota. urens* in diseases such as diarrhea, parasitic infestations, anemia, jaundice, burning sensation was also identified through this review. It can be concluded that *Caryota. urens* is a functional herbal food and herbal ingredient which has many favorable health effects and further studies will be needed to determine these effects thoroughly.


**Keywords:** *Caryota urens*, Medicinal properties, Functional food, Traditional Medicine

## Introduction

*Caryota urens* (*C. urens*) is a palm tree, which belongs to PALMAE family. This plant is native to Sri *Lanka*, India and Nepal[1]. This tree was first observed in Cambodia[2]. *C. urens* is traditionally tapped for sap from which sweet syrup (treacle), sugar (jaggery) and alcoholic beverages (toddy) are prepared. The treacle and jaggery are highly valued for culinary purposes in Sri Lanka3. *C. urens* is a tall unarmed, trunk which is 13 - 20m tall and 0.3m in diameter, cylindrical, annulated, flowering when full grown from axils of leaves begin with the upper and the thence successively downward, leaves large, flowers crowded[4]. As synonyms for *C. urens* in different languages, *"Krushna kanthu, Sthulathala"* is used in Sanskrit, *"Heenthala"* is used in Hindi and *"Tobby palm, Jaggery palm"* is used in English and locally it is known as *"Kithul"*. Chemical composition of *C. urens* is palm sugar content of the flower juice (*Meera*)[1]. *C. urens* is a plant which has a great nutritional as well as a medicinal value. When it comes to functional food, the most important are *Kithul* flowers obtained from the *Kithul* tree, especially prepared *Kithul* treacle, jaggery and flour. The medicinal components here are fermented toddy, treacle, jaggery and flour obtained from flowers (*Meera*), bark and roots.

Considering its medicinal value, it stimulates appetite[6]. This improves the digestive energy and also helps in the improvement of *Agni* (digestive fire) and relives constipation and facilitates

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defecation[6]. The root bark and the cabbage of the palm are used for the treatment of rheumatic swellings and snake- bite poisoning[4]. The inflorescences are tapped for toddy, treacle and jaggery made from it. The wood is used for building purposes. The pith yields starch which is eaten. Commercially *Kithul* fiber is produce by using leaves of the tree[4]. The cabbage of this palm before flowering is a food for elephant. It is used medicinally for gastric ulcers[4]. The root is employed for tooth ailments and the bark and seed on boils and the tender flowers for promoting growth of hair[4]. Several research studies have emphasized the pharmacological actions or beneficial health effects of *C. urens* such as anti-inflammatory, anti-oxidant, anti-microbial, anti-diabetic and anti-cancer properties.

The aim of this review was to provide a comprehensive summary of pharmacological actions, medicinal benefits and traditional medicinal formulae of *C. urens.* Those preparations which are available in Traditional texts play a major role in the treatment of various kinds of diseases. Therefore, it is important to review medicinal aspect of *C. urens* for future treatment as it will be a great subscription to healthcare system. Because the proper usage of this plant can be used as a remedy for many ailments, it would be beneficial for the people in the society to get a clear view about the therapeutic properties of *C. urens* and the disease conditions which it can be used for, in order to get rid of them. Therefore, this research was conducted with the aim of discovering the formulae and regarding the above-mentioned facts by using both Ayurveda and western medicinal approaches.

## Methodology

### *Method of data collection*

This review was conducted by using Sri Lankan authentic traditional texts such as *"Deshiya chikithsa samgrahaya", "Aushda samgrhaya"* to find out the *Kithul* containing medicinal formulae mentioned in traditional texts and to identify the composition, mode of administration and indications of *Kithul* from above mentioned formulae. Further published articles which report about the medicinal effects of *C. urens* were searched and a comprehensive review was conducted by using the data bases; Pub Med, Science direct and Google scholar for studies published regarding *C. urens.* The search terms used were *C. urens,* medicinal properties, nutritional properties and health benefits. Only the studies published in English language were considered in the electronic data bases. Apart from that, relevant texts and internet sources were also used for the purpose of gathering necessary facts about *C. urens* plant. Interpreted data were presented in scientific methods by using tables etc.

## Results

### *Results of traditional authentic texts*

Several indications mentioned according to its used parts were identified by observing traditional authentic texts such as *Deshiya chikithsa samgrahaya, Aushada samgrahaya, Osuthuru wisithru*.

### *Indications according to the used part of Caryota urens*

The collected data revealed that, various used parts of *C. urens* were mostly used for snake venom, *Pandu* (Anemia), *Kamala* (Jaundice) and in *Pitta doshic* involvement. It was also revealed that *Kithul* treacle and *Kithul* jaggery are most commonly used for these preparations. Table 01 shows the traditional medicine indications of *C. urens* according to its used part.

### *Caryota urens containing formulae mentioned in traditional authentic texts*

Sixteen medicinal formulae were found which containing *Kithul*. Among these formulae, *Basna* (A nutritional preparation) is the most abundantly mentioned preparation mode and *Kithul* treacle and jaggery are widely used for these preparations. All the formulae are used as internal preparations (Table 02). Figure 01 shown the pharmacological action of *C. urens.*

**Table 01: Traditional medicine indications of *Caryota urens* according to its used part**

| Used part | Indication |
|---|---|
| Leaves | Burning sensation, General weakness[5] |
| Bark | Grind the bark and take the juice. Pour into the ear – relives earache[6] |
| Root bark | For rheumatic swelling snake bite poisoning[4] |
| Seeds | Boils[4] |
| Flower | Promotes hair growth (tender flowers)[4] |
| Treacle | *Kamala* (Jaundice)[7] |
| Jaggery | *Pandu* (Anemia), *Kamala* (Jaundice), *Rathpita* (Bleeding from various parts of the body)[7] |
| Cabbage | For rheumatic swelling snake bite poisoning, Gastric ulcers[4] |
| Toddy | Constipation, Increase digestive power[2] |
| Starch | Hemorrhoids[6] |

**Table 02: *Caryota urens* containing formulae mentioned in traditional authentic texts**

| Type of the preparation | Formulation | | | Indication |
|---|---|---|---|---|
| | Ingredients | Method | Mode of administration | |
| Gruel[8] | *Mussenda (Mussaenda frondosa)* leaves, *Bakmi (Nauclea orientalis)* bark, *Hathawariya (Asparagus racemosus)* tuberous roots, | Take the juice extract (*Swarasa)* of these ingredients and add *Hinati hal* (Traditional rice variety) and prepare gruel. Take this with ***Kithul* jiggery** | Use this day and night for three days | *Pandu* (Anemia) *Kamala* (Jaundice) |
| Gruel[8] | *Yakinaran (Atalantia ceylanica)* leaves | Prepare a gruel and take it with ***Kithul* jiggery** | | *Pandu* (Anemia) *Kamala* (Jaundice) |
| Beverages [8] *(Paana)* | Lime juice, water of *Mung* bean (Green gram), King coconut water, ***Kithul* treacle** | Boil these ingredients | Use two tablespoon day and night | *Kamala* (Jaundice) |
| *Thala Behetha*[9] | *Sadikka (Myristica fragrans), Karabuneti (Syzygium aromaticum), Vasavasi* - Mace *(Semen myristicae), Thippili (Piper longum), Sududuru (Cuminum cyminum), Kaluduru (Nigella sativa), Dewadara (Cedrus deodara), Kothaburu (Coriandrum sativum),* | Grind the all ingredients and take fine powder. Separate into 14 parts. | Use this day and night for one week. Use it with Cow's milk | *Pandu* (Anemia) *Kamala* (Jaundice) *Rathpita* (Bleeding from various parts of the body) *Prameha* (Diabetes) *Shotha* |

| | | | | |
|---|---|---|---|---|
| | *Welmi (Glycyrrhiza glabra):* *Kalan* 1 (5g) of each ingredient<br>Red Onion*: Kalan* 9 (45g)<br>***Kithul* jaggery:** *Kalan* 10 (50g)<br>*Kalu thala* (Black sesame seeds)*:* 960ml | | | (Edema)<br>*Arshas* (Piles) |
| *Virekaya* [10] (Purgative) | *Detta (Boehmeria nivea) ala, Aralu (Terminalia chebula), Bulu (Terminalia bellirica), Nelli (Phyllanthus emblica), Maduru (Fructus Foeniculi), Jayapala (Croton tiglium): Kalan* 01 (5g)<br>*Siyabala (Tamarindus indica) bora* (juice): *Kalan* 03 (15g)<br>*Thirasthawalu (Operculina turpethum): Kalan* 7 (35g)<br>***Kithul* jaggery*:*** *Kalan* 16 (80g) | Grinding all ingredients and make a pill | Use in the morning | *Pandu* (Anemia) |
| *Yabora Lehaya* [11] | *Yabora* (Iron preparation), *Inguru (Zingiber officinale), Gammiris (Piper nigrum) Thippili: Paln* 1 (60g)<br>***Kithul* jaggery*:*** *Palan* 2 (120g)<br>*Kikirindiya (Eclipta prostrata)* juice*: Mana* 1 (480 ml) | Make a paste and use | | *Pandu* (Anemia) |
| *Yahunu Lehaya (I)*[11] | *Kikirindiya (Eclipta prostrata) juice: patha* 1 (240ml)<br>*Uk (Saccharum officinarum)* **treacle***: patha* 1 (240ml)<br>*Cow's milk: Mana* 1 (480ml)<br>***Kithul* jaggery*:*** *Palan* 3 (180g)<br>Sesame oil*: ½ Patha* (120 ml)<br>*Yahunu: Karsha* 1 (15g)<br>***Kithul* jaggery*:*** *Palan* 3 (180g)<br>Sesame oil*: ½ Patha* (120 ml)<br>*Yahunu: Karsha* 1 (15g) | Cook it until it comes for thick paste like semi-solid (*Leha padama)* | | *Pandu* (Anemia) |

| | | | | |
|---|---|---|---|---|
| *Yahunu Lehaya (II)*[11] | *Kikirindiya (Eclipta prostrata), Kalu Uk (Saccharum officinarum)* **treacle***: Mana* (480ml) Cow's milk: *Neli* 1 (960ml) ***Kithul* jaggery*:*** *Palan* 7 (420g) Sesame oil: ¼ *Patha* (60ml) *Yahunu: Karsha* 6 (90g) | Cook it until it comes for paste like semi-solid (*Leha padama)* | | *Pandu* (Anemia) *Shotha* (Edema) |
| *Puhul Basna*[12] (A nutritional preparation) | ***Kithul* Treacle**, Coconut Treacle. Lime juice: 2 bottles Ginger Juice: 1 bottle *Yabora: Kalan* 36 (180g) | Took an ash gourd and cut a piece from top (lid). Remove the flesh inside and filled with ingredients. Replaced the lid and covered the fruit with layer of mud. Leave beside a hearth for 5 days | Filter the juice and use | |
| *Maha Basna*[12] | Juice of *Kapu (Gossypium arboreum)* leaves and, Tamarind leaves, *Kikirindiya (Eclipta prostrate)* juice: *Patha* 1 (240ml) Lime juice and orange juice, ***Kithul* Treacle,** Coconut Treacle, *Uk (Saccharum officinarum)* **treacle**, Bee honey: *Patha* ½ **(**120ml) *Aralu (Terminalia chebula), Nelli (Phyllanthus emblica), Inguru (Zingiber officinale), Gammiris (Piper nigrum), Thippili (Piper longum), Sadikka (Myristica fragrans), Karabuneti (Syzygium aromaticum), Vasavasi- Mace (Semen myristicae), Garlic, Sududuru (Cuminum cyminum), Kaluduru (Nigella sativa), Wada kaha (Acorus calamus), Welmi (Glycyrrhiza glabra), Asamoda (Trachyspermum roxburghianum) , Kottam (Saussurea costus),Kottamalli (Coriandrum sativum), Yahunu , Yabora : Kalan 1(5g) of each ingredient* | Took an ash gourd and cut a piece from top (lid). Remove the flesh inside and filled with ingredients. Replaced the lid and covered the fruit with layer of mud and buried under ground. Give heat for 2 days. | Use this day and night for one week | Fever, Constipation, Headache, *Ashmari*, (Calculi) *Pittaja Pandu*, (Anemia) *Daha*, (Burning sensation) *Shotha*, (Edema), *Vata raktta Brama* (Dizziness) *Anaha*, (Distention of abdomen) |

| | | | | |
|---|---|---|---|---|
| *Yusa Basna* [12] | Juice of *Kapu (Gossypium arboreum)* leaves and, Tamarind leaves, Lime juice: *Nali* 1 (960ml) *Sududuru (Cuminum cyminum), Kaluduru (Nigella sativa), Nelli (Phyllanthus emblica), Thippili (Piper longum), Asamoda (Trachyspermum roxburghianum), Sadikka (Myristica fragrans), Karabuneti (Syzygium aromaticum), Vasavasi* – Mace *(Semen myristicae) : Kalan* 1(5g) of each ingredient ***Kithul* jaggery** | Put all ingredients into a pot and sealed it with mud and buried under ground for 3 days. Give heat. | | *Pandu* (Anemia) *Rathpita* (Bleeding from various parts of the body) |
| *Ra Bassna* [12] | *Ra* (toddy*): Neli* 02 (1960ml) Lime juice: *Mana* 01 (480ml) ***Kithul* jaggery:** *Palam* 1 (60g) *Yahunu: Palam* 1 (60g) *Kaluduru (Nigella sativa) : Palam* 1 (60g) | Put all ingredients into a pot and sealed it with mud and buried under ground for 3 days. Give heat. | | *Pandu* (Anemia) |
| *Dehi Bassna*[12] | Lime juice, Ginger juice, Bee honey, **Kithul jaggery,** *Uk (Saccharum officinarum)* **treacle**: Patha 1 (240ml) *Welmi (Glycyrrhiza glabra), Sahinda lunu; Kalan* 1 (5g) | Took an ash gourd and cut a piece from top (lid). Remove the flesh inside and filled with ingredients. Replaced the lid and keep it in water container. | Use this for 7 days | *Pandu* (Anemia) *Shotha* (Edema) *Prameha* (Diabetes) |
| Beverages *(Paana)*[13] | *Siyabala kola: Kalan* 12 (60g) *Aralu (Terminalia chebula) Kalan:* 3 (15g) *Gole pethi: Kalan* 3 (15g) Water*: Neli* 2 (1920ml) | Took all ingredients and boil into 1 *Neli* (960 ml) and filter. Then add 64 *Kalan* (320g) of sugar, ***Kithul* jaggery,** tamarind juice. Stir well and boil again. When in use add some sahinda lunu | Use for 4 times | *Pandu* (Anemia) *Shotha* (Edema) *Udara* (Distention of abdomen) |
| Beverages *(Paana)*[13] | *Aralu (Terminalia chebula), Inguru (Zingiber officinale), Karunka puwak: Kalan* 4 (5g) Tamarind: *Kalan* 12 (60g) Water: *Mana* 1 (480ml) | Took all ingredients and boil down 4*mana* of water in to 1 *mana*. Then add; ***Kithul* jaggery:** *Kalan* 6 (30g), Tamarind juice: *Kalan* 4 (20g), *Sahinda lunu: Kalan* 2 | | *Pandu* (Anemia) |

***Pharmacological actions of C. urens according to modern science (Figure 01)***

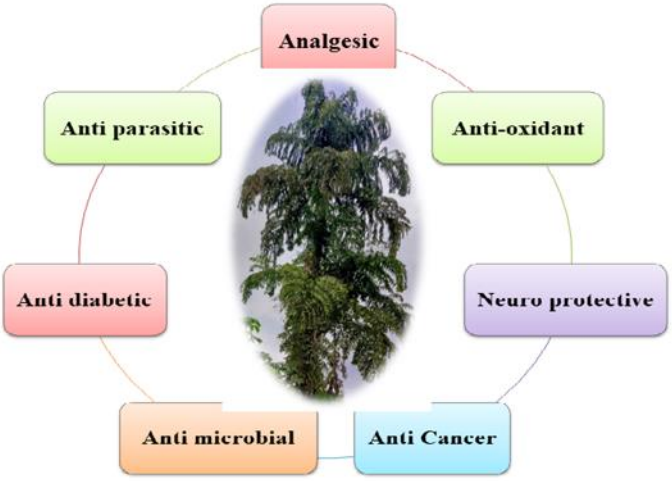


**Fig. 01: Pharmacological action of *Caryota urens***

***Anti-inflammatory properties***

*Balaji* et al. investigated the anti-inflammatory effects of *C. urens* by evaluating the Nitric Oxide (NO) production mediated by Inducible Nitric Oxide Synthase (iNOS) and revealed that the hydroalcoholic leaf extract of *C. urens* (CULHA) can be developed as a new therapeutic agent against inflammatory diseases[14]. Sujitha *et. al.* investigated if the active constituents of *C. urens* leaf hydro alcoholic extract (CULHA) umbelliferone and rutin has the ability to inhibit rheumatoid arthritis by blocking TNF-alpha and the results suggested that the presence of rutin and umbelliferone in *C. urens* could be responsible for its anti-inflammatory activity[15].

***Anti-oxidant properties***

The anti-oxidant properties of *C. urens* was investigated by Ananth *et. al.* revealed that the antioxidant activity of immature fruit and leaf extracts yielded high activity when compared to its fruit skin and the bioactive compounds of *C. urens* could be attributed to its anti-oxidant properties[16]. *Sharmin* et al. evaluated the anti-oxidant activity of fruit extract of *C. urens* by using the total phenolic content and the results showed that its fruit extract consists of a significant anti-oxidant activity[17].

***Anti-microbial effects***

Ananth *et. al.* demonstrated the anti-bacterial activities of *C. urens* against the tested pathogens *E.coli, Vibrion cholerae, Salmonella typhii, Staphylococcus aureus* and *Shigella flexneri* and stated that fruit skin and immature fruit of *C. urens* exhibited strong anti-bacterial activities than leaf [18]. The antimicrobial activity of *C. urens* samples was analyzed against five gram positive and eight-gram negative bacteria by using the disc diffusion method by Sharmin *et. al.* revealed that among all the samples, the largest zone of inhibition (13.0 mm) against *Shigella dysenteriae*[19].

***Anti-parasitic effects***

A study was undertaken to assess the larvicidal potential of *C. urens* against dengue vector *Aedes aegypti. (A. aegypti)*. For that purpose, the larvicidal activity of methanol leaf extracts of *C. urens* at various concentrations was studied by *Vanaja* et al. and the results revealed that *C. urens* can serve as a potential larvicidal agent against the dengue vector *A. aegypti*[20].

***Anti-diabetic effects***

Ferreres *et. al.* demonstrated the anti-diabetic properties of inflorescence extract of *C. urens* and suggested that *C. urens* inflorescences can support the development of new functional foods with α-glucosidase inhibitory activity[21]. Anti-diabetic properties of *C. urens* flour was estimated by Wimlasiri *et. al.* by making use of alpha amylase and alpha glucosidase enzyme inhibition assays and they stated that it did not contain marked anti-diabetic properties[22].

***Anti-cancer properties***

The potential cancer chemo preventive action of *C. urens* and *C. mitis* was evaluated by El-Akad *et. al.* by analyzing the leaf and fruit metabolites of both varieties[23].

***Neuro protective effects***

A study was carried out by Ravindran to prove the memory enhancement and cognitive effect of *C. urens* on Alzheimer's induced mice using various memory retention experiments such as Y maze, Morris water maze, Passive avoidance etc. and it was concluded that *C. urens* possesses a remarkable

effect in memory enhancement in Alzheimer's disease[24].

***Analgesic effects***

Patel *et. al.* analyzed the *C. urens* methanol extract of leaves for giving the analgesic effect by using the Hot plate method and Tail flick method. Their results suggested that *C. urens* extracts showed the presence of phytosterols, tepenoids, tannins, flavonoids and phenolic compounds which has been responsible for the analgesic effect[25].

***Effects on lipids***

Ranasingha *et. al.* examined the effect of *C. urens* treacle on serum lipid profile using Wister rats by making use of Randox test kits to calculate Total Cholesterol (TC), High Density Lipoprotein (HDL) and Triglyceride (TG) contents in serum and Friedewald equation to calculate Low Density Lipoprotein (LDL) content. The results revealed that treacle has a significant beneficial effect on serum lipid profile[26].

## Discussion

*Caryota urens (Kitul)* is a palm tree. In general, even though it is common that palm trees do not have much of a medicinal value, when thoroughly researched, coconut, *Thal* palm as well as *Kitul* offer many medicinal benefits. *C. urens* is one of the most important multipurpose medicinal plants. Each part of the plant has some important medicinal value.

According to the collected data *C. urens* has widely used for the treatment of *Pandu* (anemia), *Kamala* (Jaundice) and in Diseases occurs due to vitiated *Pitta dosha* such as *Daha* (burning sensation), *Brama* (dizziness), *Rathpita* (bleeding from various parts of the body) etc. Considering the properties of *C. urens*; *Madura rasa* (sweet taste) improves the *Rasa* (essence part soon after digestion), *Raktha* (blood), *Mansa* (muscle), *Meda* (fat), *Asthi* (bone), *Majja* (bone marrow) and *Ojas* (essence in every tissue). It has *Balakaraka* (improves the strength of the body) and *Bhagna sndhanakara* (heal the fractures) actions as well. Considering the *sheetha veerya* (cold potency), it helps to pacify the *Pitta dosha*. Altogether all the properties contribute to pacify the *Pitta* and *Vata dosha* and provide strength to the body. *C. urens* has anti-microbial, anti-parasitic, anti-oxidant, anti-inflammatory, anti-cancer and analgesic properties. In addition, it seems to lower blood glucose and serum cholesterol levels while giving neuro-protection actions too. It acts on different systems of the body in numerous ways which aids in relieving plenty of diseases such as diarrhea, migraine headaches, snake bite poisoning, rheumatic swellings, Alzheimer's disease etc.

## Conclusion

Therefore, it can be concluded that *C. urens* is a plant very much useful in the traditional medicine in order to alleviate from many diseases and furthermore it is a valuable natural source which can be used to obtain multiple therapeutic effects in curing and the prevention of diseases. It is an effective food article and a medicinal drug which can be used by the people in all the ages.

## Recommendations

Further clinical and experimental studies need to be carried out to evaluate the efficacy of therapeutic potentials in Sri Lankan traditional medicinal use of *C. urens* in the health care system.

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# Study on the bioavailability enhancers used in Unani formulations in the light of recent pharmacological advances: A review

**Farwin M.F.F.*, Mawjood A.H.M.**

## Abstract

Since ancient times herbal formulations have been used with promising efficacy. However, at present, they suffer from poor bioavailability due to poor absorption resulting in poor efficacy. This is mainly due to the role of supportive ingredients being either being ignored or neglected. This study is focused on the bio-enhancing property of the supportive ingredients. Unani classical texts, Pharmacopoeias and research articles were thoroughly reviewed with regard to Bioenhancers used in formulations commonly used in Unani. The main objective of this review is to understand the concept of bioavailability, identify supportive ingredients (*Mufrad Dawa*) to enhance the bioavailability and to promote the use of authentic supportive ingredients in compound medicines. It was found that the supportive ingredients in combination with an active drug lead to the potentiation of the main therapeutic moiety of the drug. A *Murakkab Dawa* (compound medicines) contain supportive ingredients which improve the bioavailability of the active ingredient thus, resulting in promising efficacy. This review explores the *Mufrad Dawa* in compound formulations in various Pharmacopoeias for ingredients like *Fil fil e siyah, Fil fil e daraz, Zanjabeel* with bio potentiation action. These drugs are *Garam vo Khushk* (hot and dry) in temperament with characteristic tastes like pungent, sour and salty attributed with heating property and possess actions of *Muqawwi e Hazim* (digestive tonic), *Muqawwi e Medha* (stomachic), *Kasirriyah* (carminative) etc; These supportive ingredients act collectively and synergistically to overcome the poor absorption of the active therapeutic moieties to increase the active moiety in blood enhancing the therapeutic effects which helps in minimizing the doses, side effects and shorten the period of treatment.

**Keywords**: Bio-enhancers, *Murakkab Dawa, Muqawwi e Medha, Muqawwi e Hazim.* Supportive Ingredients.

## Introduction

Indigenous Systems of Medicine have been playing a major role in preventing and effecting cure for a number of diseases since ancient times. These systems of medicine possess a large number of herbal medicinal products with promising efficacy. As a result, the use of herbal medicinal products has increased tremendously over the last few decades. However, many of these herbal medicinal products do not show promising effect as expected mainly due to poor absorption resulting in poor bioavailability of their active components[1,2,5].

Bioavailability is the rate and extent at which the active drug ingredient or therapeutic moiety is absorbed from the drug product and becomes available at the site of action[3,4]. In general, the drugs administered orally are poorly bioavailable as they readily undergo first pass metabolism. Therefore, modern medical sciences have developed various strategies and introduced a wide range of dosage forms to improve the bioavailability of poorly absorbed drugs. This shows that the bioavailability of a drug is principally determined by the property of the dosage form augmented by technology[5,7].

In the Unani System of Medicine, the property of the *Murakkkab Dawa* or dosage form mainly depends on the ingredients it consists of. A prescription of a *Murakkab Dawa* (compound medicine) usually incorporates several supportive

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views to improve the bioavailability of the active ingredient or therapeutic moiety of the formulation when they are given in the form of *Murakkab Dawa*. As a result, it is believed that the property of a Compound Medicine or the combined effect of its supportive ingredients play an important role in the absorption of the principal drug/s after the administration and thus increasing the active moiety or moieties of the *Murakkab Dawa*. In this context, the Unani System of Medicine possesses a treasure of empirically designed and developed drug combinations (*Murakkab Dawa*) that provide amazing therapeutic effects.

However, in the recent past, the substitution of supportive ingredients with low quality drugs or preparing compound medicines without supportive ingredients has become common practice. This has become a major impediment in producing effective compound medicines and thus, the compound medicines lose their effectiveness[1,5,8].

Consequently, it is essential to identify the supportive ingredients that act as bioenhancer/s in *Murakkab Dawa* and how those ingredients contribute to absorption and higher bioavailability of the active moiety or moieties in order to accomplish valuable insights into the fascinating role of the supportive ingredients incorporated into those *Murakkab Dawa.*

Therefore, this study was conducted to understand the traditional (Unani / Ayurveda) wisdom of substances in enhancing bioavailability through modern phenomena. And the specific objectives of this study were, to explore the concepts of bioavailability to achieve better therapeutic responses in Unani Compound medicines, to identify effective ingredients (*Mufrad Dawa*) used to enhance the bioavailability and to promote the use of authentic supportive ingredients in compound medicines.

***Unani concept on Bioenhancers used in compound medicines (Murakkab Dawa)***

In the Unani system of medicine, dosage forms have been designed to contain one or more herbs (ingredients) in specified quantities to provide intended benefits meant to treat, mitigate diseases of human beings and or to alter the physiological function of the body. Further, personalized medicines are prepared or designed for individual patients in terms of the Unani concept. Therefore, *Murakkab Dawa* developed by ancient *Hakeems* seems to have been prepared according to the Unani concept in order to produce surprising results.

The effectiveness of a compound medicine mainly depends not only on the main ingredients but also on the supportive ingredients incorporated in them[2,6,7]. Further, supportive ingredients minimize the side effects of medicines and increase the therapeutic efficacy of medicines. Therefore, it is apparent that supportive ingredients play a major and important role to make compound medicine more effective.

*Murakkab Dawa* (compound medicines) used in Unani system of medicine incorporate many supportive ingredients which act as bio-enhancers that determine the bioavailability of drugs. As a result, the bioavailability and therapeutic efficacy of *Murakkab Dawa* are still high due to the incorporated drugs or substances in them. These intrinsic Bio enhancers have been used in *Murakkab Dawa* since time immemorial. Meanwhile, in certain occasions, medicines are administered with a suitable vehicle with a view to increasing the effectiveness of the medicines through smooth proper transport of the medicine to the site of action[6].

A prescription of a *Murakkab Dawa* usually consists, in addition to main ingredient/s, one or more ingredients to aid absorption and deliver to the site of action. Therefore, the drugs that enhance the function of the stomach function to optimal level through their inbuilt properties are widely found in the Unani formulation (*Murakkab Dawa*). According to the Unani system of medicine, the drugs that possess the actions of *Muqawwi e Meda* (stomach tonic) strengthen and improve the function of the stomach.

They are identified as *Advia e Khareef* (pungent taste drugs), *Advia e Murriya* (bitter drugs) and *Advia e Khusbudar* (fragrant drugs). *Advia e Khareef* increases the power of digestion and absorption by strengthening the stomach through

their *Garami* or Hot properties. *Advia Murriya* act as bitter tonic and improve the stomach function through their bitterness and *Advia e Khusbudar* give pleasant odour and act as gastric tonic. In addition, *Muqawwi e Jiger* (liver tonic) drugs strengthen and correct the functions of the liver. These functions are performed by liver through *Quwwat e Hazima* (power of digestion), *Quwwat e Jaziba* (power of absorption), *Quwwat e Masika* (power of retention) and *Quwwat e Dafiya* (power of excretion).

In the meantime, some *Advia e Khareef* (hot spices) improve the digestion and absorption in the stomach partly by increasing the blood supply to the intrinsic vessels and thus resulting local vasodilatation which, in turn, enhance the bioavailability of the other drugs administered along with them. It has also been established that hot spices increase the transfer of therapeutic moieties or chemical substances across the gastrointestinal wall. Further, *Quwwat e Masika* (power of retention) and *Quwwat e Dafiya* (power of excretion) of other organs regulate the duration of activity of a particular drug without being affected by the rapid excretion through the kidneys or by sweating. Therefore, *Garam vo Khushk* mizaj drugs such as *Piper nigrum, Piper longum, Zingiber officinale, Carum carvi, Cuminum cyminum* and *Curcuma longa* are widely used.

***Bio enhancers in Ayurveda***

To achieve maximal effect of the drug Ayurveda formulations also generally incorporate *Yogvahi* (bioenhancers). It has been found that when these *Yogvahis* combined with an active drug they enhance the bioavailability of that drug at the site of action and potentiate its pharmacological effect[6]. To perform these actions, the hot potency (*Ushna veerya*) drugs such as *Piper nigrum*, *Piper longum*, and *Zingiber officinale* are used as *Yogvahi*. All these drugs increase the *Jathargni* (digestive fire or digestive power) located in the stomach. *Jathargni* is the *Agni* that is responsible for digestion, absorption and assimilation of drugs into more subtle substances which enters into the systemic circulation to exert the therapeutic effect[9]. In addition, these drugs are *Katu* (pungent), *Amila* (sour) or *Lavana* (salty) in taste and these tastes are composed of *Agni*[10,25]. They also have actions like *Deepana* (digestive), *Sookshma* (entering deep and minute channels), *Teekshna* (piercing), *Grahi* (absorbent), *Rochaka* (appetizer) etc; which helps to promote digestion, improve blood circulation and enhances absorption[11,12,13].

***Properties of drugs that act as bioenhancers***

- They are mostly *Garam vo Khushk* mizaj.
- They should be *Muqawwi e Hazim.*
- They are aromatic and impart flavour to the drug.
- It mostly possesses pungent, sour, salty or Bitter taste.
- It should be effective at very low concentrations.
- It should enhance the activity of the drug molecule[1,6,8]

***Possible mechanism of action of bioenhancers***

Different bio enhancers may have the same or different mechanism of action.

- Promoting the absorption of the drug from the gastrointestinal tract.
- Reduction in the hydrochloric acid secretion and increase in the gastrointestinal blood supply.
- Inhibiting or reducing the rate of bio transformation of the drugs in the liver or intestines.
- Inhibition of gastrointestinal transit, gastric emptying time and intestinal motility.
- Modifying the immune system in such a way that the overall requirement of the drug is reduced substantially [1,5]

***Benefits of bioenhancers***

Bio enhancers offer a comfortable, convenient, non-invasive way to administer drugs with the following advantages [6,8]

- Increased bioavailability.
- Reduced adverse drug reactions or side effects.
- Increased efficacy.
- Reduced drug dosage.

## Methodology

### *Data collection*

Pharmacopoeias (*Qarabadeens*) such as Unani Pharmacopoeia (UP), Hamdard Pharmacopoeia of Eastern Medicine (HPEM), National Formulary of Unani Medicine (NFUM), Impcops, Pharmacopoeia of Hospital of Integrated Medicine (HIM) were thoroughly scrutinized to find out the *Mufrad Dawa* (single drugs) commonly used in compound formulations (*Murakkab Dawa*) which do not possess any direct therapeutic indication to the purpose for which those formulations are generally used. Basic principles in Pharmacology (5th edition) by Mcgraw HILL Saunders Elsevier and Text book of Industrial Pharmacognosy (1st edition) by A N Kalia (2006) were also thoroughly studied to exploit modern aspects of Bio enhancing techniques. Google scholar, PubMed, WebMD, Medscape and MEDLINE databases were used to search journal articles from which current research outcomes relating to bio enhancers used in pharmacological formulations in Unani and Ayurveda were collected. The search terms (Bioenhancers, single drugs used to enhance bioavailability etc.) were used without narrowing or limiting search elements. Only the research studies in the English language were considered in the review.

### *Study design*

As the issues of poor therapeutic effect of the drug combination after the administration due to poor bioavailability have been established by a number of clinical studies, the purpose of incorporating certain *Mufrad Dawa* (single drugs) commonly in the Unani *Murakkab Dawa* were studied in Unani Pharmacopoeias. The concept of increasing bioavailability in Ayurveda formulations was extracted from authentic texts. Research articles were studied for a better understanding of ingredients or substances (chemical entities) which are used in *Murakkab Dawa* and to correlate the traditional wisdom or empirical knowledge of Unani System of Medicine with modern strategies. The knowledge of this study would open a new vista to understanding the combination of several ingredients into a single entity. Clinical trials or the intervention therapy of selected drugs related to bio enhancers from journal articles were filtered. The journal articles from 2000-2018 were considered as eligible for this review.

### *Database analysis*

After collection the formulations in pharmacopoeias and reading materials were thoroughly scrutinized and filtered the *Mufrad Dawa* used to increase the bioavailability of compound drugs. Few of them are broadly described in this study. The final summary was formulated after a thorough reading of all reading materials.

## Discussion

In this study, five (5) Unani pharmacopoeias were scrutinized for effective *Murakkab Dawa* containing supportive ingredients in small quantities but they do not possess specific therapeutic effect as that of the main ingredient/s[14,15,16]. Approximately 180 Unani formulations that are supposed to hold a good efficacy in terms of Unani concept were randomly scrutinized from the Unani pharmacopoeias for their ingredients. Fifteen (15) ingredients were identified based on their role in the *Murakkab Dawa* as supportive ingredients that act as bio enhancers. Among these the following five ingredients were found to occur very commonly. Table 01 shows the presence of *Mufrad Dawa* (supportive ingredients) in *Murakkab Dawa*

**Table 01: Prescence of *Mufrad Dawa* (supportive ingredients) in *Murakkab Dawa***

| **Supportive ingredients (*Mufrad Dawa*)** | **Number of *Murakkab Dawa*** | **Percentage of prescence out of 180** |
|---|---|---|
| *Piper nigrum (Fil fil e siyah)* | 97 | 54 |
| *Piper longum (Fil fil e daraz)* | 58 | 32 |
| *Zingiber officinale (Zanjabeel)* | 94 | 53 |
| Total number of formulations | 180 | |

The above results showed that the supportive ingredients incorporated along with the main ingredient/s in almost all the *Murakkab Dawa* are used to enhance the bioavailability and thus the therapeutic efficacy is increased.

***Fil fil e Siyah (Piper nigrum) and its bio-enhancing effects***

*Fil fil e Siyah* (black pepper) (Figure 01) is the most commonly used *Mufrad Dawa* in many compound formulations. Black pepper acts as *Muqawwi e Hazim* (digestive tonic), *Muqawwi e Kabidi* (liver tonic), *Muhallil e Riyah Ghaleez* (anti flatulence) and *Muqawwi e Meda* (stomachic) in these *Murakkab Dawa*[11,21,22]. Black pepper is also *Haar-Yabis* (hot and dry) drugs in third degree in *Mizaj* (Temperament)[22,23].

According to Ayurveda texts, the Black pepper is pungent (*Katu*) in taste and pungent (*Katu*) in *Vipaka* (post digestive effect) which increases the *Pitta* in the stomach[25]. Further it is *Ushna veerya* (Hot) and it is a warming spice that has the qualities (*Guna*) like *Teekshna* (strong, piercing) and *Sookshma* (enters deep and minute body channels)[9,11,18].

Recent research studies reveal that Piperine (Figure 02), the main alkaloid in the *Fil fil e Siyah* (black pepper) possesses bio enhancing or bio potentiation properties. Therefore, piperine is very useful for lowering the dose profile and shortening of treatment. It also acts as a nutritional bioenhancer which enhances the bioavailability and absorption of nutrients by acting on the gastrointestinal tract [1,11,12].

**Fig. 01: *Fil fil e siyah***

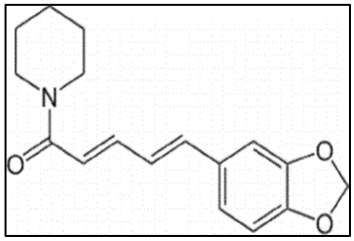


**Fig. 02: Piperine**

***Fil fil e Daraz (Piper longum) and its bio enhancing effects***

*Fil fil e Daraz* (Figure 03) is another important *Mufrad Dawa* incorporated in compound drug formulations. Long pepper acts as *Mushthahi* (appetizer), *Kasirriyah* (carminative), *Muqawwi e Meda* (stomachic), counter irritant in these *Murakkab Dawa* [22,23]. These actions favours the long pepper to be included as a bioenhancer. In addition, *Fil fil e Daraz* is temperamentally (*Mizaj*) considered as *Haar- Yabis* (hot and dry) drug in third degree (3˚)[22,23]. The hot property of the drug enhances drug absorption and digestion.

According to Ayurveda, long pepper is a drug of pungent (*Katu*) taste with hot (*Ushna*) properties [13,18,20]. Other properties of long pepper are *Deepani* (improves digestion and strength) and *Pittaprakopini* (slightly increases pitta). Because of the hot property and pungent taste, *Pitta* and *Agni* are increased leading to improved digestion (*Deepana*). These factors contribute to bio potentiation[13,24].

As in other pepper varieties, Piperine (Figure 02) is the active principle which is safe, and considered a natural and nutritive bio enhancer [1,12].

**Fig. 03: *Fil fil e Daraz***

***Zanjabeel (Zingiber officinale) and its bio enhancing effects***

*Zanjabeel / Adrak* (Figure 04) is also a very common drug incorporated in *Murakkab Dawa*. In those drug formulations, *Adrak* act as *Hazim* (digestive), *Kasirriyah* (carminative), *Muqawwi e Meda* (stomachic), *Mufatteh e Sudad e Jiger* (remove obstruction in liver), *Mushthahi* (appetizer) [19,22,23]. *Adrak* is *Garam 2˚* and *Khushk 1˚* (hot and dry) in *Mizaj* (Temperament) whereas, dried ginger (*Sont*) is *Garam 3˚*and *Dry 2˚* (hot 3˚ and dry 2˚)[22,23].

According to Ayurveda, Ginger is a *Katu rasa* (pungent taste) drug with an *Ushna veerya* (hot potency) which increases the *Agni* (Digestive power). It also possesses the properties of *Teekshna* (strong and piercing), *Rochaka* (appetizer), *Deepana* (digestive tonic) and balances *Kapha* and *Vata*. A special property seen in this herb is *Grahi* (absorbent) and bowel binding which is due to its hot property[9,18,20].

In modern contexts, ginger is said to have a powerful effect on GIT mucous membrane. *Zingiberene* which is a terpenoid and phenolic compounds like *Gingerol* regulates the intestinal function to facilitate absorption[11,18].

**Fig. 04: *Zanjabeel***

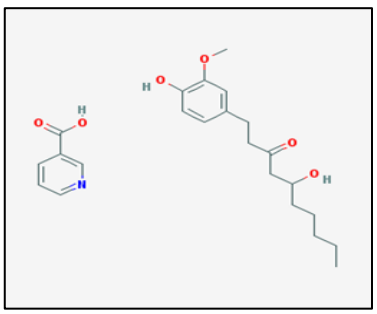

**Fig. 05: $C_{23}H_{31}NO_6$**

**Discussion**

***Drug absorption barrier***

After the administration, a drug must cross the epithelial barrier of the intestinal mucosa (Figure 06) for it to be transported from the lumen of the gut into the systemic circulation and exert its biological actions[5]. The structures of the intestinal epithelium serve as barriers to the transportation of drugs from the gastrointestinal tract to the systemic circulation. The membranes around epithelial cells are made of two layers of lipids containing proteins such as receptors and carrier molecules[1,26].

Drugs cross the lipid membrane by passive diffusion or carrier-mediated transport. In the meantime, the hydrophilic nature of the aqueous stagnant layer of the epithelium is the potential barrier to the absorption of drugs with water-soluble molecules. As a result, small water-soluble molecules pass easily through the aqueous channels within the proteins whereas molecules larger than about 0.4 nm encounter difficulty in passing through these aqueous channels[1]. Therefore, several strategies have been developed to enhance the intestinal absorption of the poorly absorbable drugs.

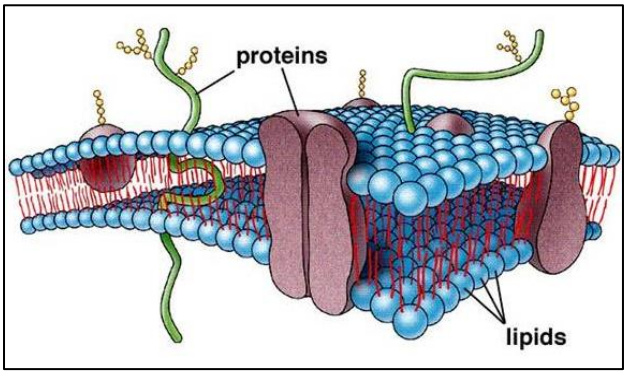


**Fig. 06: Plasma membrane of gut epithelium**

***Modern methods to enhance the absorption of Drugs***

***Absorption enhancers***

There are many substances that act as effective Absorption enhancers to improve the intestinal absorption, such as bile salts, surfactants, fatty acids and polymers. Bile, bile salts and fatty acids are surfactants which act as absorption enhancers by increasing the solubility of hydrophobic drugs in the

aqueous layer or by increasing the fluidity of the apical and basolateral membranes[1,4,26].

***Dosage form and other pharmaceutical approaches***

Utilization of permeability-enhancing dosage forms is one of the most practical approaches to improve the intestinal absorption of poorly absorbed drugs. There are various dosage forms such as liposomes and emulsions that enhance the intestinal absorption of insoluble drugs to increase the absorption. Particle size reduction such as micronization, nanoparticulate carriers, complexation and liquid crystalline phases also maximize drug absorption[1,4,26].

***P- glycoprotein inhibitors***

The application of P-glycoprotein (P-gp) inhibitors to improve the bioavailability of orally administered drug delivery has gained special interest. Several studies have shown that possible use of P-gp inhibitors reverse P-gp mediated efflux and thus, improve the efficacy of the drug transport across the epithelia[1,4,26].

***Mechanism of action of Unani bio enhancers***

In the Unani system of medicine, the bioavailability of the drug formulations is increased by using herbal bio enhancers. Therefore, the actions of the *Mufrad Dawa* play an important role to accomplish this task. In this context, the action of *Mufrad Dawa* such as *Muqawwi e Hazim* (digestive tonic), *Muqawwi e Medha* (stomachic), *Kasirriyah* (carminative) and *Mushthahi* (apppetizer) improve the digestion and absorption in the stomach. Whereas, the actions such as *Muqawwi e Kabidi* (liver tonic) and *Mufatteh e Sudad e Jiger* (deobstruent of liver) improve the proper liver digestion and thereby increase the bioavailability of the drugs.

*Fil fil e Siyah* possesses *Muqawwi e Hazim* (digestive tonic), *Muqawwi e Kabidi* (liver tonic), *Muhallil e Riyah Ghaleez* (anti flatulence) and *Muqawwi e Medha* (stomachic) and these actions are important in improving the bioavailability of the active moiety in the *Murakkab Dawa.Fil fil e Daraz* is another important *Mufrad Dawa* commonly found incorporated in compound drug formulations. These drugs also act as *Mushthahi* (appetizer), *Kasirriyah* (carminative), *Muqawwi e Medha* (stomachic), counterirritant in these *Murakkab Dawa*. These properties increase the digestion, absorption and bioavailability of the drug. *Zanjabeel* is also found to be a very common drug incorporated in *Murakkab Dawa* which possesses *Hazim* (digestive), Kasirriyah (carminative), *Muqawwi e Medha* (stomachic). These actions of *Zanjabeel* also support digestion, absorption and bioavailability of the drug[22,23].

In addition to these actions, *Fil fil e Siyah* and *Zanjabeel* possess *Muqawwi e Kabidi* (liver tonic) and *Mufatteh e Sudad e Jiger* (remove obstruction in liver) respectively. These actions improve the *Hazim e Jigeri* (liver digestion) and remove the obstructions in the liver resulting in enhanced bioavailability of the drug [23].

Further, the supportive ingredients or *Mufrad Dawa* are *Garam vo Khushk* in *Mizaj* which increase the innate heat of the *Murakkab Dawa* and thus, facilitate digestion by increased blood supply to intestinal mucosa and cells.

*Fil fil e Siyah, Fil fil e Daraz* and *Zanjabeel* are *Haar-Yabis* (hot and dry) in *Mizaj* (temperament). Owing to this *Garam* (hot) property, the blood supply to the intestinal mucosa is increased which, in turn, increases the digestive power in the stomach. This also contributes to the increased bioavailability [9,21].

In the Unani system of medicine, taste of the drugs also imparts a great importance in strengthening the digestive function. These drugs are especially categorized as *Adviya Khareefa* (pungent taste drugs), *Adviya Khushbudar* (aromatic drugs), *Adviya Murriya* (bitter drugs). Such drugs also possess the action of *Muqawwi e Hazim* (stomachic), *Kasirriyah* (carminative). In this context, the aromatic drugs *Fil fil e Siyah*, *Fil fil e Daraz* and *Zanjabeel* are good blend of volatile essential oils accredited with pungent taste capable of increasing the *Hararat e Medha* (innate heat in the stomach) leading to better absorption of drugs and its metabolism enhancing the bio availability.

In the Ayurvedic perspective, the drugs are classified based on the taste (*Rasa*) which contains six tastes. Each of the six tastes has an intimate

relationship with the *Doshas* and five main elements (*Pancha maha bhoota*). Out of the six tastes – pungent (*Katu*), sour (*Amla*), salty (*Lavana*) a crucial role in strengthening the stomach, enhancing the digestion by improving the *Agni*, increasing blood supply to the intestinal mucosal wall and thereby improves the bio availability of the drugs [9,12,13,14,25].

Each taste is composed of two elements as per the basic elemental theory (pungent – fire and air, sour – earth and fire, salty – fire and water)[24]. Therefore, it is evident that salty, sour, pungent possess in-built *Agni* (fire) and thus these tastes increase the heat in the stomach, increase and strengthen *Pitta* responsible for digestion. Further they strengthen all the functions which need increase of innate heat such as metabolism, penetration and cleansing of channels. As a result, when the drugs with these tastes are incorporated in drug formulations, they increase the bio availability of other drugs [9,25].

According to Ayurveda black pepper, long pepper and ginger are of pungent (*Katu*) in taste and hot (*Ushna*) in potency. Because of the hot property and pungent taste, *Pitta* and *Agni* are increased which in turn improves digestion (*Deepana*). These factors also contribute to bio potentiation. In addition, these drugs have the properties of *Teekshna* (piercing), *Sookshma* (entering deep and minute body channels), *Rochaka* (appetizer), *Deepana* (digestive tonic) which increase the digestion and absorption of the drugs. Further, long pepper is *Pitta prakopina* (slightly increased *Pitta*) which improves the *Deepani* (digestion and strength). Ginger has a special property called *Grahi* (absorbent) which increases the bowel absorption[12,18,20,24].

Recent research studies reveal that Piperine, the main alkaloid in the *Fil fil e Siyah* and *Fil fil e Daraz* possess bio enhancing or bio potentiation properties. Therefore, Piperine is very useful for lowering the dose profile and shortening of treatment. It also acts as a nutritional bio enhancer which enhances bio availability and absorption of nutrients by acting on gastrointestinal tract. In a recent study, it has been evident that the absorption of curcumin is increased 2000 times when incorporated with piperine[27,28]. Ginger contains Gingerol which regulates the intestinal function to facilitate absorption and thus, it improves the bioavailability of the drug[1,2,5,9].

## Conclusion

This study opens up new scope of using herbal bioenhancers to improve bioavailability of poor absorbable and bio-available in *Murakkab Dawa* embedded in the concept of empirical designing of *Murakkab Dawa* in Unani system of medicine. Therefore, the commonly found supportive ingredients are considered as the key ingredients for digestion and absorption of the active therapeutic moieties which enhances the bioavailability of the drug. They may also enhance the therapeutic effect of the main drug, by presenting in small quantities in the *Murakkab Dawa*, to a great extent that can only be possible by giving large amounts of *Mufrad Dawa*. Therefore, it can be concluded that supportive ingredients collectively and synergistically act to overcome the poor absorption of the active therapeutic moieties and thereby increase the level of the active moieties in the blood.

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# Comprehensive review of *Sumbulut Teeb* (*Nardostachys jatamansi* DC.) and its organoleptic evaluation of three samples available in the market

**Shifka W.*, Fahamiya N., Shiffa M.**

## Abstract

*Sumbulut Teeb* (*Nardostachys jatamansi* DC) belonging to the family Valerianaceae is commonly known as *Balchar*, *Iatamashi* or Indian spikenard, is an erect perennial herb. The main parts used are rhizome and rhizome oil. Because of high commerce, the rhizome of *Nardostachys jatamansi* is often subjected to adulteration with other drugs but it is essential to use genuine drugs for better therapeutic effects. Therefore, the present study is proposed to verify the *Sumbulut Teeb* available in the market to detect adulteration and to get the genuine drug. A systematic literature review has been carried out to gather authentic information on *Sumbulut Teeb* from Unani and Ayurveda classical text, Unani and Ayurveda Pharmacopeias, ethno-botanical literature, scientific journals and from the web through the macroscopic description. The rhizome samples available in the name of *Jatamansi* were collected from the market. The samples were subjected to organoleptic evaluation. The obtained results were verified by comparing the data available in the Unani Pharmacopoeia of India. The study revealed that *Sumbulut Teeb* possesses Antispasmodic, Diuretic, Carminative, Stomachic, Sedative, Antihistaminic, Anti-arthritic, Analgesic Anti-fungal and Anti-bacterial pharmacological activities. Further, it is a mouth freshener, tonic and stimulant. The organoleptic evaluation revealed that the market samples available under the name of *Jatamansi* is not actual *Sumbulut Teeb*. The sample available as *Jata makutu* is the genuine *Sumbulut Teeb*. However, further physiochemical, phytochemical and chromatographic investigations are needed to authenticate the genuine *Sumbulut Teeb* to prevent adulteration and to obtain and maintain the high quality of this plant products.

**Keywords**: *Jatamansi*, *Jatamakutu*, *Sumbulut Teeb*, Organoleptic evaluation, Rhizome, Unani medicine

## Introduction

*Sumbulut Teeb* (*Nardostachys jatamansi* DC) belonging to the family Valerianaceae is commonly known as *Balchar*, *Iatamashi* or Indian spikenard which is an erect perennial herb that grows up to 10 – 60cm in height, stout, woody rootstock that is propagated by cuttings of the underground parts[1,2]. It is found in Nepal, China, and India. The main parts used are rhizome and rhizome oil. In Unani medicine this rhizome is considered as good *Mohallil* (Anti-inflammatory*), Musakkin* (Sedative), *Mufatteh* (De-obstruent), *Mufarreh vo Muqavvi e Qalb* (exhilarant and strengthening of heart), *Daf e Tasannuj* (Anti spasmodic), *Muqavvi e Dimagh vo Meda* (strengthening of brain and stomach), *Mutayyib e Dehan* (mouth perfumer), *Mudir* (diuretic) and this is useful to treat various nervous disorders such as convulsive ailments, epilepsy and hysteria, also effective in palpitation of the heart, consumption, disease of the eye, itch, boils, swellings, disease of the head, hiccough etc.[3,4,5]. In the Indian traditional system of medicine (Ayurveda) it is well established for its use in mental disorders, insomnia, hyperlipidemia, hypertension and heart disease. It has a protective effect on epilepsy, parkinsonism, cerebral ischemia and liver damage[5].

Substituting the original crude drug either partially or fully with an intention to gain profit is known as adulteration. This can be done in various methods such as substituting with other substances which are

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lesser or free from therapeutic and chemical properties of an original drug or adding low grade or damage or false drugs which is entirely different from the original drug.[6,7].

This can also be explained in detail as substituting the original crude drug with other substances which do not agree with the certified official standards of the original drug. This can be lesser in quality, damaged, false, defective or even useless harmful parts of the same plant or a different plant can be substituted. In the case of *Sumbulut Teeb*, it is often adulterated with drugs that are similar in morphology, confused in synonyms, due to its unavailability etc.[6,7].

Because of high commerce, the rhizome of *Nardostachys jatamansi* is often subjected to adulteration with other drugs but it is essential to use genuine drugs for better therapeutic effects. Therefore, the present study proposed to do an organoleptic evaluation to verify the *Sumbulut Teeb* available in the market along with a comprehensive review of the drug.

## Methodology

A systematic literature review was carried out to gather authentic information on *Sumbulut Teeb* from Unani and Ayurveda classical text, ethnobotanical literatures and scientific journals and from authentic websites.

The rhizome samples available in the name of *Jatamansi* were collected from the market. The samples were subjected to organoleptic evaluation. The obtained results were verified by comparing the data available in the Unani Pharmacopoeia of India, published by The Government of India, Ministry of Health and Family Welfare, Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy, New Delhi, India.

## Results

Plant taxonomy is mentioned in Table 01.

**Table 01: Plant taxonomy**

| Botanical name | *Nardostachys Jatamansi* |
|---|---|
| Family name | Valerianaceae |
| Kingdom | Plantae |
| Phylum | Tracheophyta |
| Division | Magnoliophyta |
| Class | Magnoliopsida |
| Order | Dipsacales |
| Family | Valerianaceae |
| Genus | Nardostachys |
| Species | *N. Jatamansi* |

### *Vernacular names*[8]

Arabic: *Sumbulut teeb*, English: Muskroot, Indian spikenard, Hindi; *Balchar, Jatamansi*, Sanskrit *Mansi, Jatila, Jatamansi*, Sinhala: *Jatamanshi*, Tamil: *Jatamanji, Jatamanshi*, Urudu: *Sumbulutteeb, Balchar*, Persian: *Sumbul-uttib*, *Assamese* - Jatamansi, Jatamanshi; Bengali: *Jatamansi*, Gujarati: *Baalchad, kalichad, Jatamasi, Kalichhad, Jatamasi,* Kannada: *Jatamamshi, Jatamansi,* Kashmiri: *Bhut-jaat, Bhutijatt, Kukilipot*, Malayalam: *Jatamanchi, Jetamanshi, Jatamamshi*, Oriya: *Jatamansi*, Punjabi: *Billilotan, Balchhar, Chharguddi*, Bhutajata: *Japaswini*

### *Habitat*

Found in various countries especially India, high altitudes of the Himalaya, Nepal, Bhutan and Sikkim whereas it ranges between 3000 to 5000 m.[9,10,11]

### *Cultivation propagation and collection*

Propagation of this plant is by the vegetative method. Seed germination can be improved with optimum conditions of light, dark, temperature, humidity, hormonal treatment, the composition of soil, depth of seed sowing in soil and sowing months with 15$^{o}$ Celsius temperature with continuous light.

Seed sowing depth is 0.5cm in soil. Hormonal treatment with $GA_{3,}$ IAA-100PPM, and IBA-100PPM will enhance seed germination percentage. Maximum germination was found in October and February. Loss of seed viability and seed germination was higher in the summer months as

well. Storage of seed depends on temperature, the container used and duration. Under different conditions of soil and sand germination can be achieved. Therefore, it can be easily practiced for commercial cultivation.[12]

***Plant description***

***Macroscopic***

*Jatamansi* is a perennial, erect, dwarf, hairy, rhizomatous herb. The root of this herb is woody, long and fibrous from the petioles. The rhizome is dark brown in color which is 2.5-7.5cm in length cylindrical shape with reddish-brown fibres around. 10-60cm in height (stem) which is more or less pubescent upwards and often glabrate below. 15-20 radical leaves 2.5cm in length and longitudinally nerved, glabrous or slightly pubescent. Long, sessile and oblong cauline in 1 or 2 pairs within 2.5-7.5cm[13,14]. Flowers are usually 1, 3 or 5 and bracts is 6mm, oblong in shape and pubescent. Corolla tube is 6mm somewhat hairy within and filaments below[1]. Fruits are ovate in shape and 4mm long, covered with white hairs which are often having dentate calyx teeth[1]. Fruit contains obovate and compressed one seed [9,15]

***Microscopic***[11,16]

The transverse section of the rhizome in microscopic observation shows a thin periderm and a large parenchymatous cortex. This is rich in starch and volatile oil in the endodermis containing globules. A large pith scattered with groups of sclerenchymatous cells is found within a ring of collateral vascular bundles.

***Parts used***

Dried rhizome[9,10], Oil from rhizome[10,17], Root[9,10,,15,17]

***Chemical constituents***[18]

Essential oils: Coumarins and Sesquiterpenes

Major sesquiterpenes: Jatamansone, Valerone, Jatamansol, Jatamansic acid, Dihydrojatamansine and Nardosatchone

Minor constituents: Jatamol A, Jatamol B, Nardosinone, Spirojatamol, Oroseolol, Oroselone

Jatamansinone, Valeranal, Sesalinnardostachyins and Seychelane, Xynthogalin, Alkaloids, Actinidines.

***Unani perspective***

Temperament (*Mizaj*)[3,4,5]

Hot $1^0$ & Dry $2^0$ (*Garamvo Khusk*)

Adverse Effects (*Muzir*)[3,4,5]

Not good for kidneys

Corrective (*Musleh*)[3,4,5]

*Roghan e Gul* (rose oil), *Kateera, Isapgol*

Substitute (*Badal*)[3,4,5]

*Sad kufi, Izharmakki*

Therapeutic Dose (*Miqdar-e-Khurak*) [3,4,5]- 3-5g

National Formulary of Unani Medicine (*Murakkabat*) [12]

*Jawarish e Fanjnosh, Barshasha, Anoshdaru, Anoshdarululvi, Kohal e Roshani, Safoof e Mohazzil, Iyarij e Faiqra, Roghan e Babuna, Zimad e Sumbulutteeb*

***Pharmacological actions of Sumbul ut Teeb***[9,10,15,17]

Tonic (*Muqawwiyat*), Stimulant (*Muharrik*), Antispasmodic (*Daf e Tasannuj*), Diuretic (*Mudir e boul*), Carminative (*Kasurriyah*), Stomachic (*Muqawwi e Meda*), Sedative (*Musakkin*), Mouth perfumer (*Mutayyib e Dahan*), Antihistaminic, Anti-arthritic, Analgesic, Strengthen heart (*Muqawwi e qalb*), Strengthen nerves (*Muqawwi e Asab*), Anti-fungal and Anti-bacterial

***Therapeutic uses of Sumbul ut Teeb*** [9,17,18]

Growth and blackness of hair are promoted, the luster of the eyes are increased, effective in cough and chest pain, restores inflammation in the intestine and increases the appetite.

Fresh root infusions are used to treat epilepsy, hysteria, and convulsions [19,20] and act well in palpitation of the heart [19]. Roots are aromatic and bitter and they possess stimulant and anti-spasmodic property which is useful in intestinal colic and inhaled in bronchial affections. They are also used to improve the complexion, hiccough, dysmenorrhea and insomnia, produce hypotension, increase learning process, effective in treating eye diseases, itching, boils and swellings and in diseases of head. Tincture of it is used in intestinal colic and flatulence.[19] Alcoholic extract enhances the learning process. During bronchial asthma (difficulty in breathing) composition of a compound powder is burnt and inhaled. Rhizome mixed with water is

applied to the eyes in stupor and coma stage of snake bite. It is also given internally in powder form or decoction in combination with other drugs. *Jatamansi* oil is a good flavoring agent therefore it is used in medicinal oil preparations and acts well as an antiarrhythmic drug.[21] *Nardostachys jatamansi* is used as a hepatoprotective drug, cardio-tonic, diuretic, analgesic, helps to relieve the phlegm in cough and asthma, proves useful in hepatitis and treats enlargement of the liver.

***Phytochemical studies of Sumbulut Teeb***

Repeated chromatography with a silica gel and recrystallization with solvents showed the presence of nardal, jatamansic acid, and nardin during the bioassay-guided purification of the hexane fractions of the rhizomes of *Nardostachys jatamansi*. The structure of the compounds was explained on the basis of UV (Ultraviolet), IR (Infra-red rays), $^{1}H$ (Hydrogen) and $^{13}C$ (Carbon) and Mass spectral data and comparison with an authentic sample.

Volatile and non-volatile constituents have been discovered in *Nardostachys jatamansi* which has the major portion of sesquiterpenes as volatile components and coumarins, alkaloids, sesquiterpenes, lignans and neolignans as major components of nonvolatile compounds. The essential oil in the root is mainly composed of sesquiterpenes and coumarins.[11]

***Pharmacological studies***

***Hair growth promotion activity*** [22,23]

Rhizomes of *Nardostachys jatamansi* which contains hexane extract has a response in hair growth promotion activity.

***Anti-depressant like effect*** [24,25,26]

The anti-depressant activity of the methanolic extract of *Nardostachys jatamansi* DC is useful in patients suffering from depression due to sleep disturbances.

***Hypolipidemic effect*** [27,28,29]

Levels of low-density lipoproteins (LDL) and very-low-density lipoproteins (VLDL) can be reduced and cardio-protective high-density lipoproteins (HDL) cholesterol levels can be increased with the administration of *Nardostachys jatamansi.* This acts by its inhibitory effect on lipid peroxidation chain reaction and also helps to reduce triglyceride levels. A study also reported that *Nardostachys jatamansi* is useful in increasing HDL-cholesterol/cholesterol ratio during the intake of ethanolic extract.

Hepato-protective activity[30,31]

Increased levels of serum transaminase and alkaline phosphatase tend to reduce during intake of the extract of *Nardostachys jatamansi.* 50% ethanolic extract acted against thioacetamide induced hepatotoxicity. Research studies also proved that rats intoxicated with LD90 (Lethal dose) dose of the hepatotoxic drug survived in the pretreatment with the extract.

***Antioxidant acticity, Anti cataleptic activity*** [32,33]

Lipid peroxidation quantified by thiobarbituric acid reactive substance (TBARS) was protected due to the activity of anti-peroxidation in *Nardostachys jatamansi.* In a comparison of individuals who had consumed haloperidol and *Nardostachys jatamani* extract the individuals with the administration of *Nardostachys jatamansi* extract showed a maximum reduction in the cataleptic scores.

***Anti-hyperglycemic effects*** [34]

Diabetic rats with alloxan induction when given ethanolic extract of *Nardostachys jatamansi* for 7 days exhibited significant anti-hyperglycemic activity. The study concluded that there is a notable anti-hyperglycemic effect in the model of diabetes mellitus.

***Antifungal and Antibacterial activity*** [35,36]

Studies reveal that methanolic extract of *Nardostachys jatamansi* is effective against most of the microorganisms. Therefore, it justifies its role as an antimicrobial and antifungal agent.

***Anticonvulsant effects*** [37]

Ethanolic extract of *Nardostachys jatamansi* in the roots alone and in combined with phenytoin was considered to observe the anticonvulsant activity and neurotoxicity. A remarkable decrease in the extension/flexion ratio was noticed during increased seizure threshold with the root extract against maximal electroshock seizure (MES).

***Effect on Parkinson's disease*** [38]

6-OHDA was injected in Wistar rats and detected that the drug produced a significant decrease in

biogenic amine and an increase in Dopamine2 receptors.

***Radioprotective activity*** [39]

*Nardostachys jatamansi* root extract showed effective actions against exposure to radiations. This protected against damage caused by exposure to radiation by regulating antioxidant enzymes, scavenging free radicals and preventing oxidative stress.

***Cardiotonic and actions in Respiratory disorders*** [40]

Antiarrhythmic activities and hypotension action of the plant have been studied in various studies. Pre-treatment with the extract of *Nardostachys jatamansi* prevented and restored the antioxidant enzyme activity and lipid peroxides to normal levels.

***Tranquilizing activities*** [41]

Sesquiterpene, valeranone (Yatamanson) which were separated from the rhizome of *Nardostachys jatamansi* showed a significant action of tranquilizing activity. The study demonstrated a prolongation of barbiturate hypnosis in rodents.

Anticancer activity[42].

Proliferation of both the cell lines of neuroblastoma was inhibited after the intake of alcohol extract (95%) of *Nardostachys jatamansi*.

***Adulteration***

Substituting the original crude drug either partially or fully with an intention to gain profit is known as adulteration. This can be done in various methods such as substituting with other substances which are lesser or free from therapeutic and chemical properties of an original drug or adding low grade or damage or false drugs which is entirely different from the original drug.[6,7]

This can also be explained in detail as substituting the original crude drug with other substances which do not agree with the certified official standards of the original drug. This can be lesser in quality, damaged, false, defective or even useless harmful parts of the same plant or a different plant can be substituted. In case of *Sumbulut Teeb*, it is often adulterated with the drugs which are similar in orphology, confused in synonyms, due to its unavailability etc.[43]

***Reasons for adulteration*** [44,45,46]

Having names that looks alike in traditional systems of medicine is the main reason for adulteration which causes confusion in vernacular names, not having proper knowledge of the original drug description, herbs often reciprocate, having similarity in the shape and structure externally (morphologically) is another reason for adulteration, unavailability or reduction of authentic plant, similarity in color and ignorance during collections can be some reasons for adulteration.

***Macroscopic characters of market samples collected from Sri Lanka and India***

The general appearance of the herb looks similar to other related species. Therefore, a proper study should be done for the exact identification of the morphological characters. Visual appearance to the naked eye is known as macroscopic identification. Size, color and taste are important parts of morphology of a particular drug. For each particular morphological group, a particular systemic examination can be carried out. (Anonymous, 1996).[12]

***Organoleptic assessment***

The five main sense organs of a human (eye, nose, tongue, ear and skin) being used to assess a drug is known as organoleptic or macroscopic assessment. This can be analyzed by seeing the color, size, shape, other external features, smell, taste, touch (soft/ hard/ hairy/ sharp etc.) and hearing of sounds.

The first sample was purchased at an herbal drug shop, Gabo's Lane, Colombo 11, Sri Lanka, under name of *Jatamansi* (Figure 01). The organoleptic characters of sample one is shown in Table 02.

**Fig. 1: Sample 01**

**Table 02: Organoleptic characters of sample 01**

| Rhizome | Characters |
|---|---|
| Shape | Irregular or appears like coral reefs, no fibrous covering |
| Size | 4 to 5 cm long, 1 to 3 cm diameter |
| Colour | Dark brown with some light brown spots in between |
| Fracture | Hard and difficult to break |
| Surface | Rough |
| Odour | Gives a strong fragrance |
| Taste | Sour and acidic like, pungent and slightly bitter |

The second sample was purchased from Jani Jahan Khan Road, Royapettah, Chennai, India which is available as *Sumbul-ut-Teeb* (Figure 2)**.** The organoleptic characters of the second sample are shown in Table 3.

**Fig. 02: Sample 02**

The third sample was purchased at an herbal drug shop, Gabo's Lane, Colombo 11, Sri Lanka, which is having similar macroscopic characters of *Sumbulut Teeb* described in the Unani Pharmacopoeia of India (Figure 03). The name of the third sample given by the local vendors is "*Jata makuta*". The organoleptic characteristics of the third sample are shown in Table 04.

**Table 03: Organoleptic characters of sample 02**

| Rhizome | Characters |
|---|---|
| Shape | Cylindrical shape surrounded by reddish brown fibres forming a network which are skeletons of sheathing leaves |
| Size | 3 to 7 cm long, 0.5 to 1.5 cm in diameter |
| Colour | Dark brown and reddish brown internally |
| Fracture | Breakable |
| Surface | Fibrous |
| Odour | Strong fragrance |
| Taste | Acrid, slightly bitter and aromatic |

**Fig. 3: Sample 03**

**Table 04: Organoleptic characters of sample 03**

| Rhizome | Characters |
|---|---|
| Shape | Cylindrical, covered with reddish brown fibres |
| Size | 11 to 14 cm long, 0.4 to 0.5 mm width |
| Colour | Dark brown with reddish brown shades |
| Fracture | Breakable |
| Surface | Fibrous |
| Odour | Slight fragrance |
| Taste | Sour acidic like, slightly bitter |

**Discussion**

Assessment of a drug is known as a confirmation of its identity, its quality persistence, purity and detection of its nature of adulteration. Obtaining the genuine drug is important to have good coordination between the quality of raw materials, in process materials and the final products.

For pharmaceutical purposes, the quality of medicinal plant material must be as highly similar to the quality of other medicinal preparations. The morphological, microscopic, physicochemical and chromatographic studies play a major role to identify, differentiating and authenticating the original plant from adulterants. Identification of the drug through morphological features is the first step in the authentication of the drug to detect adulteration.

Keeping in view the importance, organoleptic evaluation of market samples was done to compare the macroscopic description of *Sumbulut Teeb* available in Unani Pharmacopoeia of India, Part I, Volume I. Macroscopic description of *Sumbulut Teeb* has been described in Unani Pharmacopoeia of India, rhizome is dark brown in color which is 2.5-7.5cm in length cylindrical shape with reddish brown fibers around forming a network which are skeletons of sheathing leaf bases, they can break easily, has a strong fragrance, taste, sour and slightly bitter.

When comparing the organoleptic features of market samples, it is recognized that Sample 01 is not similar to the macroscopic description of *Sumbulut Teeb* given in the Unani Pharmacopoeia of India but samples 02 and 03 revealed resemblance to the Pharmacopoeial description of *Sumbulut Teeb*. However, market sample 03 is under name of *Jata makuta* which is the actual *Sumbulut Teeb* available in the market.

The drug *Jata makuta* is *Flickingeri amacraei* (Lindl.) and belongs to family Orchidaceae. In Ayurveda, it is known as *Jivanti*. The rhizome of this plant is creeping, annulate and green coloured, 0.4 – 0.5 mm width, 11 – 14 cm long, 5 – 6, distinct nodes present on rhizome and rooting is from the nodes of the rhizome. The plant has branching stems terminating in a fusiform pseudobulb which is 2.5-5 cm long, shining, flat and grooved longitudinally. Leaves are 1.2-4.2 cm broad, sessile, linear, oblong or lanceolate, obtuse, dark green and shining above, paler beneath and has many veins. Flowers are bilaterally symmetrical, bisexual, white with pale yellow and 1-3 arising from the pseudobulb at the base of the leaf. Peduncles are 5.4mm long and enveloped by a number of scaly leaves. Floral bracts are 1.8mm long, broadly ovate, acute, fleshy and 3-veined. Dorsal sepals are 10.5-11mm long, oblong, acute and 5 or 7-veined. Lateral sepals are 10-11mm long, oblong, acute and 7 veined. Petals are 9.5-10mm long, lanceolate, oblong, midlobe recurved, crenulate and crisped. Anther terminal, pollinia 4 in two pairs, ovary inferior, 3 capillary, unilocular with numerous parietal ovules. The plant flowers during March and August. Distribution of this plant are Assam, Mizoram, Nagaland Orissa, Nilgiri hills, Sri Lanka, Nepal, Myanmar, Laos and Vietnam. Therefore, the drug known as Jata makuta in Sri Lankan market is the real *Sumbulut Teeb*. The drug which is known as *Jatamansi* is not an actual SumbulutTeeb.[47]

## Conclusion

For pharmaceutical purposes the quality of medicinal plant material must be as high similar to the quality of other medicinal preparations. The morphological, microscopic, physicochemical and chromatographic studies play a major role to identify, differentiate and to authenticate the original plant from adulterants. Identification of the drug through morphological features is the first step in the authentication of the drug to detect adulteration. Having names that looks alike in traditional systems of medicine is a main reason for adulteration which causes confusion in vernacular names, not having proper knowledge on the original drug description, Herbs often reciprocate, having similarity in the shape and structure externally (morphologically) is another reason for adulteration, unavailability or reduction of authentic plant, Similarity in color and ignorance during collections can be some reasons for adulteration. Therefore, the authentication of herbal drugs and identification of adulterants from genuine medicinal herbs are essential for both pharmaceutical companies as well as public health and to ensure the reproducible quality of herbal medicine.

The purpose of standardization of medicinal plant products is obviously to ensure therapeutic efficacy.

Therefore, an effort has been made in this study to authenticate *Sumbulut Teeb* is available in the market. The study revealed that the market sample available under the name of *Jata makutu* is the genuine drug of *Sumbulut Teeb.* The sample is available as *Jatamansi* which is not an actual *Sumbulut Teeb*. However, further physiochemical, phytochemical and chromatographic investigations are needed to authenticate the genuine *Sumbulut Teeb* to prevent adulteration and to obtain and maintain the high quality of this plant products. It is also necessary to identify the sample which is known as *Jatamansi* in the market.

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# Potential health benefits of commonly used spices in Sri Lanka: A review

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**Abstract**

A spice is a dried seed, fruit, root, bark or flower of a plant or an herb used in small quantities as flavoring agent, coloring agent, food additive and preservative. Sri Lanka as a tropical island of Indian Ocean, has been famous for its quality spices since time immemorial. Globalization has made these spices easily available, and increasing their popularity. A literature search was carried out to gather the information available in the literature on selected spices in the view of part used, temperament, therapeutic action and uses, and recent scientific evidences of phytochemical analysis and pharmacological activities. All the available information was compiled from Unani textbooks and Pharmacopoeias and electronic databases such as Google scholar and PubMed. While reviewing the literature, it revealed spices are functional foods and those can be demonstrated to have a beneficial effect on the body beyond basic nutritional requirements. The active phytochemicals derived from these spices have provided the scientific basis for the pharmacological actions. Nowadays, people are increasingly interested in spice, not only to enhance the flavor of cuisine, but for the collective evidence in complementary and alternative medicine. Researches are progressing and mounting evidences which support the therapeutic benefits of spices. This study was aimed to review the potential benefits of some traditional spices commonly used in Sri Lanka.

**Keywords**: Spices, Phytochemical constituents, Pharmacological activities

## Introduction

A spice is a dried seed, fruit, root, bark or flower of a plant or an herb used in small quantities as flavoring agent, coloring agent, food additive and food preservative. Moreover, spices stimulate appetite and create visual appeals to food. All types of spices were used from the ancient time in our kitchen daily to fulfill the body requirements on routine basis. Many of the spices are also used in traditional systems of medicines. Herbs and spices have been used for generations by humans as food and medicine. Long before modern medicine, spices were used to help individuals in disease prevention and health promotion. Traditionally spices, as part of the diets, have holistic effects on human health[1].

Since ancient times, spices had played an important role in the lifestyle of people from certain parts of the world. The history of spices from Ceylon dates back to 14th century and evidence has been revealed of the spice trade being conducted through the roman period. The western nations such as the Portuguese, Dutch and the English were attracted to the island mainly for its riches in spices, precious stones and ivory that was to be found here. Sri Lanka as a tropical island of the Indian Ocean, formally known by names such as Taprobane, Serendib and Ceylon has been famous for its quality spices since time immemorial. Globalization has made these spices easily available, and increasing their popularity. Sri Lanka being a tropical island close to the equator, the fertile and diverse soil types, varying micro climates and the favourable temperature variations, enhances the intrinsic value of most crops grown on this island[2].

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Spices have served numerous roles through history, including as coloring agents, flavoring agents, preservatives, food additives and medicine. Culinary herbs and spices are foods that are a rich source of bioactive molecules such as sulfur-containing compounds, tannins, alkaloids, phenolic diterpenes, and vitamins, especially flavonoids and polyphenols and a pigment which impart characteristic flavor and aroma and gives a herbal appeal to the food and beverages and enhances their consumer acceptability. The active photochemical constituents derived from these spices have provided the molecular basis for these actions. Further, the active phytochemical components of these herbs and spices possess wide range of functional properties and medicinal values providing several health benefits[2,3]. Recent researches have reported that bioactive constituents of spices possess the diverse range of health benefits. There is now ample evidence that culinary herbs and spices are sources of constituents that possess antioxidative, anti-inflammatory, antitumourigenic, anticarcinogenic, and glucose and cholesterol-lowering activities as well as properties that affect cognition and mood, which are actively used in preclinical, clinical, and therapeutic trials investigating new treatments of diseases[2]. Spices are functional foods and those can be demonstrated to have a beneficial effect on certain target functions in the body beyond basic nutritional requirements. This review highlights potential health benefits of commonly used spices in Sri Lanka.

## Methodology

A systematic literature search was carried out to review articles and to gather the authentic information available in the literature on selected spices in the view of part used, temperament, therapeutic action and uses, and recent scientific evidences of phytochemical analysis and pharmacological activities.

Literature searches were carried out using the terms of 'Spices', 'Phytochemical constituents', 'Pharmacological activities', and 'Therapeutic uses'. All the available information on selected spices was compiled from Unani textbooks and Pharmacopoeias and electronic databases such as Google scholar and PubMed.

Inclusion criteria

- The research articles which are in English language
- Peer reviewed indexed journals
- Animal trials
- Clinical trials done in human
- Laboratory assays

Exclusion criteria

- Duplicate publications
- Not related to the medicinal uses

After a through literature review, the collected data were organized in a systematic order.

## Results and Discussion

### *Classification of Spices*[4]

Spices can be classified in several ways based on,

- Plant part used- leaves, flowers, barks, rhizomes, fruit and seeds.
- Botanical relationship- family to which it belongs.
- Longevity of spices plants- annuals, biennials and perennials.
- Morphology of aerial parts of spice plants- herbs with aerial stem, herbs with pseudo stem, climbers, shrubs, trees etc.

### *Parts used and Mizaj (Temperament) of the spices*

Following table (Table 01) shows parts of the spices used for medicinal purposes and *Mizaj* (Temperament) of the spices.

### *Therapeutic actions and uses of the spices according to Unani system of medicine*

Following are the therapeutic actions and uses of spices mentioned in the Unani text books

***Darchini - Cinnamon***

*Naf 'e Khas* (Actions): *Daf-e-Taffun* (antiseptic), *Jazib* (absorbent), *Muharrik* (stimulant), *Mulattif* (demulscent), *Mufatteh* (deobstruent), *Mudir-e-Haiz* (emmenagogue), *Mudir-e-Baul* (diuretic), *Muharrik-e-Bah* (sex stimulant), *Mufarreh-e-Qalb, Mufarreh-e-Dimag* (exhilarant), *Muqawwi-e-Meda*

**Table 01: Parts used and *Mizaj* (Temperament) of the spices**

| Name of the Spice | Part used | *Mizaj* |
|---|---|---|
| *Darchini* - Cinnamon[9] (*Cinnamomum zeylanicum*) | Leaf, Stem bark | Hot and Dry $3^0$ |
| *Heel Khurd/ Elachi* - Cardamom[5] (*Elettaria cardamomum*) | Dried fruit, Seeds. | Hot $2^0$ Dry $2^0$ |
| *Filfil Aswad, Filfil Gard* - Black Pepper[5] (*Piper nigrum*) | Berries | Hot and Dry $3^0$ |
| *Filfil Daraz* - Long Pepper[7] (*Piper longum*) | Root and fruits | Hot $2^0$ Dry $2^0$ |
| *Kabab Chini* - Tailed Pepper/ Cubeb[6] (*Piper cubeba*) | Fruit and its oil | Hot $2^0$ and Dry $2^0$ |
| *Baobarang* - False Black Pepper[7] (*Embelia ribes*) | Root and fruits | Hot $2^0$ Dry $2^0$ |
| *Kishneez* – Coriander[5] (*Coriandrum sativum*) | Fruits & Leaves. | Cold and Dry (Leaves), Cold $2^0$ Dry $2^0$ (Fruits) |
| *Anisoon* - Aniseed[9] (*Pimpinella anisum*) | Fruit | Hot $2^0$ Dry $2^0$ |
| *Ajwain Desi, Nankhuah* - Bishopweed[8] (*Trachyspermum ammi*) | Leaf, Fruit, Seed, Root | Hot and Dry $3^0$ |
| *Zeera Siyah* - Caraway[10] (*Carum carvi*) | Seeds | Hot and Dry $3^0$ |
| *Karafs* – Celery[7] (*Apium graveolens*) | Fruits and root | Hot $2^0$ Dry $2^0$ (Root & Seed) |
| *Karafs-e-Hindi* - Wild Celery[5] (*Trachyspermum roxburghianum*) | Seeds | - |
| *Zeera Safed* - Cumin[10] (*Cuminum cyminum*) | Seed, Fruit, Oil, Flower | Hot $2^0$ Dry $2^0$ |
| *Kalonji, Shuneez, Habbat-us-Sauda* - Black Cumin[6] (*Nigella sativa*) | Fruit, Seed | Hot and Dry $2^0$ |
| *Soya* - Dill[9] (*Anethum graveolens*) | Fruit, Seed | Hot, Dry $2^0$ |
| *Badiyan, Saunf* – Fennel[7] (*Foeniculum vulgare*) | Fruits, leaves, roots and oil from fruits. | Hot $2^0$ and Dry $2^0$ |
| *Rai/ Khardal* - Mustard[10] (*Brassica nigra*) | Seed and Seed oil | Hot and Dry |
| *Methi/ Hulba* - Fenugreek[5] (*Trigonella foenum*) | Seeds | Hot $2^0$ and Dry $2^0$ |
| Qaranfal, Laung - Clove[8] (*Syzygium aromaticum*) | Flower bud | Hot and Dry |
| Jaiphal, Javitri/ Bisbasa – Nutmeg[7] (Arillus/Mace) (*Myristica fragrans*) | Seed, arillus (mace) | Hot $2^0$ Dry $3^0$ |
| *Adrak / Zanjabeel* - Ginger[10] (*Zingiber officinale*) | Rhizome (raw as well as dry) | Hot $2^0$ and Dry $1^0$ (Fresh), Hot $3^0$ and Dry $2^0$ (Dry) |
| *Lahsun* – Garlic[7] (*Allium sativum*) | Bulb, oil | Hot and Dry $3^0$ |
| *Chob Zard/ Haldi* - Turmeric[10] (*Curcuma longa*) | Tuber, rhizome. | Hot and Dry $2^0$ |
| *Tamar Hindi* - Tamarind[8] (*Tamarindus indica*) | Bark, leaf, fruit and seed | Cold and Dry (Fruit) |
| *Podina* - Mint[7] (*Mentha arvensis*) | Leaves, stem | Hot $3^0$ Dry $3^0$ |
| *Karafs* – Parsley[9] (*Petroselinum crispum*) | Root, leaf, fruit | Hot $2^0$ Dry $2^0$ |
| *Heeng, Hilteet* - Asafoetida[5] (*Ferula asafoetida*) | The exuded gum | Hot $4^0$ Dry $2^0$ |
| *Zafran* - Saffron[8] (*Crocus sativus*) | Flower stigma | Hot $3^0$ Dry $3^0$ |

(stomachic), *Muqawwi-e-Kabid* (liver tonic), *Muqawwi-e-Aza-e-Rayeesa* (tonic for principal organs)[9]

*Afal e Khawas* (Therapeutic uses): *Zof-e-Meda* (weakness of stomach), *Zeequn-Nafas* (asthma), *Sual* (cough), *Dard-e-Sar* (headache)[9]

***Heel Khurd/ Elachi - Cardamom***

*Naf 'e Khas* (Actions): *Moattar-e-Qawi* (powerful aromatic), *Muharrik* (stimulant), *Kasir-e-Riyah* (carminative), *Muqawwi-e-Meda* (stomachic), *Mudir-e-Baul* (diuretic), *Musakkin-e-Alam* (analgesic), *Mubarrid* (refrigerant), *Muhallil* (resolvent)[5]

*Afal e Khawas* (Therapeutic uses): *Ghasayan* (nausea), *Qai* (vomiting), *Nafakh* (flatulence), a decoction of whole cardamom together with their pericarp and jiggery added is a popular home remedy to relieve *Sadrodawar* (giddiness) caused by biliousness.[5]

***Filfil Aswad, Filfil Gard - Black Pepper***

*Naf 'e Khas* (Actions): *Muharrik* (stimulant), *Kasir-e-Riyah* (carminative), *Man-e-Naubat* (anti-periodic), *Daf-e-Humuzat* (antacid)[5]

*Afal e Khawas* (Therapeutic uses): Diseases of throat, pain in liver & muscles, piles, night blindness, spleen disorders, leucoderma, lumbago, chronic fevers, paralysis, vertigo, arthritis, urinary disorders, biliousness and externally used in skin diseases.[5]

***Filfil Daraz - Long Pepper***

*Naf 'e Khas* (Actions): *Hazim* (digestive), *Mudir-e-Baul* (diuretic)[7]

*Afal e Khawas* (Therapeutic uses): *Amraz-e-Jigar wa Meda* (liver and stomach diseases)[7]

***Kabab Chini - Tailed Pepper/ Cubeb***

*Naf 'e Khas* (Actions): *Muteeb* (aromatic), *Muharrik* (stimulant), *Daf-e-Zeequn Nafs* (antiasthmstic), *Mudir-e-baul* (diuretic), *Kasir-e-riyah* (carminative), *Musakkin* (sedative)[6]

*Afal e Khawas* (Therapeutic uses): *Amraz-e-Alate-Tanasul-wa-Baul* (genito urinary diseases), Like, *Itihab-e-Masana* (cystitis) & *Suzak* (gonorrhoea) as Internal *Daf-e-Taffun* (antiseptic), *Zaheer* (dysentry), *Wajul Mafasil* (rheumatism), *Munaffis-e-Balgham* (expectorant), *Muharrik* (stimulant) to the bronchial mucous membrane and oil used in throat lozenges.[6]

***Baobarang - False Black Pepper***

*Naf 'e Khas* (Actions): *Qatil wa Mukhrij Deedan-e-Ama* (vermicidal), *Mushil Balgham wa Sauda* (bilogogue)[7]

*Afal e Khawas* (Therapeutic uses): Used to kill and expel Deedan-e-Ama (intestinal worms)[7]

***Kishneez - Coriander (Coriandrum sativum)***

*Naf 'e Khas* (Actions): Leaves: *Musakkin* (sedative), *Dafe Humuzat* (antacid), *Dafe Humma* (antipyretic) (Internally) and *Muhallil* (resolvent)[5]

Fruits: *Kasir-e-Riyah* (carminative), *Mubarrid* (refrigerant), *Mudir-e-Baul* (diuretic) and *Mufarreh* (exhilarant)[5]

*Afal e Khawas* (Therapeutic uses): Leaves: Externally it is used to cure *Amraz-e-Chashm* (eye diseases), *Khuraj* (abscess) and boils. Fruits: The fruit are used in flatulence and weakness of stomach and in diarrhoea due to indigestion, It quenches excessive thirst, the drug is useful in *Malankhuliya* (melancholia) and *Khafqan* (palpitation), It is also useful in *Qurooh-e-Majra-e-Baul* (urethral ulcers) and its application checks *Nazf-ud-Dam* (bleeding) from the wounds, It is useful in the weakness of heart, stomach and brain.[5]

***Anisoon - Aniseed***

*Naf 'e Khas* (Actions): *Kasir-e-Riyah* (carminative), *Musakkin-e-Auja* (analgesic), *Munaffis-e-Balgham* (expectorant), *Mudir-e-Baul* (diuretic), *Mudir-e-Haiz* (emmenagogue), *Jali* (detergent), *Musakkin* (sedative), *Muqawwi-e-Kulya* (renal tonic), *Muqawwi-e-Bah* (aphrodisiac)[9]

*Afal e Khawas* (Therapeutic uses): *Zeequn Nafas* (asthma), *Nafakh e Shikam* (flatulance in the stomach), *Waja ul Meda* (stomachache), *Waja ul Uzn* (otalgia), *Islah e Meda* & *Jiger, Falij vo Laqwa* (hemiplegia & facial paralysis)[9]

***Ajwain Desi / Nankhuah - Bishopweed***

*Naf 'e Khas* (Actions): *Mushtahi* (appetizer), *Kasir-e-Riyah* (carminative), *Dafe Tashannuj* (antispasmodic), anticonvulsive, antiseptic, expectorant[8]

*Afal e Khawas* (Therapeutic uses): Flatulence, stomachache, atonic dyspepsia, colic, anorexia and

diarrhoea, epidemic diseases especially cholera, also used for sore throat, bronchitis and pertusis, often used as ingredient of cough mixtures, also used in antiseptic lotions and ointments.[8]

***Zeera Siyah - Caraway***

*Naf 'e Khas* (Actions): *Mulattif* (demulcent), *Muhallil* (resolvent), *Qabiz* (constipative), *Muqawwi Meda wa Ama'a wa Jigar wa Gurda* (tonic for stomach, intestine, liver and kidney), *Dafe Waram-e-Tihal, Dafe Ishal* (anti-diarrhoeal), *Muhallil-e-Awram* (anti-inflammatory), *Mudir-e-Bol wa Haiz* (diuretic and emmenagogue), *Hazim* (digestive), *Kasir Riyah* (carminative), *Mufriz-e-Sheer* (galactagogue), *Mushtahi* (appetizer) and *Muqawwi Riya* (tonic for lungs)[10]

*Afal e Khawas* (Therapeutic uses): *Sue Hazam* (dyspepsia), *Nafakh-e-Shikam* (flatulence), *Dard-e-Shikam* (stomachache), *Ihtebas-e-Haiz* (amenorrhoea), *Usr-e-Haiz* (dysmenorrhoea), *Qillate Laban* (oligogalactia), *Zof-e-Gurda wa Jigar* (weakness of kidney and liver), *Zof-e-Basr*, *Warm-e-Khusiya, Rua'af (Nakseer), Sailan-ur-Rahem* (leucorrhoea), *Ishal* (diarrhoea), *Kasrat-e-Haiz* (menorrhagia), *Kasrat-e-Lua'ab-e-Dahan* (excessive salivation)[10]

***Karafs - Celery***

*Naf 'e Khas* (Actions): Root & Seeds: *Mufatteh* (Deobstruent), *Muarriq* (Diaphoretic), *Mushtahi* (Appetiser), *Kasir-e-Riyah* (Carminative), *Mufattit-e-Hasat* (Lithotriptic), *Mudir-e-Baul* (Diuretic), *Mudir-e-Haiz* (Emmenogogue)[7]

*Afal e Khawas* (Therapeutic uses): Root & Seeds: *Zatul-Jamb* (Pleurisy), *Irqun Nisa* (Sciatica), *Nuqras* (Gout), *Wajuzzohr* (Backache), *Istisqa* (Dropsy), *Ehtebas-e-Baul* (Anuria), *Hasat-e-Kuliya wa Masana* (Kidney, Bladder calculi), *Ehtebas-e-Tams* (Amenorrhoea), It removes the *Sudda* (Emboli) form liver and resolves flatulence.[7]

***Karafs-e-Hindi - Wild Celery***

*Naf 'e Khas* (Actions): Seeds: *Kasir-e-Riyah* (carminative), *Muqawwi-e-Meda* (stomachic), *Muharrik* (stimulant), *Muqawwi-e-Qalb* (cardiac tonic) and *Mudir-e-Tams* (emmenagogue)[10]

*Afal e Khawas* (Therapeutic uses): The seeds are useful for flatulence, dyspepsia, vomiting, hiccough, bronchitis, asthma, and pain in bladder, A popular remedy for diarrhoea in children is an infusion of the powder made by roasting these seeds with seeds of *Holarrhena antidysenterica*, the root is regarded as a diuretic and prescribed for anasarca.[10]

***Zeera Safed - Cumin***

*Naf 'e Khas* (Actions): Flower & Seed: *Kasir-e-Riyah* (carminative), *Muteeb* (aromatic), *Muqawwi-e-Meda* (stomachic), *Muharrik* (stimulant), *Qabiz* (astringent), *Mudir-e-Laban* (galactagogue) and *Mubarrid* (cooling)[10]

*Afal e Khawas* (Therapeutic uses): Hoarseness of voice, dyspepsia, chronic diarrhoea and gonorrhoea[10]

***Kalonji, Shuneez, Habbat-us-Sauda - Black Cumin***

*Naf 'e Khas* (Actions): *Jali* (detergent), *Munzij* (coctive), *Mudir-e-Haiz*, (emmenagogue), *Mufiz-e-Sheer* (galactagogue), *Musqit* (abortifacient), *Muhallil-e-Waram* (ant inflammatory)

*Afal e Khawas* (Therapeutic uses): Used to increase lactation, in headache, *Nazla* (cold), *Sual* (cough), *Qulanj* (colic), and used to expel kidney stones

***Soya - Dill***

*Naf 'e Khas* (Actions): *Kasir-e-Riyah* (carminative), *Hazim* (digestive), gives relief in dysentery and diuretic[9]

*Afal e Khawas* (Therapeutic uses): Good for the pain due to cold & dry cough, it breaks kidney stone and passes them out, good for liver & spleen, plaster along with honey over stomach is good for constipation, its ash is good for wounds.[9]

***Badiyan, Saunf - Fennel***

*Naf 'e Khas* (Actions): *Muhallil-e-Waram* (anti-inflammatory), *Kasir-e-Riyah* (carminative), *Mudir-e-Baul* (diuretic)[7]

*Afal e Khawas* (Therapeutic uses): The root is regarded useful in *Ehtibas-e-Tams* (amenorrhoea), *Wajul Mafasil* (rheumatoid arthritis)[7]

***Rai/ Khardal - Mustard***

*Naf 'e Khas* (Actions): Seed: *Dafe Tashannuj* (anti-spasmodic), anti-rheumatic, emetic, rubefacient, and counter-irritant.[10]

*Afal e Khawas* (Therapeutic uses): Oil-paste: digestive condiment to induce animals in heat,

rubefacient to massage rheumatic joints, massage on chest in pneumonia.

Paste of seed: applied on chest in lung infection.[10]

***Methi/ Hulba - Fenugreek***

*Naf 'e Khas* (Actions): *Mulattif* (demulcent), *Mudir-e-Baul* (diuretic), *Mudir-e-Haiz* (emmenagogue), *Mulayyin* (laxative), *Munaffis-e-Balgham* (expectorant), *Muhallil-e-Waram* (anti-inflammatory)[5]

*Afal e Khawas* (Therapeutic uses): *Sara* (epilepsy), *Niqras* (gout), *Istisqa-e-Ziqqi* (dropsy), *Sual Muzmin* (chronic cough), *Izm-e-Tihal-o-Kabid* (enlargement of spleen and liver), *Waram-e-Rahem* (uteritis), decoction of seeds with honey is beneficial for *Bawaseer* (piles)[5]

***Qaranfal, Laung - Clove***

*Naf 'e Khas* (Actions): *Muqawwi-e-Aza-e-Rayeesa* (tonic for vital organs), *Muharrik* (stimulant), *Mufarreh* (exhillarant), *Muqawwi-e-Bah* (aphrodisiac), *Mukhaddir* (anaesthetic), *Musakkin-e-Alam* (analgesic), *Kasir-e-Riyah* (carminative), *Daf-e-Qai* (antiemetic)[8]

*Afal e Khawas* (Therapeutic uses): *Zof-e-Aza-e-Rayeesa* (Weakness of vital organs), *Qai* (Vomiting), *Nafkh-e-Shikam* (Flatulence), *Falij* (Paralysis), *Laqwa* (Facial palsy), *Zukam* (Catarrh), *Zof-e-Basarat* (Weakness of vision), *Zof-e-Hazm* (Indigestion)[8]

***Jaiphal, Javitri/ Bisbasa - Nutmeg (Arillus/Mace)***

***Jaiphal (Nutmeg)***

Naf 'e Khas (Actions): *Muqawwi-e-Meda* (stomachic), *Muqawwi-e-Bah* (aphrodisiac), *Muqawwi* (tonic), *Muhallil-e-Waram* (anti-inflammatory)[7]

Afal e Khawas (Therapeutic uses): *Ishal* (diarrhoea), *Falij* (paralysis), *Wajaul Mafasil* (arthritis)[7]

***Javitri/ Bisbasa (Arillus of the Nut-Mace)***

*Naf 'e Khas* (Actions): *Muqawwi-e-Meda* (stomachic), *Hazim* (digestive), *Kasir-e-Riyah* (carminative), *Muqawwi-e-Qalb* (cardiotonic)[7]

*Afal e Khawas* (Therapeutic uses): *Amraz-e-Qalb* (cardiac diseases), *Su-e-Hazm* (indigestion), *Zof-e-Bah* (sexual debility)[7]

***Adrak / Zanjabeel* - Ginger**

*Naf 'e Khas* (Actions): *Mulayyin* (laxative)- Dry, *Mushil* (purgative)- Raw, *Dafe Qai* (anti-emetic), *Dafe Sual* (anti-tussive), *Qatile Kirm Shikam* (vermicidal), *Kasir e Riyah* (carminative), *Hazim* (digestive), *Muqawwi-e-Bah* (aphrodisiac), *Munaffis-e-Balgham* (expectorant), *Jali* (detergent), *Muqawwi-e-Hafiza* (brain tonic), *Mushtahi* (appetizer), *Muqawwi e Meda* (stomachic), *Muqawwi e jigar* (liver tonic), *Mufatteh Sudad Jigar* (remove obstruction of liver)[10]

*Afal e Khawas* (Therapeutic uses): *Sue hazm* (indigestion), *Zofe Jigar* (liver debility), *Amraz-e-Barida* (balghami) (phlegmatic disorders), *Zof-e-bah* (sexual debility), *Nisyan* (dementia), *Suzak* (gonorrhea), chronic fevers, in pregnancy, in *Balghami wa Saudawi Amraz, Suaal* (cough), in *Sailanur Rahem* (leucorrhoea), backache, *Suda* (headache), *Zeequn Nafas* (asthma), *Irqunnasa* (sciatica), *Wajaul Mafasil* (arthritis), *Bawaseer* (haemorrhoids), *Istisqa* (ascites), bad breath, *Khuroojul Miqad* (rectal prolapse)[10]

***Lahsun - Garlic***

*Naf 'e Khas* (Actions): *Kasir-e-Riyah* (carminative), *Mudir-e-Baul* (diuretic), *Muharrik* (stimulant), *Muhalhil-e-Waram* (anti-inflammatory), *Qatil-e-Deedan* (anthelmintic)[7]

*Afal e Khawas* (Therapeutic uses): *Irqunnasa* (sciatica), *Niqras* (gout), expels out the worms, also good for stomach.[7]

***Chob Zard/ Haldi - Turmeric***

*Naf 'e Khas* (Actions): *Muhallil* (anti-inflammatory), *Kasir-e-Riyah* (carminative), *Mushil-e-Safra* (cholagogue), depurative, *Mudir-e-Haiz* (emmenagogue), *Muqawwi-e-jigar* (hepatic), *Muqawwi-e-Meda* (stomachic) and tonic[10]

*Afal e Khawas* (Therapeutic uses): Cold, cough, bronchitis, respiratory disorders and gastric disorder.[10]

***Tamar Hindi - Tamarind***

*Naf 'e Khas* (Actions): Fruit: *Dafe Qai* (anti-emetic), *Mubarrid* (refrigerant), *Kasir-e-Riyah* (carminative), and *Mulayyin* (laxative). Seed: *Qabiz* (constipative), retentive, impuissant to semen[8]

*Afal e Khawas* (Therapeutic uses): Fruit: Nausea, vomiting, fever, thirst, febrile, bilious disorders, sore throat and inflammation. Seed: Seed pulp in the form of powder is used in premature ejaculation as well as in spermatorrhoea. Seeds are adjuvant in the callus formation of fractured bones.[8]

***Podina - Mint***

*Naf 'e Khas* (Actions): *Kasir-e-Riyah* (carminative), *Hazim* (digestive), *Dafe Taffun* (antiseptic), *Mudirr-e-Baul* (diuretic), *Mudir-e-Tams* (emmenagogue), *Masakkin* (sedative)[7]

*Afal e Khawas* (Therapeutic uses): *Istisqa* (dropsy), *Yarqan* (jaundice), *Ehtibas-e-Baul* (anuria), *Ehtibas-e-Tams* (amenorrhoea), *Ishal* (diarrhoea), *Su-e-Hazm* (indigestion), *Nafakh* (flatulance), *Haiza* (cholera)[7]

***Karafs – Parsley***

*Naf 'e Khas* (Actions): *Mudir-e-Baul* (diuretic), *Kasir-e-Riyah* (carminative), *Mudir-e-Haiz* (emmenogogue), *Daf-e-Humma* (antipyretic)[9]

*Afal e Khawas* (Therapeutic uses): Used to relieve kidney and bladder calculi, used for gastrointestinal disorder, inflammation, halitosis, and amenorrhoea, leaves also are employed as antitussive[9]

***Heeng, Hilteet - Asafoetida***

*Naf 'e Khas* (Actions): *Dafe Tashannuj* (anti-spasmodic), *Muharrik-e-A'sab* (stimulant), *Kasir-e-Riyah* (carminative), *Muqawwi-e-Bah* (aphrodisiac), *Qatil-e-Kirm-e-Shikam* (anthelminthic)[5]

*Afal e Khawas* (Therapeutic uses): *Qoolanj* (colic), *Haiza* (cholera), when taken daily it is said to ward off attacks of malarial fever, it produces excellent effects in the advanced stages of *Zatur-Riya* (pneumonia) and *Warm-e-Sha'b* (bronchitis) in children, as *Qatil-e-Kirm-e-Shikam* (anthelminthic) in cases of *Hayyat* (round worm), Asafoetida is also a powerful nervine stimulant and is used in the nervous disorder of *Ikhtinaqur-Rahem* (hysteria).[5]

***Zafran - Saffron***

*Naf'e Khas* (Actions): *Mufarreh* (refrigerant), *Mudir-e-Baul* (diuretic), *Mudir-e-Haiz* (emmenagogue), *Muqawwi-e-Reham* (uterine tonic), *Muqawwi-e-Bah* (aphrodisiac), *Muqawwi-e-Meda* (stomachic), *Daf-e-Thashannuj* (anti-spasmodic), *Musakkin* (analgesic)[8]

*Afal e Khawas* (Therapeutic uses): *Zof-e-Rahem* (uterine weakness), *Zof-e-Meda* (weakness of stomach), *Qoolanj* (colic), *Ehtebas-e-Tams* (amenorrhoea)[8]

***Scientific evidence of phytochemical constituents and pharmacological activities of the spices***

The following table (Table 02) shows the recent scientific evidence of phytochemical constituents and pharmacological activities of the spices selected for this study.

**Table 02: Scientific evidences of phytochemical constituents and pharmacological activities of the spices**

| Name of the Spice | Phytochemical constituents | Pharmacological activities |
|---|---|---|
| *Cinnamomum zeylanicum* | Cinnamaldehyde, Linalool, β-Caryophyllene, Eucalyptol, & Eugenol[11] | Anti-hyperglycemic activity[12] & Anti-hyperlipidemic activity[13] |
| *Elettaria cardamomum* | 1, 8-Cineole, α-Pinene, Sabinene, Linalool, α-Terpineol & Nerol[14] | Antibacterial activity & Anti-inflammatory[15] |
| *Piper nigrum* | Piperine[16] | Anti-inflammatory activity[17] |

| | | |
|---|---|---|
| *Piper longum* | Piperine[18] | Anti-hypertensive activity[18] |
| *Piper cubeba* | Glycosides, Alkaloids, Tannins & Phenolics[19] | Antioxidant activity[19] |
| *Embelia ribes* | Phenolics, Flavonoids, Coumarins, Fatty Acids[20] | Antioxidant activity & Anti-inflammatory[20] |
| *Coriandrum sativum* | Coriander lactone & Hydroxy coriander lactone[21] | Antioxidant & Anticancer properties[22] |
| *Pimpinella anisum* | Trans-anethole[23] | Antiproliferative activity[23] |
| *Trachyspermum ammi* | Carvone, Limonene & Dillapiole[24] | Antibacterial activity[25] |
| *Carum carvi* | p-cymene, Carvacrol & α-pinene[26] | Immunomodulatory activity[26] |
| *Apium graveolens* | Flavonoids, Tannins, Saponins & Steroids[27] | Antioxidant activity & Antimicrobial activity[27] |
| *Trachyspermum roxburghianum* | Cyclohexenone & Roxydienone[28] | Cytotoxic activity[28] |
| *Cuminum cyminum* | Sesquiterpenoids, Monoterpeneoid epimers & Chalcone[29] | Antiglycation activity[29] |
| *Nigella sativa* | Polyphenols Flavonoids, Alkaloids, Steroids, Terpenes Coumarins, Tannins & Saponins[30] | Antioxidant activity[30] |
| *Anethum graveolens* | Polyphenols, Flavonoids & Tannins[31] | Antidepressant & Analgesic effects[31] |
| *Foeniculum vulgare* | Alkaloids, Flavonoids, Tannins, Saponins & Cardiac Glycosides[32] | Antibacterial activity[32] |
| *Brassica nigra* | Tannins, Flavonoids & Alkaloids[33] | Antiproliferative Effect & Antibacterial activity[33,34] |
| *Trigonella foenum* | 4-hydroxyisoleucine, Trigonelline, Isoorientin, Isovitexin, Pinitol & Sarsasapogenin[35] | Anti-diabetic activity[36] |
| *Syzygium aromaticum* | Eugenol, Beta-Caryophyllene, Alpha-Humulene & Eugenyl Acetate[37] | Antioxidant activity[37] |
| *Myristica fragrans* | Myristicin, Myristic Acid, Trimyristin, Elemicin & Safrole[38] | Anti-diabetic activity[39] |
| *Zingiber officinale* | Gingerol[40] | Antioxidant activity[40] |
| *Allium sativum* | Diallyl Disulphide, Carvone, Diallyl Trisulfide, & Allyl Tetrasulfide[41] | Neuroprotective activity[41] |
| *Curcuma longa* | Curcumin[42] | Antioxidant activity & Alpha-glucosidase inhibitory effect[42] |
| *Tamarindus indica* | Tartaric acid[43] | Antihyperglycaemic activity[43] |
| *Mentha arvensis* | Menthol & Menthone[44] | Antibacterial activity[45] |
| *Petroselinum crispum* | Apiin & Apigenin[46] | Antioxidant activity[46] & Antihypertensive activity[47] |
| *Ferula asafoetida* | Sesquiterpene coumarins & Polysulfides[48] | Neuro protective effect[49] |
| *Crocus sativus* | Crocin, Crocetin, Picrocrocin & Safranal[50] | Anti-tumour activity[51] |

## Conclusion

While reviewing the literature, it revealed spices are functional foods and those can be demonstrated to have a beneficial effect on the body beyond basic nutritional requirements. The active phytochemicals such as Alkaloids, Flavonoids, Tannins and Saponins etc. derived from these spices have provided the scientific basis for these actions. Recent studies have proven that the spices have numerus pharmacological activities such as Antioxidant, Anti-inflammatory, Antihyper-glycemic, Antihypertensive and Antibacterial activities etc. Nowadays, people are increasingly interested in spice, not only to enhance the flavor of cuisine, but for the collective evidence in complementary and alternative medicine. Researches are progressing and mounting evidences which support the therapeutic benefits of spices. This review validates the therapeutic actions and uses of spices mentioned in authentic Unani classical texts.

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