



Review Article

www.ijrap.net

(ISSN Online:2229-3566, ISSN Print:2277-4343)



A CONCISE REVIEW OF PANDU ROGA, INCLUDING THE ACTION MECHANISM

Wati KS¹, Ehsan M^{1*}, Pandey S²

¹ M.Pharm Scholar (Ay.), Ayurvedic Pharmacy Laboratory, Faculty of Ayurveda, Institute of Medical Sciences, Rajiv Gandhi South Campus, Banaras Hindu University, Barkaccha, Mirzapur, Uttar Pradesh, India

² Assistant Professor, Ayurvedic Pharmacy Laboratory, Faculty of Ayurveda, Institute of Medical Sciences, Rajiv Gandhi South Campus, Banaras Hindu University, Barkaccha, Mirzapur, Uttar Pradesh, India

Received on: 04/03/22 Accepted on: 19/04/22

*Corresponding author

E-mail: mohammadehsan333@gmail.com

DOI: 10.7897/2277-4343.130369

ABSTRACT

Panduroga has been well known to Indian people since the Vedic period. It is described in complete detail by the Acharyas of Ayurveda as a specific disease with its pathogenesis and treatment. In panduroga, the colour of the body gets changed to pale, sclera, nail, tongue, etc. Due to Rakta-Alpata, haemoglobin level decreases from the normal level. It is linked with both important Dhatus, i.e., Rasa and Rakta. It is represented as anaemia, recognised as the world's second important cause of disability and responsible for about one million deaths a year. Recently, physicians preferring ayurvedic medicines to manage panduroga as these formulations are considered safe compared to modern treatments like Vit-B₁₂ and Ferrous Sulphate. With this research interest, the present study has been undertaken thoroughly to review the management of panduroga by ayurvedic formulations and extracts. This study has selected nine herbal extracts and nine ayurvedic formulations. The reported pre-clinical and clinical trials performed on these herbal extracts and formulations are discussed in detail, with special efforts towards the ayurvedic opinion of panduroga.

Keywords: Avaleha, Lauha, Mandoor, Pandu, Takra

INTRODUCTION

Pandu is a disease characterised by the pallor of the body, which looks like 'Anaemia' of modern science.¹ The person with this disease suffers from decreased blood amount, strength, and complexion, leading to Nihara (loss of natural integrity, tone, and strength).²

In Ayurveda, pandu is considered as a specific disease with its own pathogenesis and treatment and is described under Rasa Pradoshaj Vikara.³ Panduroga is described in ayurvedic text like Charaka Samhita⁴, Sushruta Samhita⁵, and Ashtanga Hridayam.⁶ According to Acharya Charaka, signs and symptoms are Panduta (paleness), Daurbalya (weakness), Hridspandanadhikya (Heart Tonic), Akshikutashoth (Eye Inflammation) etc., which are considered the cardinal features of Panduroga and often observed in patients.⁷

The nearest correlation of iron deficiency anaemia (IDA) can be made with Panduroga because of the predominance of Panduta or pallor in the whole body. Iron deficiency is a pervasive nutritional disorder worldwide and affects approximately one-third of the global population. While its incidence in affluent countries is low, the incidence of IDA in India is very high. Nutritional iron deficiency is the most common cause of anaemia in India. Anaemia caused due to deficiency of iron is the most found nutritional deficiency disorder present throughout the world. It may occur at any stage of life, but it is more prevalent in children, women of reproductive age and women during pregnancy.⁸

Recent advances in Ayurveda with scientific exploration influence physicians to recommend herbal and herbomineral formulations to manage panduroga. Our Acharya's science uses these formulations from ancient times without severe side effects. This review studied some reported herbomineral formulations prepared according to the classical Ayurvedic texts and some herbal extracts, which are reported as prepared by cold maceration technique with a suitable solvent like methanol, ethanol and water. These extracts and formulations said as anti-anaemic agents and showed significant results against iron-deficient anaemia in several pre-clinical trials. The detailed description is mentioned in Table 1 and 2.

Plant Extracts in Panduroga

Chirayata (*Swertia chirata*)

The extract of *Swertia chirata* was reported to be prepared from newly collected aerial parts of the plant by hot percolation in a Soxhlet apparatus using ethanol at a temperature range of 40-80 °C. The extract was concentrated to a dry mass in a water bath and kept in desiccators¹⁹. The obtained extract was used for Anti-anaemic activity in albino rats, and anaemia was induced in rats by oral administration of phenylhydrazine (PHZ) at 10mg/kg for 8 days. This way, the haemoglobin levels were reduced below 13g/dl. The anaemic rats were treated for 4 weeks with ethanolic extract of *Swertia chirata* at a dose of 200mg/kg and 400mg/kg, respectively. Vit-B₁₂ syrup (1ml/rat) was used as a standard drug for the comparative study. This study reported that after 4 weeks, the haematological parameters like haemoglobin level, RBC and WBC were improved to normal value⁹.

Table 1: Plant Extracts used in the management of Panduroga

Herbal Extract	Dose & Duration	Toxicant	Standard Drug	Observation
<i>Swertia chirata</i> ⁹	Ethanol extract at 200mg/kg to 400mg/kg/day	Phenylhydrazine at 10mg/kg for 8 days	Vit-B ₁₂ Syrup at 1ml/Rat	Hb increased from 6.53±1.30g/dl to 13.00±1.23g/dl
<i>Kedrostis foetidissima</i> ¹⁰	Ethanol extract at 200mg/kg suspended with CMC solution for 28 days	Phenylhydrazine at 60mg/kg for 2 days	Vit-B ₁₂ Syrup at 1ml/Rat	Hb increased from 6.22±0.23g/dl to 13.05±0.74g/dl
<i>Mangifera indica</i> ¹¹	Ethanol extract at 20mg/kg	Phenylhydrazine hydrochloride at 30mg/kg for 3 days	-	Significant Anti-anaemic effect seen. (Increase Hb level)
<i>Telfairia occidentalis</i> ¹¹	Aqueous extract at 20mg/kg	Phenylhydrazine hydrochloride at 30mg/kg for 3 days	-	Significant Anti-anaemic effect seen. (Increase Hb level)
<i>Amaranthus hybridus</i> ¹¹	Aqueous extract at 20mg/kg	Phenylhydrazine hydrochloride at 30mg/kg for 3 days	-	Minimal Anti-anaemic effect seen. (Increase Hb level)
<i>Brillantaisia nitens</i> ¹²	Methanol extract at 400, 800, 1600, 3200mg/kg	Phenylhydrazine at 10mg/kg for 8 days	Vit-B ₁₂ Syrup 1ml/Rat	Significant increases in Hb count were seen at 800mg/kg.
<i>Tectona grandis</i> ¹³	Ethanol extract 1g/kg and 2g/kg	Phenylhydrazine at 40mg/kg for 2 days	-	Hb count increased from 10.0g/dl to 13.46g/dl.
<i>Psidium guajava</i> ¹⁴	methanol extract 200mg/kg, 400mg/kg and 800mg/kg	1/3 rd of the total blood volume of the rat was bled to induce anaemia	Folic acid 30mg/rat	200mg/kg dose of test drug was found to be a booster in anaemic conditions
<i>Sorghum bicolor</i> ¹⁵	Aq. Extract at 200 mg/kg and 300 mg/kg	Phenylhydrazine at 40mg/kg for 2 days	(Ferrous Sulphate)1ml/rat	Significant increase in Hb count.

Table 2: Formulations and research review

Formulation	Dosage with Anupana	Initial Hb%	Final Hb%
Punarnavadi Mandoor ¹⁶	2×125mg Tab. twice a day with <i>Takra</i> (Buttermilk)	7.50±1.8	11.10±1.89 (Final)
Draksha Avaleha ¹⁷	10g with lukewarm water twice a day before meal	Significant increase in blood Hb % levels	
Pradarantak Lauha ¹⁶	2×125mg Tab. twice a day with honey/sugar	7.14±2.05 (Initial) and	8.09±2.03
Sarva-Jwara Hara Lauha ¹⁶	2×125mg Tab. twice a day with honey	7.35±1.86	12.11±1.65
Vrihat Yakrdari Lauha ¹⁶	2×125mg Tab. twice a day with <i>Adrakaswarasa</i> (Ginger juice)	7.94±2.08	11.03±2.09
Dhatrariasha ¹⁸	20ml with water twice a day before meal for 45 days	10.77	11.30
Pandughna Vati ¹⁸	150mg after meal thrice a day 45 days	10.63	10.91
Dhatrilaauha ¹⁶	2×125mg Tab. twice a day with honey/sugar	7.76±1.91	11.06±2.11
Navayasa Churna ¹⁶	2×125mg Tab. twice a day with honey/sugar	7.86±1.49	11.66±1.58

Stinking *Kedrostis* (*Kedrostis foetidissima*)

It was reported that the extract of *Kedrostis foetidissima* was prepared from collected leaves (coarse powder) of the plant by a maceration process using 90% ethanol as a solvent at room temperature for 7 days. The ethanolic extract was concentrated by vacuum distillation to dry. The collected extract was deposited in desiccator²⁰. The extract was obtained for anti-anaemic activity in adult albino rats, and anaemia was induced in rats by intraperitoneal administration of phenylhydrazine (PHZ) at 60mg/kg for 2 days. This way, the levels of haemoglobin reduced below 13g/dl and anaemic rats were treated for 28 days with ethanolic extract of *Kedrostis foetidissima* at a dose of 200mg/ml and 1mg/kg, respectively. Vit-B₁₂ syrup (1ml/rat) was used as a standard drug for the comparative study. This study reported that after 28 days, the haematological parameters like haemoglobin level, RBC and WBC were improved to the normal value of¹⁰.

Mango (*Mangifera indica*) / Fluted pumpkin (*Telfairia occidentalis*) / Marasa (*Amaranthus hybridus*)

It was reported that the extracts of *Mangifera indica* /*Telfairia occidentalis* / *Amaranthus hybridus* were prepared by Soxhlet extraction, the plant materials were thoroughly washed and dried at room temperature, and 40g of *Mangifera indica*, *Telfairia occidentalis*, and *Amaranthus hybridus* each were soxhlet extracted. The choice of water as the solvent for *T. occidentalis* and *A. hybridus* was to mimic the traditional method of preparing crude plant extracts, and that of ethanol for *M.indica* was to enhance the extraction of more constituents. Besides, our pilot study revealed that *M. indica* powder was not readily soluble in

water. The yield for *M. indica*, *T. occidentalis* and *A. hybridus* were 26.95, 17.1 and 11.67% (w/w), respectively,²¹. The obtained extract was reported for the study of Anti-anaemic activity in 12 healthy rabbits of both sex; anaemia was induced by subcutaneous administration of 2.5% neutralised phenylhydrazine hydrochloride at 30mg/kg for 3 days. About 1 to 4 ml of blood was collected from each rabbit into bijoux bottles by puncturing the prominent ear vein with syringe needles. 1ml of blood was collected before anaemia induction, and 4ml of blood was collected at the end of the experiment. Group B, C and D rabbits were treated by daily oral administration of plant extracts. After the analysis, these extracts were reported to be anti-anaemic active¹¹.

Tropical giant sage (*Brillantaisia nitens*)

It was reported that the extracts of *Brillantaisia nitens* were prepared from air-dried fresh leaves (coarse powder) of the plant by cold maceration using the methanol extract (ME; 365.08g, and 36.51 % w/w), n-Hexane (HE; 49.45g; 24.7% w/w) and chloroform (CE; 52.51g; 26.2% w/w)²². The obtained extract was used for Anti-anaemic activity in adult albino rats, and anaemia was induced by oral administration of phenylhydrazine (PHZ) at 10mg/kg for 8 days. This way, the haemoglobin levels reduced below 13g/dl, and the anaemic rats were treated for 4 weeks with methanolic extract with a dose of 400mg/kg of MF, CE, and HE, respectively. Vit-B₁₂ syrup (1ml/rat) was used as a standard drug for the comparative study. This study reported after 4 weeks, the haematological parameters like haemoglobin level, RBC and WBC were improved to normal value¹².

Teak (*Tectona grandis*)

It was reported that the extract of *Tectona grandis* was prepared from air-dried leaves powder) of the plant by maceration in 50% aq. Et. OH for 72 hours under manual discontinuous agitation. The solution was filtered and evaporated in a vacuum to give the extract (yield 11.34%)²³. The obtained extract was used for Anti-anaemic activity in adult albino rats, and anaemia was induced in rats by intraperitoneal administration of phenylhydrazine (PHZ) at 40mg/kg for 2 days. This way, the haemoglobin levels were reduced below 13g/dl, and the anaemic rats were treated for 15th days with ethanolic extract of *T. grandis* at a dose of 1g/kg and 2g/kg, respectively. This study reported that after the 15th day, the haematological parameter like haemoglobin level, RBC and WBC were improved to normal value¹³.

Guava (*Psidium guajava*)

The extract of *Psidium guajava* was reported to be prepared from the dried and powdered bark of the plant *Psidium guajava* by deeply maceration in 80% methanol for 72 hours at room temperature. After decantation, the extract was then filtered and concentrated using a rotary evaporator at 40°C²⁴. The obtained extract was used for Anti-anaemic activity in adult male albino rats and haemorrhage induced anaemia in rats. This way, the haemoglobin levels were reduced below 13g/dl. The anaemic rats were treated for 6 days with methanolic extract of *P. guajava* at 200mg/kg, 400mg/kg and 800mg/kg, respectively.

This study reported that after the 15th day, the haematological parameter like haemoglobin level, RBC and WBC were improved to normal values. The reported results signify that *Psidium guajava* has anti-anaemic activity¹⁴.

Indian millet (*Sorghum bicolor*)

It was reported that extract of *Sorghum bicolor* was prepared by drying at 20-25°C, safe from moisture for four weeks. The extract was prepared by decoction; the extract was dried in an oven at 50°C. The dry residue was powdered and kept in the fridge in a black bottle²⁵. The obtained extract was used for Anti-anaemic activity in adult albino rats. The anaemia was induced in rats by intraperitoneal administration of phenylhydrazine (PHZ) at 40mg/kg for 2 days. This way, the haemoglobin levels were reduced below 13g/dl, and the anaemic rats were treated for 15 days with ethanolic extract of *Sorghum bicolor* at a dose of 200mg/kg and 300mg/kg, respectively. Ferrous sulphate (1ml/rat) was used as a standard drug for the comparative study. This study reported that after 15 days, the haematological parameters like haemoglobin level, RBC and WBC were improved to the normal value¹⁵.

Formulation and their Mode of action

Punarnavadi Mandoor

It was reported that this herbomineral formulation was prepared by heating Shodhita Mandoor with gomutra till it gets solidified, then adding powdered plant drugs, i.e. Punarnava Root (*Boerhavia diffusa*), Sunthi (*Zingiber officinale*), Maricha (*Piper nigrum*), Pippali (*Piper longum*), Vidanga (*Embllica ribes*), Devdaru (*Cedrus deodara*), Chitraka (*Plumbago zeylanica*), Pushkarmula (*Inula racemosa*), Haritaki (*Terminalia chebula*), Vibhitaki (*Terminalia belerica*), Amalaki (*Phyllanthus emblica* Fr.), Haldi (*Curcuma longa*), Daruharidra (*Berberis aristata*), Dhatriamula (*Phyllanthus emblica* Rt.), Chavya, Kutaj, Pippalimula, Nagarmotha and Mardan (Trituration) was done¹⁹. The obtained Punarnavadi Mandoor was studied on the activity of anti-anaemia with 20 anaemic patients (8-males and 12-females) for 30 days, 2 tablets each of 125mg were administered by these patients with takra (buttermilk) as a vehicle, and the iron-

related parameter gets improved with a significant increase in Hb count³⁵.

Mode of action: Mandura Bhasma (an incinerate form of iron Fe₂O₃), the chief component, is the activator of the formulation and is the principal responsible part of the pharmacodynamics of Punarnava Mandura. The advantage of rasa and guna pacifies intensified Pitta and keeps the normalcy, improving digestion and metabolism. Looking into the differentiated actions, Acharya Charaka says that Mandura and its preparations are vital in treating cases of Pandu. The ferric ferrous fraction of Mandura provides a satisfactory amount of iron to the living matter, which is needed for normal erythropoiesis.³⁷

As Gomutra (Cow's urine) is one ingredient of Punarnava Mandura.³⁸ It is an excellent immune enhancer. The occurrence of erythropoietin hormone in cow urine may be one of why Gomutra is useful in anaemia. Iron present in Cow's urine maintains balance and helps produce red blood cells and Hb³⁹.

Draksha Avaleha

It was reported that the avaleha technique of Ayurveda prepared this formulation; in this technique, sugar syrup was boiled till it became thready (*tantuvata*) and mixed with the powdered plant drugs, i.e., Draksha (*Vitis vinifera*), Pippali (*Piper longum*), Yastimadhu (*Glycyrrhiza glabra*), Sunthi (*Zingiber officinale*), Vanslochan (*Bambusa arundinacea*) and Amalaki (*Phyllanthus emblica*) into it and boiled at mild flame²⁰. After shelf cooling, Draksha Avaleha was obtained. The Draksha avaleha prepared was reported for an Anti-anaemic activity study; in this study, the polyherbal formulation was administered to 20 patients in the age group 18-40 years who had Hb levels ranging from 7gm/dl to 10gm/dl with a dose of 10g twice a day with lukewarm water as a vehicle, the reported observation of Draksha avleha was found to be effective against anaemia symptoms, and Hb count got increased³⁶.

Mode of action: This formulation contains Draksha, Pippali, Amalaki Madhu, Sarkara etc. Draksha has Ayurvedic properties of drugs, i.e., Madhura Rasa. It acts as Rakta Vardhak; Pippali having Katu Rasa, Madhura Vipaka, Snigdha, Laghu Guna, it helps in rakta vikara and helps in anaemia treatment. Draksha has the unique property of increasing rakta dhatu (blood), and all above the ingredients help improve Rakta¹⁷.

Pradrantak Loha

It was reported that this herbomineral formulation was prepared by the *mardan* (trituration) process of Loha Bhasma (Incinerated Iron), Tamra Bhasma (Incinerated Copper), Shuddha Hartala (Orpiment), Vanga Bhasma (Tin Incinerated), Abhrak Bhasma (Incinerated Mica), Varatika Bhasma (Incinerated Cowries), Sunthi (*Zingiber officinale*), Maricha (*Piper nigrum*), Pippali (*Piper longum*), Haritaki (*Terminalia chebula*), Vibhitaki (*Terminalia belerica*), Amalaki (*Phyllanthus emblica*), Eranda (*Ricinus communis*), Vidanga (*Embllica ribes*), Saindhava Lavana (Rock Salt), Samudra Lavana (Common Salt), Vida Lavana (Vida Salt), Sauvarchala Lavana (Sochal Salt), Chavya (Piper Chaba), Vacha (*Acorus Calamus*), Hapushpa (*Juniperus communis*), Kushta (*Saussurea lappa*), Shati (*Curcuma zoodaria*), Patha (*Cyclea peltata*), Devdaru (*Cedrus deodara*), Ela (*Elettaria cardamomum*) and Vriddhadaru (*Argyrea speciosa*)²¹. The obtained Pradrantak Loha was studied on the activity of anti-anaemia with 20 anaemic patients (20-females) for 30 days, 2 tablets each of 125mg were administered by these patients with honey/ghee as a vehicle, and the reported iron-related parameter get improved with a significant increase in Hb count seen³⁵.

Sarva-Jwara Hara Lauha

It was reported that this herbomineral formulation was prepared by *mardan* (trituration) process of 21 powdered ingredients, i.e. Sunthi (*Zingiber officinale*), Maricha (*Piper nigrum*), Pippali (*Piper longum*), Haritaki (*Terminalia chebula*), Vibhitaki (*Terminalia belerica*), Amalaki (*Phyllanthus emblica*), Vidanga (*Embllica ribes*), Mustak (*Cyperus rotundus*), Chitrak (*Plumbago zeylanica*), Gajapippali (*Piper longum*), Pippalimula (*Piper longum* Rt.), Ushir (*Vetiveria zizanioides*), Devdaru (*Cedrus deodara*), Kiratikta (*Swertia chirata*), Katuka (*Picrorhiza kurroa*), Kantakarik (*Solanum surattense*), Shigru (*Moringa oleifera*), Yashtimadhu (*Glycyrrhiza glabra*), Hrivera (*Plectranthus vettiveroides*), Kutaja (*Holarrhena antidysenterica*), Loha Bhasma (Iron incinerated)²². The obtained Sarva-Jwara Hara Lauha was studied on the activity of anti-anaemia with 20 anaemic patients (9-males and 11-females) for 30 days, 2 tablets each of 125mg were administered by these patients with honey as a vehicle, and the iron-related parameter gets improved with a significant increase in Hb count³⁵.

Vrihat Vakrdari Lauha

It was reported that this herbomineral formulation was prepared by the *mardan* (trituration) process of ingredients, i.e., Loha Bhasma (Iron Incinerated), Abhraka Bhasma (Mica Incinerated), Tamra Bhasma (Copper Incinerated), and Mrighashruna Bhasma (Deer Horn Incinerated) And Nimbu Swarasa (*Cirus Limon*)¹⁶. The obtained Vrihat Vakrdari Lauha was studied on the activity of anti-anaemia with 20 anaemic patients (7-males and 13-females) for 30 days, 2 tablets each of 125mg were administered to these patients with ginger extract as a vehicle, and the iron-related parameter gets improved with a significant increase in Hb count³⁵.

Dhatrariyashita

It was reported that this polyherbal formulation was prepared by Sandhan (Fermentation); the ingredients, i.e., Amalaki swaras (*Phyllanthus emblica*), sugar, and honey, were filled after proper mixing in a porcelain jar and kept for 45 days under undisturbed condition after the fermentation starts²⁴. The obtained Dhatrariyashita was studied for Anti-anaemic activity with 35 anaemic patients. Dhatrariyashita was administered to patients with a dose of 20 ml twice a day for 45 days. The reported observation has recorded an increase in the Haemoglobin levels and an improvement in symptoms of the disease³⁴.

Mode of action: This formulation contains Dhatri (Amalaki) as the main ingredient, and Amalaki is the best rasayana, Tridoshhara. It has a high amount of vitamin C, which reduces ferric iron to ferrous iron and increases iron absorption¹⁸.

Pandughna Vati

It was reported that this polyherbal formulation was prepared by *mardan* (trituration) and bhavana (levigation) process by using Amalaki (*Phyllanthus emblica*), Vibhitaki (*Terminalia belerica*), Sunthi (*Zingiber officinale*), Maricha (*Piper nigrum*), Pippali (*Piper longum*), Punarnavamula (*Boerhavia diffusa*) Vidanga (*Embllica ribes*), Katuki (*Picrorhiza kurroa*), As Churna Dravya and 1 bhavana of Gomutra (Cow's Urine), 1 Bhavana of Kumari Swaras (Aloe Vera Juice), 2 Bhavana of Punarnavamula (*Boerhavia diffusa*) and 2 Amalaki (*Phyllanthus emblica*)²⁵. The obtained pandughna vati was studied for Anti-anaemic activity with 35 anaemic patients. Pandughna vati 150mg was administered to patients thrice a day for 45 days of duration. The reported observation was an increase in the Haemoglobin levels and improvement in symptoms of disease³⁴.

Mode of action: This formulation contains Deepana, Pachanadravya, which leads to increased gastric acidity through their Ushna Viryaand Tikshaguna properties to help destroy the

Srotorodha. So, metabolism improves digestion ultimately was improves leading to proper Dhatu Poshan¹⁸.

Dhatri Lauha

It was reported that this herbomineral formulation was prepared by *Mardan* (Trituration) process, by using Amalaki, Loha Bhasma (Iron Incinerated), Sunthi (*Zingiber officinale*), Maricha (*Piper nigrum*), Pippali (*Piper longum*), Haldi (*Curcuma longa*), honey, ghee and khanda²⁶. The obtained Dhatri Lauha was studied on the activity of anti-anaemia with 20 anaemic patients (8-males and 12-females) for 30 days, 2 tablets each of 125mg were administered by these patients with ghee or honey as a vehicle; the reported observation was the iron-related parameter get improved with a significant increase in Hb count³⁵.

Mode of action: Amalaki and loha are the primary ingredients in this formulation. The action of the medicine mainly depends upon its constituents like Rasa, Guna, Virya, Vipaka etc. Amalaki is an Amlarasa pradhana and can increase rakta and enhance in rakthalpatha. It also has a rich source of Vit-C that helps in the absorption of iron. Sunthi, Marich Pippali and Haridra are Katu Rasa Pradhana dravya which can promote Agni by their deepana and pachana properties which can nullify the aruchi like laksanas of Pandu Roga. They also provide an acidic media for better absorption of iron⁴⁰.

Navayasa Churna

It was reported that this herbomineral formulation was prepared by *mardan* (trituration) process, by using powdered ingredients 1 part each i.e., Sunthi (*Zingiber officinale*), Maricha (*Piper nigrum*), Pippali (*Piper longum*), Haritaki (*Terminalia chebula*), Vibhitaki (*Terminalia belerica*), Amalaki (*Phyllanthus emblica*), Nagarmotha (*Cyperus rotundus*), Vidanga (*Embllica ribes*), Chitrak (*Plumbago zeylanica*) and 6-part loha bhasma (Iron incinerated)²⁷. The obtained Navayasa Churna was studied on the activity of anti-anaemia with 20 anaemic patients (9-males and 11-females) for 30 days; these patients were administered 2 tablets each of 125mg with honey/water as a vehicle. The reported observation was the iron-related parameter get improved with a significant increase in Hb count³⁵.

Mode of action: Pippali, a bioavailable drug, improves nutrients' absorption and systemic consumption. Navayasachurna showed highly significant results in correcting Mean corpuscular volume (MCV); iron deficiency slows the process of red blood cell production.

Amalaki holds the highest level of vitamin C, which enhances iron absorption. When more iron is absorbed, it helps make normal erythrocytes. Navayasa churna improves the disproportionate reduction of red blood cell haemoglobin. It also showed a highly significant result by improving haemoglobin concentration in red blood cells, which implies that the regeneration of blood constituents is also being taken care of⁴¹.

DISCUSSION

In this review, the reported pre-clinical trials of several plant extracts were studied; regarding pandu roga or anaemia, nine plant extracts were selected to discuss in detail in this review. The plant extract of *Swertia chirata* was prepared using the hot percolation extraction technique using alcoholic solutions. The phytoconstituents of *Swertia chirata* directly influence the blood formation in the bone marrow. The ethanolic leaf extract of *Kedrostis foetidissima* may have anti-anaemic properties because its leaf contains high iron content. The plant extract of *Mangifera indica* contains tannins, cardiac glycosides and flavonoids. *A. hybridus* is positive for saponins, alkaloids and flavonoids. *T. occidentalis* extract contains saponins, alkaloids, cardiac

glycosides and flavonoids. It has been reported that phenylhydrazine causes oxidative damage to red cells by increasing the formation of reactive oxygen species. The alkaloids and flavonoids protect cells as powerful antioxidants that repair or prevent red cell damage. A study on *M. indica* showed that mangiferin, a normal metabolite in the plant leaves and stem, has substantial antioxidant properties. The aqueous extract of *Brillantaisia nitens* contains a suitable amount of Vit-B₁₂ and Folic acid and other mineral constituents necessary for erythropoiesis, such as iron, Vit-B₆ and Vit-C. The extract of *Tectona grandis* potentiates the increase in the number of reticulocytes. The extract could stimulate erythropoiesis. An increase in young reticulocytes explains the solid osmotic resistance of red blood cells in rats treated with the plant extract. *Psidium guajava* extract contains alkaloids, saponins, cardenolides, tannin, and flavonoids that could interact and stimulate erythropoietic growth factors. Erythropoietin systems have been reported to enhance the rapid synthesis of blood cells. Sorghum bicolor extract contains catechol tannins, flavonoids, leucoanthocyanes, steroids, cardenolides, reducing compounds and coumarins, which stimulate haemoglobin synthesis by activation of erythropoiesis. The nine herbomineral and polyherbal formulations also reported the Anti-anaemic activity, i.e., in Punarnavadi Mandoor, Mandura (Fe₂O₃) provides a satisfactory amount of iron to the living matter Gomutra is helpful in anaemia due to the occurrence of erythropoietin hormone. Draksha Avaleha, Draksha has the unique property of increasing Rakta Dhatu, and all above the ingredients help improve rakta. Pradrantak loha, Sarva-Jwara Hara Lauha, Vrihat Vakdari Lauha, Dhatriyarishtha, Pandughna Vati, this formulation contains deepana, pachana dravya, which lead to increase gastric acidity through their Ushna Virya and Tiksha Guna property help to destroy the srotorodha. So, metabolism improves digestion, ultimately improved lead to proper dhatu poshana.

Navayasa Churna contains Pippali being bioavailable drug it improves the absorption and systemic consumption of the nutrients. Amalaki holds the highest level of vitamin C, which enhances iron absorption. Dhatri Lauha contains Amalaki and loha are the primary ingredients in this formulation. The action of the medicine mainly depends upon its constituents like Rasa, Guna, Virya, Vipaka etc. Amalaki is an Amlarasa pradhana and can increase rakta and enhance in raktalpatha. It also has a rich source of Vit-C that helps in the absorption of iron.

This review has studied the reported anti-anaemic activities in different herbal extracts of well-known plants, Ayurvedic herbomineral and polyherbal formulations through pre-clinical and clinical trials. In a study of iron-deficient anaemia, there were several symptoms and parameters to determine the Anti-anaemic activity; in this review, we have taken only one parameter that was commonly reported in every study, either in clinical or in the pre-clinical research, i.e., Haemoglobin count. By observing this parameter, we can predict the Anti-anaemic activity of herbal extract and formulations.

CONCLUSION

In this review, we have studied several research articles, reviews and several classical Ayurveda literatures; after a thorough study, we conclude that the nine herbal extracts and nine herbomineral formulations, as well as polyherbal formulations discussed in this study, have the potential to work against the iron-deficient anaemia which is a Panduroga according to Ayurveda and these herbal extracts and formulation could perform better than the modern iron supplements. These herbal extracts and the formulations in minimal doses could replace current iron supplements used in anaemia.

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Cite this article as:

Wati KS et al. A concise review of pandu roga, including the action mechanism. *Int. J. Res. Ayurveda Pharm*. 2022;13(3):104-109 <http://dx.doi.org/10.7897/2277-4343.130369>

Source of support: Nil, Conflict of interest: None Declared

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