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THERAPEUTIC POTENTIAL OF TRYUSHNADI MANDURA IN IRON-DEFICIENCY ANEMIA: A REVIEW

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ABSTRACT: Background: Iron deficiency anemia (IDA) is a major global health problem, especially affecting children, women, and pregnant females. In Ayurveda, IDA can be correlated with *Pandu Roga*, which is associated with impaired digestion (*Mandagni*) and defective formation of *Rakta Dhatu*. Iron deficiency anemia (IDA) is the most frequent hematological disorder in children, with an incidence in industrialized countries of 20.1% between 0 and 4 years of age and 5.9% between 5 and 14 years (39 and 48.1% in developing countries). **Objective:** To critically review the available classical and contemporary evidence on the safety and therapeutic potential of *Tryushanadi Mandura* in the management of iron deficiency anemia. **Material and Mathods:** A narrative literature review was conducted using Ayurvedic classical texts such as *Chakradutta* and electronic databases including PubMed, Google Scholar, and Medline. Relevant articles on formulation components, pharmacological actions, and anemia management were screened. The index, non-index medical journals has also referred to collect information of relevant topic. **Results:** The formulation contains multiple herbal and mineral ingredients with reported *Deepana*, *Pachana*, *Rasayana*, and *Raktavardhaka* properties. Individual components demonstrate pharmacological activities such as antioxidant, anti-inflammatory, hepatoprotective, and bioavailability-enhancing effects. However, there is limited direct clinical evidence specifically evaluating *Tryushanadi Mandura* in IDA. **Conclusion:** *Tryushanadi Mandura* shows potential as a supportive formulation in IDA management based on classical rationale and pharmacological properties. However, current evidence is insufficient to conclusively establish its clinical safety and efficacy. Well-designed clinical trials are required.

INTRODUCTION: Iron deficiency Anemia (IDA) is a global public health crisis, so also in India.

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As per the World Health Organization's (WHO's) report, there are about two billion Anemia cases globally, of which half of them are IDA [1].

Anemia is the late indicator of iron deficiency in the human body, hence the prevalence of iron deficiency is estimated 2.5 times higher than that of Anemia. Similarly, IDA during pregnancy is associated with maternal mortality, preterm labor, low birth weight, and infant mortality [2].

IDA among children affects their cognitive and motor development and increases the susceptibility of infections [3]. According to the World Health Organization, the global prevalence of anemia was estimated at 29.9% in women of reproductive age, 29.6% in non-pregnant women of reproductive age, 36.5% in pregnant women, 39.8% in children aged 6–59 months, and 60.2% in children under 5 years old in 2019. It leads to symptoms such as lassitude, general debility, lethargy, and poor work performance, and in some cases, it can result in mental retardation, low intelligence, and an aberrant immune response [4].

The Ayurvedic anemia correcting agents are found to be practiced since centuries [5]. With this background, an effort is made to review various types of Ayurvedic formulations that have prove efficient in the management of IDA. In Ayurveda, the disease Pandu Roga can be compared with that of IDA, especially owing to the clinical manifestation of Panduta or pallor in the whole body [6]. Unlike modern medicine, which primarily addresses hematological parameters, Ayurveda emphasizes a systemic imbalance rooted in digestion, metabolism, and tissue nourishment [7].

The Concept of Iron Deficiency Anemia in Ayurveda: In Ayurveda, a condition with striking resemblance to anemia is described as *Pandu Roga*. Irregular and faulty *PittaPrakopaka* dietary habits and lifestyle like *Amla*, *Lavana*, *Katu Rasa Atisevana*, *Kshara*, *Ushna*, *Tikshna*, *Ruksha Ahara Atisevana* impairs the digestion, leading to *Mandagni*. Due to *Nidana*, *Pittadosha* gets vitiated and expelled by *Vayu*. It then reaches the *Hridya* and from there it mobilizes into entire body *via Dashadhamani* and get localized between *Twaka* and *Mamsa* causing *Dhatushaithayata* and *Guruta*. Vitiated *kapha*, *Vata*, *Asruk*, *Twaka* and *Mamsa* cause *Twakavaivarnata* such as *Pandu*, *Haridra*, *Harita* etc. There are systemic symptoms like Exertion dyspnoea, tiredness, breathlessness, leg cramps, etc. In ayurvedic classics, this diseased condition is known as Pandu Roga.

Exploring the Potential Superiority of Traditional Medicine in Managing IDA: The burden of iron-deficiency anemia (IDA) remains persistently high in India due to the poor tolerability of oral iron supplementation. Therefore, more focus is required to explore traditional medicine for safe and effective options for managing IDA. The primary treatment for IDA is oral iron replacement therapy, which is convenient, affordable, and effective in the management of stable IDA patients [8]. It rapidly improves hemoglobin levels, but it is often poorly tolerated over time due to associated nausea, vomiting, constipation, and abdominal discomfort [9]. The poor tolerability of oral iron supplementation may compromise its good compliance and, in turn, leads to the persistence of IDA [10]. Hence, it is imperative to explore traditional medical systems for interventions with comparable efficacy to oral iron supplementation, minimal adverse event/adverse drug reaction, and better tolerability.

Drug Review: *Tryushanadi Mandura* (*Chakradutta* Pandu Roga Chikits Adhyaya8/35-40).

TABLE 1: INGREDIENTS OF *TRYUSHANADI MANDURA*

S. no.	Drug	Botanical Name	Part used
1	*Tvak*	*Cinnamomum zeylanicum Breyn.*	Twak, Patra
2	*Shunthi*	*Zingiber officinalis Rosc.*	Rhizome
3	*Maricha*	*Piper nigrum Linn.*	Phal
4	*Pippali*	*Piper longum Linn.*	Phal
5	*Pippalimool*	*Piper longum Linn.*	Mool
6	*Vidang*	*Embelia ribes Burm. F.*	Phal
7	*Devdaru*	*Cedrus deodara Lond.*	Kandsar
8	*Chitrak*	*Plumbago zeylanica Linn.*	Mool Twak
9	*Daruharidra*	*Berberis aristata DG.*	Mool
10	*Haritaki*	*Terminalia chebula Retz.*	Phal
11	*Bhibitaki*	*Terminalia bellerica Roxb.*	Phal
12	*Amalaki*	*Embelica officinalis Gaertn.*	Phal
13	*Chavya*	*Piper retrofractum Vahl.*	Mool
14	*Mustak*	*Cyperus rotundus Linn.*	Rhizome
15	*Swarnmakshik*	Chalcopyrite	Bhasma

16	*Mandura*	Ferric oxide	Bhasma
17	*Gomutra*	Cow urine	

TABLE 2: THE *RASA-PANCHAKA* OF CONTENTS OF *TRYUSHANADI MANDURA*

S. no.	Drug	*Rasa*	*Guna*	*Virya*	*Vipaka*	*Doshaghnata*
1	*Tvak* [11]	*Katu, Madhura, Tikta*	*Laghu, Rooksha, Tikshna*	*Ushna*	*Katu*	*Kaphavatahara,*
2	*Shunthi* [12]	*Katu*	*Laghu, Snigdha*	*Ushna*	*Madhura*	*Vata Kaphahara*
3	*Maricha* [13]	*Katu*	*Laghu, Teekshna*	*Ushna*	*Katu*	*Vata Kaphahara*
4	*Pippali* [14]	*Katu*	*Laghu, Teekshna, Snigdha*	*Anushna sheeta*	*Madhura*	*Kaphavatahara*
5	*Pippalimool* [15]	*Katu*	*Laghu, Rooksha*	*Ushna*	*Katu*	*Kaphavatahara, Pittakara*
6	*Vidang* [16]	*Katu, Tikta*	*Ruksha, Laghu, teekshna*	*Ushna*	*Katu*	*Kaphavatashamaka*
7	*Devdaru* [17]	*Tikta*	*Laghu, Snigdha*	*Ushna*	*Katu*	*Kaphavatashamaka*
8	*Chitrak* [18]	*Katu*	*Laghu, Rooksha, Teekshna*	*Ushna*	*Katu*	*Kaphavatashamaka, Pittavardhaka*
9	*Daruharidra* [19]	*Tikta, Kashaya*	*Laghu, Rooksha*	*Ushna*	*Katu*	*Kaphapittashamaka*
10	*Haritaki* [20]	*Kashaya pradhanalavanavarjita sadrasa*	*Laghu, Rooksha*	*Ushna*	*Madhura*	*Tridoshasamaka*
11	*Bhibitaki* [21]	*Kashaya*	*Laghu, Rooksha*	*Ushna*	*Madhura*	*Tridoshahara*
12	*Amalaki* [22]	*Amla pradhana lavana varjita rasa*	*Laghu, Rooksha*	*Sheeta*	*Madhura*	*Tridoshasamaka*
13	*Chavya* [23]	*Katu*	*Laghu, Rooksha*	*Ushna*	*Katu*	*Kaphavatashamaka, Pittavardhaka*
14	*Mustak* [24]	*Katu, Tikta, Kashya*	*Laghu, Rooksha*	*Sheeta*	*Katu*	*Kapha Pittashamaka*
15	*Swarnmakshik* [25]	*Madhura, Tikta*	*Snigdha, Guru*		*Katu*	*Tridoshanghan*
16	*Mandura* [26]	*Madhura, Kashaya Tikta*	*Guru Rooksha*	*Sheeta*	*Madhura*	*Pittasamaka*
17	*Gomutra* [27]	*Katu, Tikta, Kashya Anurasa-Lavana*	*Laghu, Rooksha Tikshna*	*Ushna*	*Katu*	*Kaphavatashamaka Pittavardhaka*

TABLE 3: AYURVEDA PROPERTIES AND PHARMACOLOGY ACTION FOUND IN THE INGREDIENTS OF *TRYUSHANADI MANDURA*

S. no.	Drug	Ayurveda properties	Pharmacology Action
1	*Tvak*	*Pachan, Ruchya* [28]	antioxidant, Anti-inflammatory Activity [29]
2	*Shunthi*	*Hrdya, Deepana, Ruchya, and Pachana* [30]	anti-inflammatory, bioavailability enhancer, anti-oxidant and gastroprotective [31]
3	*Maricha*	*Deepana, Pachana, Vatanulomana, Krimighna,*[32]	Increases the permeability of intestinal cells [33]
4	*Pippali*	*Deepana, Hrdya, Ruchya, Rasayana,* and *Balya* [34]	Anti-inflammatory [35], anthelminthic, immunomodulator [36], bioavailability enhancer [37]
5	*Pippalimool*	*Agnideepana, Pachana*[38]	Tonic, anthelmintic, digestive, anti-inflammatory [39]
6	*Vidang*	*Balya, Deepana, Pachana, Anulomana and Rasayana* [40]	Anthelminthic [41]
7	*Devdaru*	*Vatanulomana, Amahara and Deepana* [42]	Anti-inflammatory, anti-ulcer [43]
8	*Chitrak*	*Deepana, Pachana, Rasayana* [44]	Anthelminthic, and appetizer, digestive [45]
9	*Daruharidra*	*Dipana, Pachana, Rasayana* [46]	Anti-inflammatory, anti-diarrheal [47]
10	*Haritaki*	*Rasayana, Cakshushya, Ayuvardhaka, Brhmana, Anulomana, Balya, Medhya, Deepana Pachana* [48]	Anti-oxidantlaxative, stomachic, cardio tonic, hypotensive, myocardial depressan [49]
11	*Bhibitaki*	*Deepana, Pachana, Anulomana, Dhatuvardhaka* [50]	Hepatoprotective, anti-inflammatory, and anti-oxidant [51]
12	*Amalaki*	*Rasayani, Deepana, Stambhana, Medhya, Anulomana, and Hrdya* [52]	Anti-inflammatory, anti-oxidant [53], hepatoprotective, growth promoting, improves homeostasis, and cytoprotective [54]
13	*Chavya*	*Deepana, Pachana, and Vatanulomana* [55]	Muscle relaxant, anti-catarrhal [56]

14	*Mustak*	*Medhya, Deepana, Pachana, Balya* [57]	Anti-inflammatory, anti-oxidant, and gastroprotective activity [58]
15	*Swarnmakshik*	*Rasayan, Hrudya, Chakshushya* [60]	Anti-oxidant, Neurological action [59]
16	*Mandura*	*Ruchikaraka, Deepana, Raktavriddhirikara,* and *Dardyakara 61*	Hematinic, cytoprotective, hepatoprotective, and provides sufficient amount of iron essential for normal erythropoiesis [62]
17	*Gomutra*	*Krimighna, Medhya,* and *Agnideepana Lekhana* [63]	Immunity enhancer, anti-oxidants, bio-enhancer, and contains erythropoietin stimulating factor [64]

TABLE 4: CHEMICAL CONSTITUENTS FOUND IN THE INGREDIENTS OF *TRYUSHANADI MANDURA*

S. no.	Drug	Chemical constituents
1	*Tvak*	Essential oil, tannin and mucilage [65]
2	*Shunthi*	Essential oil, pungent constituents (gingerol and shogaol), resinous matter and starch [66]
3	*Maricha*	Alkaloids (Piperine, Chavicine, Piperidine, Piperetine) and Essential Oil [67]
4	*Pippali*	Essential Oil and Alkaloids [68]
5	*Pippalimool*	Alkaloids (Piperine, Piperlongumine, Piperlonguminine etc), Essential Oils [69]
6	*Vidang*	Benzoquinones, alkaloid (Christembine), tannin and essential oil [70]
7	*Devdaru*	Terpenoids, Flavonoids and Glycosides [71]
8	*Chitrak*	Plumbagin [72]
9	*Daruharidra*	Alkaloids [73]
10	*Haritaki*	Tannins, anthraquinones and polyphenolic compounds [74]
11	*Bhibitaki*	Gallic acid, tannic acid and glycosides [75]
12	*Amalaki*	Ascorbic acid and gallotannins [76]
13	*Chavya*	Alkaloids, Glycosides and Steroids [77]
14	*Mustak*	Volatile Oil [78]
15	*Swarnmakshik*	Iron, Sulphur
16	*Mandura*	Iron, Silica, fayalite
17	*Gomutra*	Salt, minerals, urea and enzymes

DISCUSSION: Due to the predominance of *Katu-Tikta Rasa Tryushanadi Mandura* will improve the *Agni*, exhibit germicidal action, and will aid in clearing the Srotas [79]. Due to predominance of *Laghu Rooksha Guna*, it will act as *Pathya, Ropana, and Sthambana*. Since most of the drugs possess mainly *Katu Vipaka*, it will help in subsiding the symptoms due to vitiated *Kapha.* The formulation will enhance *Pachana* due to its *Ushna Veerya* which is very essential in conditions associated with *Mandagni* and *Ama* [80]. The ingredients such as *Chitraka*, Chavya, and *Pippali* will act as appetizer, digestive, hepatoprotective, cholagogue, and gastro protective which will alleviate *Aruchi*. Further, *Tryushanadi Mandura* contains *Amalaki*, one of the richest sources of ascorbic acid which helps in the absorption of iron Further, *Lauha Bhasma* possesses hematinic and hemoglobin regeneration properties [81]. *Pippali*, *Amalaki*, *Musta* is *Balya* and will act as immunomodulator which is helpful for controlling *Shrama*. *Mandura Bhasma*, *Daruharidra*, and *Gomutra* are digestive and hematinic which will help in balancing erythropoiesis and thus alleviates *Panduta*, the cardinal symptom of the disease. The drugs such as *Maricha, Pippalimula*, *Chavya, Shunti*, and *Pippali* will act as analgesic and thus help in managing *Pindikodweshtana*. *Pippali*, *Musta*, *Chitraka*, *Triphala, Maricha, Shunti*, *Vidanga*, and *Daruharidra* possess *Dipana*, *Pachana*, and *Amahara* properties along with antipyretic activity and are effective against symptoms such as *Jwara, Alasya,* and *Gaurava*. The *Rasayana* and *Raktavardhaka* action of *Triphala*, *Vidanga*, *Daruharidra*, and *Mandura bhasma* will act against *Dhatu kshaya*. Few drugs such as *Pippali*, *Shunti*, *Bibhitaki*, and *Daruharidra* act on *Pranavaha Srotas* and help in alleviating *Shwasa*, that is, shortness of breath. Drug such as *Triphala*, and *Gomutra* exhibits properties such as *Dipana*, *Pachana*, *Rechana*, and *Bhedana.* *Gomutra*, and *Shunti* ingredients will act as *Mutrala* and *Shothaghna* and thus alleviate *Shotha*. In cases of anemia of inflammation due to associated inflammatory diseases in which features such as low serum iron despite adequate systemic iron stores is present, drugs possessing anti-inflammatory action such as *Pippali*, and *Amalaki* will come in aid [82]. *Rakta Dhatu* gets vitiated due to the intake of *Nishpava, Masha, Pinyaka, Tila*, *Kshara*, *Mrit*, and food substances which are *Ushna*, *Vidahi, Teekshna, Asatmya, and Viruddha*

Ahara. The vitiated *Rakta Dhatu* will further affect the *Moolasthana of Raktavaha Srotas*, that is, *Yakrut* and *Pleeha* [83]. The drugs possessing hepatoprotective action will help in preventing the condition from further progression. Anti-ulcerative drugs such as *Amalaki*, *Devadaru* and *Musta* will help in sustaining the gastric function which is very essential for absorption of Iron [84]. Helminths that are transmitted through soil may get ingested and further infect the gastrointestinal tract leading to hampered food intake, malabsorption, and nutrient loss due to the intake of *Mrit* (pica) which is enlisted as one of the causative factors for *Pandu Roga* [85]. Drugs such as *Vidanga*, *Musta*, *Chitraka*, *Pippali*, and *Pippalimoola* possesses anti-helminthic property and can act against the progression of the disease in such conditions. *Mandura bhasma* is considered as incinerated red oxide of iron, which is the main component of *Tryushanadi Mandura*. It pacifies aggravated Pitta and improves digestion and metabolism. The required amount of iron for normal erythropoiesis can be supplied by the ferric and ferrous forms of *Mandura*. *Gomutra*, the *Dravya* which is used for the *Shodana* of *Mandura*, is an antioxidant and it contains erythropoietin hormone which helps in the production of red blood cells and hemoglobin. The functional grouping of the formulation ingredients according to their principal Ayurvedic actions (*Deepana-Pachana*, *Rasayana*, *Balya*, and *Anulomana*) is summarized in **Fig. 1.**

CONCLUSION: *Pandu* is a *Tridoshaja Vyadhi* with *Pitta* as a predominant *Dosha*. It is more prevalent among poor and middle class and especially women are more prone to this disease. It is found more in *Mandagni* people. It can be concluded that *Tryushanadi Mandura*, a poly herbomineral formulation. Iron is an essential element as it is essential for various metabolic processes such as oxygen transport, DNA synthesis, and electron transport [86]. The body requires iron for the synthesis of its oxygen transport proteins, that is, hemoglobin and myoglobin and for the formation of heme enzymes and other iron-containing enzymes involved in electron transfer and oxidation reductions [87]. Anemia, if left untreated, can affect cognitive development, immunity mechanisms, work capacity, and learning ability. In case of unresolved IDA during pregnancy, it can lead to increased risk of sepsis, maternal mortality, perinatal mortality, and low birth weight [88]. So, we can use *Tryushanadi Mandura* as easily obtainable, palatable, cost-effective alternative drug of choice in iron deficiency anemia (IDA) in children.

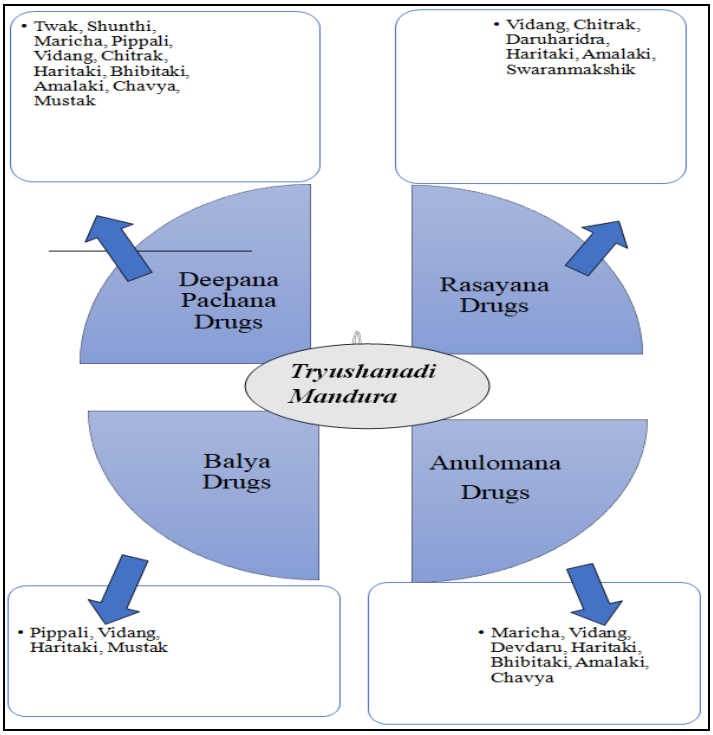

FIG. 1: FUNCTIONAL GROUPING OF THE INGREDIENTS OF TRYUSHANADI MANDURA ACCORDING TO THEIR PRINCIPAL AYURVEDIC ACTIONS

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CONFLICTS OF INTEREST: Nil

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