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The Role of Complementary Herbal Supplements on Phenylhydrazine-Induced Toxicities.

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ABSTRACT

Phenylhydrazine is a toxic compound that can induce a range of adverse effects in the body, including haemolytic anaemia, liver damage, and oxidative stress. Phenylhydrazine and its derivatives were initially used in medicine at the end of the nineteenth century, although with limited success. At high concentrations, Phenylhydrazine causes haemolytic anaemia. It causes haemolytic anaemia by causing the loss of red blood cells due to oxidative stress within erythrocytes and alterations at the cellular level. Other Phenylhydrazine adverse effects include the production of Methaemoglobin and Heinz bodies. This substance has the ability to influence immunological responses. Phenylhydrazine was originally used to treat hemocytopenia, a condition that causes damage at several levels in various organs. Various herbal supplements with single or multiple biological activities have been reported to be effective and beneficial against anaemia caused by Phenylhydrazine derivatives tested on rats because they have anti-oxidant, anti-inflammatory, cytoprotective, immunomodulatory, and anti-anaemic effects, depending on the phytochemical constituents present in the particular plant.

KEYWORDS: phenylhydrazine, haemolytic anaemia, *Cucurbita maxima, Rubia cordifolia, Eclipta Prostrata,* Phytochemical Constituents.

INTRODUCTION.

In 1875, Hermaan Emil Fischer discovered phenylhydrazine, the first hydrazine derivative [1,2,3].It was originally used as an antipyretic, but it is now deemed life-threatening due to its toxic side effect on red blood cells[1,3].Phenylhydrazine is a powerful medicine that reduces the number of red blood cells in the body.It lowers haemoglobin levels and packed cell volume while raising Mean Cell Volume, Mean Cell Haemoglobin, and Mean Corpuscular Haemoglobin Concentrations[2,4,5].It's a powerful oxidant agent that's commonly employed in industries, laboratories, and therapeutic settings. Haemolytic anaemia, immunological disturbances, hypoxia in human leukemogensis, inflammation, polycethimea, changes in the liver, kidney, and central nervous system, and cancer have all been reported as adverse effects of Phenylhydrazine[2,6,7].The strong oxidant phenylhydrazine is well-known. It includes phenyldiazene, phenylhydrazil radical, and benzenediazonium, all of which oxidise haemoglobin and cause damage to RBCs[8].Phenylhydrazine causes haemolytic damage, which is caused by oxidative changes in red blood cell proteins, and it also affects immunological responses[9].

Anemia is defined as a drop in haemoglobin levels in the blood, resulting in a reduction in oxygen carrying capacity[10].Green tea use in excess may cause iron deficiency anaemia in middle-aged patients[11].For many years, phenylhydrazine was used to induce anaemia until Morrawitz and Pratt hypothesised that it may be used to treat polycythaemia vera,a clonal condition that causes the body's total number of erythrocytes to increase[3].The impact of polycythemia on blood flow in certain organs has been studied, as well as the impact of different stages of anaemia on cardiac output[12]. Oral phenylhydrazine is hazardous, as well as inhalation and dermal phenylhydrazine[5,13].It defines a material's propensity to cause harm to biological systems[3].Phenylhydrazine causes an increase in reactive oxygen species and lipid peroxidation while also lowering glutathione levels[1,2].Furthermore, N-acetyl cysteine[1] reverses these effects. Haemolytic anaemia is caused by the absorption of erythrocytes by macrophages in the spleen and the translocation of phosphatidylserine from the inner to outer plasma membrane[1, 6]. It produces oxidative stress in erythrocytes, culminating in oxyhemoglobin oxidation, methemoglobin production, and then irreversible hemichrome synthesis [5]. Erythrocyte destruction is caused by the oxidative stress caused by phenylhydrazine. Vitamins E and C help to reduce the oxidative stress brought on by phenylhydrazine. Hepatic alterations in expression of the subset of genes Alas2, beta-glo, Eraf, Hxmol, Lgals, and Rhced that are mechanically connected to haematotoxicity are detectable by phenylhydrazine[2].

Table 1: HERBAL SUPPLEMENTS AND THEIR IMPACT ON PHENYLHYDRAZINE-INDUCED TOXICITIES

Sr no	Name of herbs	Pharmacological actions	Parts used	Phytochemical constituent	References	Year
1	*Amaranthus cruentus*	Anti-anemic, immunomodulatory	leaf	Alkaloid, carbohydrates ,glycosides	[1]	2021
2.	*Cucurbita maxima*	anti-oxidant, anti-tumor, anti-inflammatory, anti-bactrial	Seed, fruit pulp	linoleic acid, palmitic acid, alkaloids, flavanoids	[5]	2019
3.	*Rubia cordifolia*	blood purifier, anti-oxidant, immune modulator, anti-inflammatory, analgesic, hepatoprotective, naphroprotective	Leaf,root	Purpurin, Manjistin, alkaloids, gylcosides, tannins,phenols, and flavonoids	[8]	2017
4.	*Sesamum indicum*	anti-diabetic, anti-cancer, antioxidant, anti-inflammatory, hepatoprotective, anti-fungal, anti-microbial	seeds	polyphenols, alkaloids, flavanoids, terpenoids, glycosides	[25]	2021
5.	*Eclipta prostrate*	anti-inflammatory, anti-oxidant, anti-microbial, anti-cancer	Whole plant	Alkaloids, stigmasterol daucosterol	[6]	2017
6.	*Azadirachta indica*	anti-oxidant, anti-inflammatory	All parts	limonoids, terpenoids, azadironw, azadirachtin,	[2]	2017

				and flavonoids		
7.	*Moringa oleifera*	anti-oxidant, anti-inflammatory, anti-cancer, and anti-hyperglycemic	leaf	Alkaloids, anthraquinone, coumarins, flavones, phenols, quinines and tannins, steroids, glucosinolates	[30]	2018
8.	*Fumaria Indica*	Antibacterial, anti-implantation, anti-estrogenic, anti-cancer, hypotensive, hepatoprotective, analgesic, and anti-inflammatory	Leaf,root	alkaloids narceimine, narlumidine, and adlumidine	[32]	2020
9.	*Murraya Koenigii*	Anti-oxidant, anti-inflammatory, cytotoxicity	Fruit,leaf,root, stem	koenimbine, koenine, koenigine, mahanine, bismurrayafoline E, Euchrestine, Bimahanine, Bispyrafoline, Isomahanine, O-methyl murrayamine A, O-methyl mahanine,	[33]	2015

				Lutein, Tocopherol, Carotene, and mahanimbine		
10.	*Glycyrrhiza glabra*	Antibacterial, anti-inflammatory, anti-oxidant, anti-malarial, and anti-hyperglycemic	plant	Liquorice,triterpenes and flavonoids	[36]	2017
11.	*Solanum Nigrum*	anti-tumor, anti-oxidant, anti-inflammatory, diuretic, hepatoprotective, and anti-pyretic	leafs	flavanoids	[58]	2018
12.	*T chebula* (haritaki), *E officnalis* (amalaki), and *T bellirica*	Immunomodulatory,cytoprotective, antioxidanr, anti-inflammatory	Leaf,root	ellagic and gallic acids, whereas E. Officinalis contains gallic acid derivatives such as epigallocatechingallate.	[21]	2016
13.	*Zingiber officinale*	anti-inflammatory, anti-oxidant.	root	6-gingerol, 8-gingerol, 10-gingerol, and 6-shogaol are among the constituents	[56]	2020
14.	*Trigonella foenum-graecum*	Anto oxidant, anti-inflammatory	Leaves and seeds	Alkaloids, carbohydrates, proteins,	[59]	2021

				flavonoids, tannins		
15.	*Tinospora cordifolia*	Antioxidant, anti-inflammatory, and immune-stimulant	Leaf,root	Alkaloids, berberine, palmatine, tinosporin	[64]	2021
16.	*Allium Sativum*	Garlic contains sulphur-containing compounds, which have anti-inflammatory, immunomodulatory, anti-tumor, anti-cancer, and cardioprotective	Garlic	Alliin Allicin E-Ajoene Z-Ajoene	[66]	2021
17.	*Aloe Vera linn*	Anti-inflammatory, anti-oxidant, anti-cancer, immunoboosting	Leaf gel	Phenylalanine, arginine, tyrosine, aspartic acid and histidine	[78]	2015
18.	*Phyllanthus niruri*	anti-inflammatory and antioxidant properties[83]. In flavonoids, rutin has anti-oxidant properties, and astraglin has immunomodulatory properties[81].	leaf	Quercetin contains a flavonoid called naringin. In flavonoids, rutin and astraglin .	[79]	2020
19.	*Ipomoea batatas L*	anti-oxidant, anti-inflammatory, and anti-anemic, anti-sickling	leaf	Anthocyanins, beta carotene, flavonoids, phenols	[85]	2021
20.	*Beta vulgaris*	anti-oxidant, anti-inflammatory, and anti-anemic,	root	phenolics, including	[91]	2021

				rutin, epicatechin, and caffeic acid		

- **<u>Detailed summary of herbal plants and supplements on toxicity of phenylhydrazine</u>**

(A) Amaranthus

It is sometimes known as pigweed, is a gluten-free pseudocereal[14]. *Amaranthus cruentus* is high in calcium, iron, and vitamins A, E, and C, as well as protein, calcium, and folic acid [8, 15]. This is used to cure anaemia since it is high in iron [8]. This vitamin is beneficial in a variety of ways and is involved in hematopoiesis[8]. The extracts were discovered to be high in tannins, alkaloids, flavanoids, and polyphenols, indicating that they have antioxidant characteristics, with rutin and quercetin being the most abundant. As a result, it protects against phenylhydrazine toxicity and has antianemic qualities [8]. In addition, it exhibits immunomodulatory properties [16].

(B)*Cucurbita maxima*

Pumpkin is a genious plant that belongs to the cucurbitaceae family[17]. There are various species of pumpkin, the most common of which are *cucurbita maxima*, *cucurbita pepo*, and *cucurbita moschata* [17]. The leaves of *Cucurbita maxima* have been shown to be effective in the treatment of anemia[18]. Pharmacologically, it is utilised for anti-oxidant, anti-tumor, anti-inflammatory, anti-bactrial, and other functions. *Cucurbita pepo* constituents such as linoleic acid, palmitic acid, alkaloids, and flavanoids are responsible for these activities[19].

(C)*Rubia cordifolia*

It is used in modern pharmacology and is known as manjistha[20,21]. Indian madder has anti-inflammatory properties due to active constituents such as rubimallin found in the roots [20, 22].

It inhibits the lipoxygenase enzyme pathway, which catalyses the production of various inflammatory compounds [22]. Alizarin, hydroxyl anthraquinones, and rubiadin are anti-

oxidants[20,22]. It also functions as an immunomodulator due to the presence of alkaloids, gylcosides, tannins, phenols, and flavonoids. This plant has pharmacological properties such as blood purifier, anti-oxidant, immune modulator, anti-inflammatory, analgesic, hepatoprotective, naphroprotective, and many more[22,23]. Furthermore, constituents such as Purpurin and Manjistin have anti-oxidant properties[21].

(D)*Sesamum indicum*

The seeds are referred to as the "queen of the oil seed corps"[24]. Several studies have revealed anti-diabetic, anti-cancer, antioxidant, anti-inflammatory, hepatoprotective, anti-fungal, anti-microbial, and other activities[25]. *Sesamum indicum* included polyphenols, alkaloids, flavanoids, terpenoids, and glycosides, among other secondary metabolites. Sesame seeds are high in magnesium, which is beneficial to respiratory health. The iron-rich black seeds are beneficial in the treatment of anemia. Flavonoids are well-known for their anti-oxidant properties. Sesamol, a powerful phenolic anti-oxidant found in sesam seeds, is a potent phenolic anti-oxidant. Sesame seeds are readily ingested as part of a regular diet, and they provide several health benefits. Natural anti-oxidant having a wide range of uses in the food industry. Terpenoids also have an anti-inflammatory effect[24]. Because of its ability to scavenge free radicals, sesame has antioxidant activity and so decreases oxidative stress through modulating antioxidant enzymes and oxidative stress markers. Compounds such as unsaturated fatty acids (oleic, stearic, and palmitic) and lignans are anti-inflammatory (sesamol,sesamolin,sesamin). It has been linked to anti-inflammatory action in sesame oil[25].

(E)*Eclipta prostrate*

It is often known as false daisy in English, and in Ayurveda, it is known as eclipta abla and bhringraj. The plant extract has a number of anti-inflammatory properties. Food contains natural anti-oxidants such as alkaloids, flavonoids, phenols, and tocopherols[26]. Lutenolin-7-glucoside, luteolin, apigenin, and orobal are flavanoids that have anti-oxidant and anti-inflammatory properties. The active element of thiopenes is bithiophenes, which possesses anti-inflammatory, anti-microbial, anti-cancer, and other properties. Procatechuc and 4 hydroxy benzoic acid, which are phytochemical constituents of phenolic acid, have anti-oxidant, anti-inflammatory, and anti-cancer properties[27]. Active constituents in saponins include Eclabatin and dasyscyphin C, both of which have anti-oxidant properties. [20-epi-3dehydroxy-3-oxo-5,6dihydro-4,5-dehydroverazine], a phytochemical found in alkaloids, has antioxidant and cytotoxic properties.

Finally, sterol contains anti-oxidant and cytotoxic constituents such as stigmasterol and daucosterol[27].

(F)*Azadirachta indica*

Often known as Neem, is a member of the Meliaceae family, and all parts of the plant have been employed in Ayurveda from ancient times. These are used to isolate compounds such limonoids, terpenoids, azadironw, azadirachtin, and flavonoids[2]. Alkaloids, polysaccharides, gylcosides, tannins, and phenolics are all present. Because of its high anti-oxidant content, neem has the ability to scavenge free radicals. It also acts as an anti-inflammatory by regulating the activity of proinflammatory enzymes such as cyclooxygenase (COX) and lipoxygenase (LOX) enzymes[28].

(G*)Moringa oleifera*

It is a commonly grown plant in the Moringaceae family. Alkaloids, anthraquinone, coumarins, flavones, phenols, quinines and tannins, steroids, glucosinolates, and other phytochemical constituents are found in the leaves[29-31]. It is also said to alleviate malnutrition since the leaves are abundant in protein and micronutrients[29]. It is also high in minerals and vitamins A and B[30]. It possesses 46 different anti-oxidant effects in its leaves[29]. Apart from that, it's renowned for its anti-inflammatory, anti-cancer, and anti-hyperglycemic properties[30]. In morigna leaf, flavonoids including quercetin and kaempferol are recognised to be more strong anti-oxidants[29]. Biological activities of this plant's leaves include inflammation, digestive problem, antioxidant, and immunomodulator [31]. As a result of its anti-oxidant effects, it is a potential treatment for anemia[29]. Mangiferin, a component found in the fruit, has anti-inflammatory properties[21].

(H)*Fumaria Indica*

In indian medicine, it is one of the most regularly utilised herbs[3]. *Fumaria indica (L)* is the scientific name for this plant, which belongs to the fumariceae family[32]. This plant is used to make parpatadya kawatha and parpatadya arista[3], among other traditional recipes. Antibacterial, anti-implantation, anti-estrogenic, anti-cancer, hypotensive, hepatoprotective, analgesic, and anti-inflammatory properties have been reported for this plant extract. The alkaloids narceimine, narlumidine, and adlumidine, among others, have anti-inflammatory properties [33]. Because it

has a significant amount of phenolic, flavonoid, and alkaloid content, the blossoms of fumarica indica have hemoprotective properties[3].

*(*I)*Murraya Koenigii* Spreng

Vitamins, alkaloids, carbazole, phenolic, terpenoids, and minerals such as calcium, iron, and zinc were found in the leaves of this plant[33-35]. In mice, the fruit juice causes a rise in Hb and RBC levels[33]. The entire plant is used as an anti-inflammatory and blood purifier, while the leaf is used to treat anaemia and is anti-inflammatory[34]. Mukoeic acid, a component found in the stem bark, has antioxidant properties[34]. Constituents found in the leaf include koenimbine, koenine, koenigine, mahanine, bismurrayafoline E, Euchrestine, Bimahanine, Bispyrafoline, Isomahanine, O-methyl murrayamine A, O-methyl mahanine, Lutein, Tocopherol, Carotene, and mahanimbine[30]. Mulokine, a substance found in the root, has cytotoxic action, whereas koenoline, found in the seed, has cytotoxic activity[34].

(J)*Glycyrrhiza glabra*

Glyccyrrhizic acid, saponin, and triterpene are active components that help to stop the synthesis of anti-inflammatory cytokines[36]. Antibacterial, anti-inflammatory, anti-oxidant, anti-malarial, and anti-hyperglycemic activities have also been discovered in this plant extract[37]. According to a research by Samadnejat et al., licorice has potent anti-inflammatory properties via lowering pro-inflammatory cytokines[38,39]. TNF-alpha, NO, and IL-6 concentrations were reduced[34]. Three triterpenes (including 18beta glycyrrhetinic acid, 18 alpha-glycyrrhizin, and 18 beta-glycyrrhizin) and flavonoids (dehydroglysasperin D, dhydroglyasperin C, licorisoflavan A, and others) were shown to have anti-inflammatory activity. Antioxidant components in this plant are reported to have a significant hematoprotective effect. Because free radicals tamper with biological cell membranes such as Rbcs through peroxidation of unsaturated fatty acids and produce pathological alterations, anti-oxidants play a key role in the destruction of free radicals and hazardous materials, as well as the maintenance of hemostasis. Li et al.(2011) and Liu et al.(2013) found that liquorice is high in triterpenes and flavonoids (antioxidant compounds), indicating that it possesses hematoprotective properties[38].

(K) *Solanum Nigrum*

(Black night shade), also known as kumbi in Hausa, is an extensively utilised anti-tumor, anti-oxidant, anti-inflammatory, diuretic, hepatoprotective, and anti-pyretic herb[40-44]. It also

exhibits other actions, such as cytotoxic activity[40]. It is a member of the solanaceae family[40,42]. It is used to treat anaemia in north-eastern Nigeria[41]. The antioxidant activity of a methanolic extract of plant berries was investigated, and the extract was found to have anti-oxidant properties[40]. The ethanolic extract of Solanum nigrum linn's dried fruit revealed antioxidant and cytotoxic activity, as well as free radical scavenging characteristics (flavonoids)[40,45]. The anti-inflammatory effect of a methanolic extract of the entire plant was tested in carrageenin. The ethanolic extract of Solanum nigrum Linn's dried fruit has cytotoxic activity[40].

(L) Triphala

It is powder with *T chebula* (haritaki), *E officnalis* (amalaki), and *T bellirica* (bibhitaki) ingredients [46,47,48,49,50]. It's an anti-oxidant that's utilised to cure anaemia [47,51,48,49,50]. *E.officnalis* is well known for its rasayana, which has anti-oxidant characteristics and is used for immunomodulation and cytoprotection[46,51,50,44]. Antioxidant properties are found in *Terminalia chebula*[46]. Three of the compounds have anti-inflammatory, anti-oxidant, and cytoprotective properties [46-50]. *T belerica* contains ellagic and gallic acids, whereas E. Officinalis contains gallic acid derivatives such as epigallocatechingallate, which has antioxidant and anti-inflammatory properties [21,45,48,50,51].

(M) *Zingiber officinale*

Ginger is another popular name for this plant, which belongs to the zingieraceae family[52]. 6-gingerol, 8-gingerol, 10-gingerol, and 6-shogaol are among the constituents. It has anti-inflammatory characteristics, and investigations have indicated that it has pharmacological qualities in common with non-steroidal anti-inflammatory drugs[53]. The plant also has anti-oxidant capabilities, such as preserving superoxide dismutase catalase and glutathione peroxide activity, which lowers lipid peroxidation[54]. Apart from its anti-inflammatory properties, it also functions as an antioxidant, blood purifier, and immune booster[52,55]. Sesquiterpenoids are the primary ingredients, with (-)- zingiberene as the predominant component[56].

(N) *Trigonella foenum-graecum*

Also known as fenugreek, is a member of the Fabaceae family[57,58]. Alkaloids, carbohydrates, proteins, flavonoids, tannins, and many other components are present[57]. It has a lot of flavonoids in it[21]. Antioxidant activity of the seeds is employed in treatment[59]. To begin with, the active

ingredient present, iron, aids in the treatment of anaemia. Second, it has anti-oxidant characteristics owing to the presence of flavonoids and polyphenols, and it also functions as an immunomodulator due to the presence of natural oxidants[60]. Fenugreek leaves and seeds are also high in beta-carotene, calcium, and other vitamins[61].

(O) *Tinospora cordifolia*

Commonly known as guduchi, giloe, and heart-leaved moonseed, is a member of the menispermaceae family and is used to cure anaemia[62,63]. It has immunomodulatory properties and improves immunomodulatory effects in mice by boosting WBC count[64]. Antioxidant, anti-inflammatory, and immune-stimulant activities are establish in the stem[63,65]. Alkaloids, berberine, palmatine, tinosporin, and other chemicals are found to be present[63]. It also has anti-oxidant and anti-cytotoxic properties[63,64]. Antioxidant properties are found in terpenoids and alkaloids[65].

(P) *Allium Sativum*

It is the scientific name for garlic, which is a member of the onion family and belongs to the Amaryllidacae family[66-68]. Garlic contains sulphur-containing compounds, which have anti-inflammatory, immunomodulatory, anti-tumor, anti-cancer, and cardioprotective properties[66]. It has been demonstrated that it acts as a protective agent against blood diseases and helps to alleviate hematoxicity[66]. An experiment on horses showed that taking too much garlic might cause anemia[69,67]. It also has anti-oxidant properties[68].

(Q) *Aloe Vera linn*

It is a member of the liliaceae family[70]. Anti-inflammatory, anti-oxidant, anti-cancer, immunoboosting, and many other properties have been discovered[70,71,72,44]. A daily dose can help with strokes, heart attacks, lukemia, anaemia, digestive problems, and more.The leaf component has anti-inflammatory, immune-stimulating, anti-oxidant, and immune-boosting properties, and is used to treat sickle cell disease[70]. Aloe is utilised to treat anaemia and reduces the irritating effects of iron in the GIT tract[73]. Aloe vera has a positive effect on haematological indices and immune cells in the blood and may be administered in safe therapeutic quantities via the oral route[74]. Its extracts are used to treat anaemia and immune deficiency disorders because they have hematopoetic and immunomodulatory properties[74,77]. It contains a lot of antioxidants and has a healthy appetite[75,76]. Because of the presence of vitamins, iron, anti-oxidants, and

other nutrients, it helps the haemopoietic process[76]. After long-term treatment, they exhibit free eadical scavenging action, improve haemoglobin concentration and erythrocyte count, and protect against anemia[77,78].

(R) *Phyllanthus niruri*

It is often known in Spanish as Chanca pidera, is a member of the Euphorbiaceae family[79-81]. It's used to cure a variety of ailments, including anaemia, jaundice, flu, hepatitis, and more[79,82,81] Flavonoids, alkaloids, anthraquinones, saponin, steroids, tannins, and a variety of other compounds are all present[79-82,]. Both ethanolic and methanolic extracts have antioxidant effects. Because flavonoids and alkaloids are the primary constituents, it has an anti-enamic effect[79]. There are also antioxidant, anti-inflammatory, and antiviral properties[80,82]. Quercetin contains a flavonoid called naringin, which has anti-inflammatory and antioxidant properties[83]. In flavonoids, rutin has anti-oxidant properties, and astraglin has immunomodulatory properties[81].

(S)Sweet potatoes

They are another name for *Ipomoea batatas L* from family convolvulaceae[84]. The invitro study of this plant reveals that the leaf extract has anti-oxidant, anti-inflammatory, and anti-anemic properties[85,88]. Because of the presence of anthocyanins, it also has anti-sickling properties[86]. It has anti-oxidant properties because it acts as a barrier against free radical damage[87,89]. Sweet potatoes can be consumed to treat anemia. Because of the phenolic compound, it has a high anti-oxidant content[88]. It is high in anti-oxidants because it contains beta carotene, flavonoids, phenols, and many other derivatives. The hydroalcholic extract of the leaves has anti-inflammatory properties[90].

(T)*Beta vulgaris*

It is a species of *Beta vulgaris,* also known as beetroot, table beet, beet garden, red beet, or golden beets, and their leaves[100]. It belongs to the Amaranthaceae family, and it has been proven that beetroot powder has significant and positive health effects[91,92]. It increased Rbc and Hb levels, possibly due to the presence of vitamins, minerals, and other elements, as well as MCV, MCH,

and MCHC levels[91]. It contains a significant amount of phenolics, which have anti-oxidant and anti-anemic properties. Iron, which is used to treat anaemia, is discovered[92]. Anti-inflammatory properties are found in aqueous extracts, ethanolic extracts, and beetroot pomace[93]. Betalains have been linked to beet roots' anti-oxidant, anti-inflammatory, and anti-tumor properties[93]. It also has a hematopoietic effect[94]. Beet root juice improves serum iron and CBC[95]. The betalains found in beet root have significant antiradical and antioxidant properties. Beetroot contains a variety of highly bioactive phenolics, including rutin, epicatechin, and caffeic acid, all of which are powerful antioxidants[96]. Phytochemical and mineral composition are thought to be responsible for the medicinal properties. Alkaloids, flavonoids, phenols, coumarins, terpenoids, fatty acids, tannins, saponins, anthocyanms, beta carotene, amino acids, and vitamins A, C, E, and K are all identified, as are minerals like magnesium, copper, calcium, iron, potassium, manganese, and folic acid. Beetroot has been shown to have an anti-anemic effect[97]. Polyphenol content in methanolic extracts of pulp waste from beet root ranged from 67 to 110mg, which was higher than in ethanolic and aqueous extracts[98]. Beet root has shown promise as a treatment for a variety of clinical pathologies associated with oxidative stress and inflammation. Its constituents, most notably betalain pigments, have anti-oxidant, anti-inflammatory, and chemoprotective properties. Members of the betalain family are classified as either betacyanin pigments (red) or betaxanthin pigments (yellow orange).Other plant-derived anti-oxidants, such as apicatechin, rutin, and caffeic acid, have also been identified in beet root[99]. The nutrition of 5% dried beet green for four days is non-toxic, safe, and aids in the prevention of anemia. The leaf contains the most iron. Vitamin content such as riboflavin, pyridoxine, cyanocobalamin, and folic acid of dried beet root from beet has rich source of vitamin B6 and B12 and folic acid while ethanolic extract root as source of vitamin B2 and show anti anaemic effect produced by leaf powder is due to their high content[100].

CONCLUSION

Phenylhydrazine is capable of efficiently producing anaemia in rats, which results in blood dyscrasia and abnormalities, as well as organ toxicity. Each herbal plant listed has different phytochemical constituents present in stems, leaves, barks, roots, or the entire plant is used, with constituents such as gallic acid, quercetin, phenolics, flavanoids, alkaloids, rubamallin, berberin, tannins, saponins, Eclabatin, dasyscyphin, and others that are responsible for biological activities and are reported to help cure anaemia. There have also been reports of herbal plant mixes being used to cure anaemia.

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