Research Article

Therapeutic Potential of Triphala against Human Diseases

Sonal Bhatnagar[1], Anita Rani[2], Reeta Kumari[3]*
[1]Department of Botany, Hindu College, University of Delhi, Delhi, India.
[2]Department of Botany, Dyal Singh College, University of Delhi, New Delhi, India.
[3]Department of Botany, Deen Dayal Upadhyaya College, University of Delhi, New Delhi
***Corresponding author's E-mail:** gautam.rita@gmail.com

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ABSTRACT

Triphala a combination of extract is derived from dried fruits of *Emblica officinalis*, *Terminalia chebula* and *Terminalia bellerica,* in equal proportions (1:1:1). The mixture and its individual ingredients are highly valued in the field of Ayurveda and considered as a controller of the human system aiding digestion, nutrient absorption and body metabolism. Triphala is known for its medicinal properties such as anti-aging, antianaemic, antibacterial, anticancerous, antidiabetic, antidiarrhoeal, antimutagenic, antioxidant, antiparasitic, antiviral, cardio protective, hepatoprotective, hypocholesterolaemic, radio protective and colon cleanser. All of the three constituents of Triphala are active and shows slight difference in activities under different sets of environmental conditions but the combination all three showed a significant and efficient effect as compared to individual components. Triphla is rich in active ingredients like tannins, carbohydrates, saponins, ellagic acid, sorbitol and ascorbic acid. The present review paper focuses on the potential of Triphala as therapeutic agent against various diseases.

Keywords: Anticancerous, Chebulic acid, *Emblica officinalis,* Gallic acid, *Terminalia bellerica, Terminalia chebula.*

INTRODUCTION

Triphala a traditional Ayurvedic herbal formulation is a combination of dried and powdered fruits of three medicinal plants *Emblica officinalis* L. (Euphorbiaceae) *Terminalia bellerica* Roxb. (Combretaceae) and *Terminalia chebula* Retz. (Combretaceae) in equal proportions (1:1:1). Triphala (Three Myrobalan) is highly valued in the treatment of headache, dyspepsia, healing activity on an infected wound and leucorrhoea in Ayurvedic and Iranian systems of medicines.[1-4] Triphala known as *'tridoshic rasayan'*, in Ayurveda shows steady and rejuvenated effects on three major elements of life i.e. vata (mind/nervous system), pitta (bile) and kapha (mucus***)*** in the Charaka Samihita.[5] The individual components of Triphala are active but shows slightly different activities under different environmental conditions, however, in combination of three showed a significant and efficient effect.[6] Triphala is rich in active ingredients like tannins, carbohydrates, saponins, ellagic acid, sorbitol and ascorbic acid.[7-14]

A large number of medicinal properties are attributed by Triphala such as anti-aging, antimutagenic, anticancerous, anti-inflammatory, antibacterial, antiviral, antioxidant, antianemic, antidiabetic, antiparasitic, antidiarrhoeal, cardioprotective, hepatoprotective, hypo cholesterolaemic, radioprotective, colon cleanser and gas distentioner.[13,15-20] According to Jagetia et al.[1] (2002) protective action against the deleterious effects of radiation is shown by Triphala by scavenging free radicals. Triphala induces cytotoxicity in tumour cells with significant cytotoxic effect on cancer cell-lines.[18,21] Triphala helps in improving digestion, assimilation and liver functions, and reducing lipid peroxidation, blood sugar and serum cholesterol. In this review paper we have highlighted the therapeutic potential of Triphala and its wide applications in the field of medicines. Collection of such a database is useful for future course of research and preparation of medicinal formulations. The therapeutic potential of Triphala is dependent on properties of its individual herbs which are described below:

Emblica officinalis L. (Amalaki)

Emblica officinalis or Amla is known as Indian Goose berry has been used since thousands of years in Chinese and Indian traditional system of medicine. It helps in body purification, effective removal of toxins and enhancing food absorption. *E. officinalis* regulates liver and eye functions[22], maintains skin glow and also reduces wrinkles. The body immunity is enhanced by producing more antibody to fight against invasion of antigens.[23] It accelerates blood clotting, wound healing and renews lost sexual vigour in men and women. It is rich in vitamin C and act as a powerful antioxidant agent by removing excess free radicals which forms the basis of reducing degenerative disease and ageing. Regular intake of *E. officinalis* shows an increase in cardiac glycogen and decrease in serum GOT, GPT and LDH which suggest a cardio protective action. *E. officinalis* is known to offer a wide range of biological effect on jaundice and diarrhoea, and also act as an antioxidant, antibacterial, antidiabetic, antiviral, antimicrobial, anti-inflammatory, antimutagenic, antitumor's agent.[24-36] The herb shows various pharmacological and therapeutic properties such as cytoprotective, gastro protective, hepatoprotective laxative, purgative, hypolipidemic and chemo-protective properties.

Table 1: Phytochemical constituents and ethnobotanical uses of Triphala

Botanical Name	Phytochemical Constituents	Ethnobotanical Uses	References
Emblica officinalis	Astragalin-flavanol, gallic acid-benzenoid emblicol, phyllembic acid, emblicanin-B embicanin, ellagic acid-canmarin, pedunculagin punigluconin-tanin, terchebin, trigalloylglucose corilagin, vitamin 'C', protein, carbohydrates linoleic acid,and 2 major alkaloids (phyllantidine andphyllantine).	Astringent, antioxidant, antidiarrhoeal, antacid, diarrhoea, dyspepsia, cough, indigestion, constipation, piles, jaundice, anaemia, weight loss and cardiac problems. It is beneficial for urinary infection, ulcers, stomach and intestinal inflammation.	8,10,11,16,23,25,28,31,34,60-62
Terminalia bellerica	Gallic acid, ellagic acid, 3, 4, 5-trihydroxybenzoic acid; ethyl gallate, Beta-sitoserol, Major tannins composed of chebulin, chebulinic acid, chebulagic acid, 1,3,6-Trigalloylglucose and 1,2,3,4, 6-pentagalloylglucose, corilagin, terchebin, glucogallin, palmitic acid, stearic acid, oleic acid, linoleic acid, arachidic acid, behenic acid.	Analgesic, antiallergenic, antibronchitic, antipyretic, anti-spasmodic, digestive aid, astringent, anaemia, asthma, bronchitis, tonic, laxative, leprosy, leucoderma, eye disorders, dyspepsia, diarrhoea, dysentery, intestine inflammation, liver diseases and germicidal, and agent, cough and tuberculosis.	38,39,41,42,58,59
Terminalia chebula	Gallic acid, ellagic acid, 1,6-di-O-galloyl-β-D-glucose, 3,4,6-tri-O-galloyl-β-d-glucose, 1,2,3,4,6-penta-o-galloyl-β-D-glucose, β-Sitosterol, bellericanin, nicalagin, casuarinin, corilagin, terchebin, terchebulin, tannic acid, nonchebulinic acid, corilagin, chebulanin, chebulin, chebulagic, chebulinic acid, anthraquinone glycoside, arjungenin, chebupentol, daucosterol, phyllemblin, punicalagin, quercetin, termilignan, thaninilignan, flavannolignan behenic acid.	Astringents, antitussive, antispasmodic, antiseptic, laxative, digestive, diuretic, chronic diarrhoea, dysentery, allergies, asthma, anaemia, carminative, eye disorders, diabetes, chronic and recurrent fever, hypertension, homeostatic, laxative, stomachic tonic. Increases appetite, digestive aid, liver stimulant, stomachic, gastrointestinal prokinetic agent, renal calculi, skin and dental disorders and cardio tonic activities.	9,17,47,49,53,55,63-70

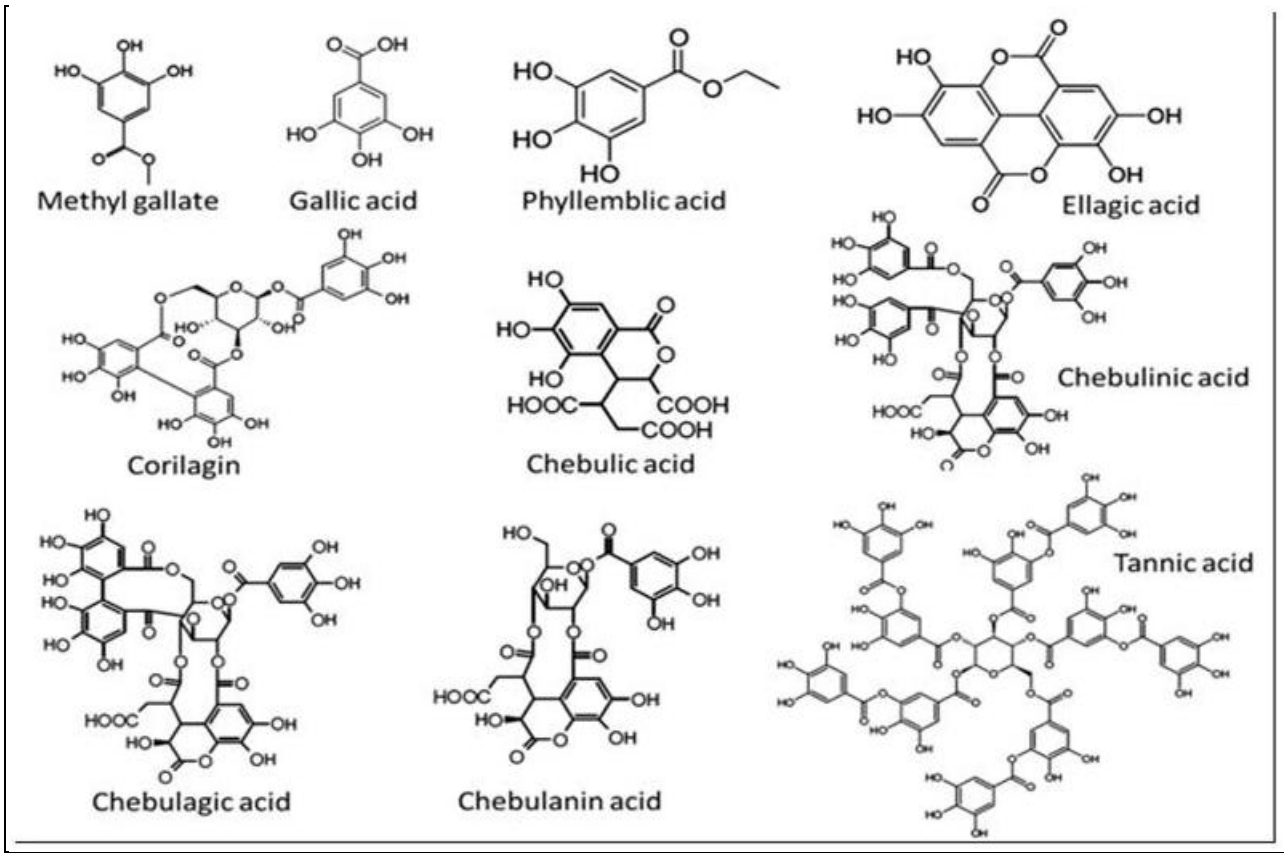

Figure 1: Major compounds of Triphala

Terminalia bellerica Roxb. (Bibhitaki/Vibhitaki)

Terminalia bellerica is known as "Behara" in Hindi and Vibhitaki' in Sanskrit is a homeostatic and bitter herb that aids in purification and circulation of blood in the body. It delivers the same valuable power as of *E. officinalis* in healing wounds, reducing fever, cough, diarrhoea, skin diseases, oral thrush, laxation and cleansing of bowels. It is effective against toxic accumulations in gall bladder, kidney, digestive, respiratory and urinary tract. *T. bellerica* has a specific anti-diarrheal and antiparasitic action against bacterial infection. Fruit extracts of *T. bellerica* show antimutagenic [37], antimicrobial [38], antiviral, antimalarial, anti-HIV, antifungal activities [39], antidiabetic, anti-mutagenic effects [40] and hepato-protective activities. It facilitates in controlling fat metabolism and blood cholesterol level.[41-43] It aids in liver and heart treatment by reducting atherosclerosis and the amount of lipid in liver and heart (protects from myocardial necrosis) which lower down the risk associated with these organs.[44]

Terminalia chebula Retz. (Haritaki)

Terminalia chebula is known as 'black/chebulic myroblans' in English and 'Harad' in Hindi. It is also known as "King of Medicine" in traditional system of medicine which is exploited extensively for its purgative activity to cure bleeding, piles and eye disorders.[45-47] It plays an important role in blood circulation and cleansing of macro and micro circulatory channels.[48] *T. Chebula* organizes the activity of the brain and its nerves, inhibits local anaphylaxis and acts as an anti-ageing drug that helps in the prevention of age related disorders such as muscular, cataract and retinal degeneration.[49,50] *T. chebula* act as a safe laxative, prevents blood clotting, supports body immune system, improves stomach functioning (absorption, digestion, assimilation and excretion) and maintains nutritional imbalance in body.[51-53] The pharmacological actions of *T. chebula* includes antibacterial, antimutagenic[54], antioxidant, anticancerous[55], antidiabetic, antimutagenic[56], cardioprotective and hypolipidemic activities.[57]

Chemical constituents of Triphala

Triphala is known to possess a large number of pharmaceutical and therapeutic properties due to the presence of various chemical constituents or phytochemicals such as tannin, phenols, alkaloids and flavonoids (Table 1, Figure 1). The fruits of *E. officinalis* are rich in tannins and possess 28 % of the total tannins distributed in the whole plant. It has hydrolysable tannins, emblicanin A and B which on hydrolysis gives gallic acid, ellagic acid and glucose wherein the other gives ellagic acid and glucose. [10] The principle component of *Terminalia bellerica* is gallic acid (3,4,5-trihydroxybenzoic acid). Chemically, the presence of β-sitosterol [58], gallic acid, ellagic acid, ethyl gallate, chebulagic acid, mannitol, glucose, galactose, fructose and rhamnose in the fruit of *T. bellerica* have been reported. The fruit extract shows marked bile stimulating activity and strong antioxidant properties.[44,59]

Terminalia chebula fruits are extensively practiced in Ayurvedic, Unani and Homoeopathic medicines. The compounds responsible for these properties includes chebulic acid, chebulagenic acid, arjungenin, arjun glucoside, arjunolic acid, chebupentol, corilagin, daucosterol, punicalagin, quercetin, terchebin, terchebulin and behenic acid. The phytochemical investigation of *T. chebula* shows the presence of various phenols such as gallic acid, ellagic acid, tannic acid, β-sitosterol, ethyl gallate, chebulic acid and mannitol.[64-70] Gallic acid (3,4,5-trihydroxybenzoic acid), is a naturally occurring polyphenol obtained by hydrolysis of tannins in plants is well known to show antioxidant, antimutagenic, cytotoxic and anticarcinogenic activities in a variety of *in vivo* and *in vitro* studies and its three adjacent hydroxyl groups are believed to be responsible for cytotoxic potential of plant fruit extract. [71] Several derivatives of gallic acid such as ethyl gallate, 2,3,4-trihydroxybenzoic acid and ellagic acid, induces apoptotic cell death in cancer cell lines such as human stomach cancer and human colon adenocarcinoma.[55,72] Inhibitory action on cancer cell growth by extract of *T. chebula* is due to the presence of chebulinic acid, tannic acid and ellagic acid which slows down the rate of cell proliferation and cell death in cancer cell line.[62]

Therapeutic Potential of Triphala

Anticancerous activity

Triphala helps in inducing cytotoxicity in tumour cells while leaving normal cells. The differential response shown by Triphala is due to differences in production of intracellular reactive oxygen species (ROS). It reduces the growth of cancer cells (metastasis) by inhibiting spindle formations at the mitotic phase.[16] It is also established that Triphala is more effective or significant in reducing tumour incidences as compared to its individual constituents. The constant consumption of Triphala in the diet significantly affects the antioxidant status and reduces benzo(a)pyrene component, which is responsible for tumour incidences, thus significantly establishes the chemo preventive potential.[15] Triphala shows a chemoprotective role against a highly toxic and carcinogenic compound (1,2-Dimethylhydrazine dihydrochloride) which induces carcinogenic damage to mouse liver. The major constituents such as ellagic acid, gallic acid, ethyl gallate, 2,4- chebulyl-β-glucopyranose, chebulinic acid, luteolin and tannic acid were found to be the growth inhibitory phenolic. [55] The structural analysis by spectroscopic techniques (mass spectroscopy, nuclear magnetic resonance and infrared) showed gallic acid as the major component responsible for cancer cell suppression.[21] *T. chebula* methanolic extract showed its effects on growth of several malignant cell lines with decreased cell viability with reduced proliferation that induced cell death due to necrosis in a dose dependent manner. It was also found that apoptosis was significantly

higher in the excised tumour tissue of Triphala fed mice as compared to the control, suggesting the involvement of apoptosis in tumour growth reduction.[73]

Triphala is an effective weapon against pancreatic cancer. Research carried out at the University of Pittsburgh, cancer institute has shown that Triphala can significantly slow down the growth of pancreatic cancerous cells of mice. It was observed that Triphala triggered the cancerous cells to die off and has significantly reduced the size of tumors without causing any toxic side effect. The results obtained are in correlation to the fact that Triphala is known to have some anti-cancerous properties although such direct correlation had not been established earlier. The cytotoxic effects of aqueous extract of Triphala have been investigated on human breast cancer cell line which suggests that Triphala possesses the ability to induce cytotoxicity in tumour cells.[18] Conventional and synthetic drugs used for the treatment of liver diseases can have many severe side effects as compared to Triphala which improves digestion and assimilation, reduces serum cholesterol, exerts potent cardio protective effect, improves liver functions.[74]

Antioxidants

Antioxidants play important role in reducing the process of excess oxidation and to protect cells from the damage caused by free radicals which in turn may cause or accelerate many diseases. Free radicals are nothing but the chemical species which contains one or more unpaired electrons and in order to attain stability by extracting electrons from them causes serve damage to other molecules.[75,76] Triphala acts as a potential source of natural antioxidant and is recommended to guard against free radicals and protect cells from damage caused by excess oxidation. Gallic acid a major polyphenol of Triphala has strong antioxidant property. Major phenolic compounds such as total phenols, flavonoids and triterpenoids contents of *Terminalia chebula* extract showed significant antioxidant activity by free radical scavenging activity and inhibition of DNA damage of plasmid. Triphala is also useful for free radical induced disorders such as paracetamol toxicity, heavy metal and radiation.[77,78] Thus, it plays an important role in preventing or slowing the progression of ageing and age-associated oxidative stress-related degenerative diseases. The antioxidant properties combined with its analgesic, antipyretic, chemo preventive, antidiabetic, antimutagenic and wound healing properties played by Triphala, a vital role is also played in the prevention, cure and repair of many of the age-related diseases.[79]

Antimutagenic activity

Medicinal plants and their active principles have been largely explored for their potential in the field of the modern system of medicine. The extract obtained is largely used for the prevention and control of various chronic diseases. Research in this field has highlighted the importance of plant metabolites which are either antimutagenic or anticarcinogenic. The polyphenolic fractions isolated in the chloroform and acetone extracts from Triphala has been evaluated for antimutagenic properties which include interference in metabolite activation of promutagen, formation of adducts with ultimate mutagens and scavenging of free radicals. Besides exhibiting antimutagenic activity, Triphala also possess cytotoxic activities attributes to gallic acid and related polyphenols.[12]

Hypolipidemic activity

Hyperlipidema, the condition of increased levels of lipids and lipoproteins in the blood, is considered as one of the risk factors for CAD (coronary artery disease). These lipids include cholesterol, cholesterol esters, phospholipids and triglycerides. The number of people suffering from CAD is increasing day by day all over the world. Though a large number of factors such as age, family history, diet rich in fat and cholesterol and hypertension are considered as important reason for heart failure, high level of cholesterol particularly low density lipoprotein (LDL) is responsible for the cause of coronary heart disease. The efficacy of Triphala on total cholesterol, Low density lipoprotein (LDL), Very low density lipoprotein (VLDL), High density lipoprotein (HDL) and free fatty acid were tested on hypercholesteremic rats. It was observed that all of the above mentioned parameters were significantly reduced in Triphala treated hypercholesteremic rats as compared to control. It was assumed that hypolipidemic action of Triphala may be due to the presence of flavonoids and polyphenolics.[80,81]

Anti infective property

Triphala extract prepared in alcohol shows antimicrobial and antibacterial activities against various bacterial isolates such as *Enterococcus faecalis*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *S. paratyphi-B*, *Staphylococcus aureus*, *Streptococcus pyogenes* and *Vibrio cholerae*. Ointment prepared from the Triphala shows wound healing property and significant reduction in bacterial count when applied on bacterial infected rat. The ointment showed strong antibacterial, wound healing, and antioxidant activities for the management of infected wounds.[79,82]

Antidiabetic activity

Diabetes mellitus is one of the major diseases in the world that has killed many people in both developed nations and developing countries. WHO states that more than 300 million people worldwide suffered from diabetes. The oral administration of Triphala extract reduces blood sugar level in normal and in diabetic rats significantly within few hours and continued daily administration of the drug produced a sustained antidiabetic effect.[13]

Analgesic, antipyretic and ulcerogenic activities

A recent increase in the intake of anti-inflammatory drugs have grabbed much attention as these drugs show

analgesic, antipyretic effect associated with gastric damage. The result is increased body temperature and pain against the inflammatory stimulation. Regular intake of Triphala exhibits analgesic and antipyretic activities without any gastric damage.[83] The analgesic, antipyretic and ulcerogenic activities of Triphala when compared with anti-inflammatory drug such as Indomethacin on the experimental models in mice showed excellent analgesic and antipyretic effect, with the absence of gastric damage. [84] Besides anti inflammatory dugs Triphala is also effective against several prokinetic drugs. The process of digestion involves contraction and relaxation of muscles of the stomach and intestines. When the process of digestion gets infected several prokinetic drugs (Metoclopramide or Bethanechol) are prescribed to increase the muscular contractions and improve gastric digestion. Triphala was found to be a safe alternate to prokinetic drugs with no side effects as it is involved in removal of gastric wastes. [85]

Triphala as oral disinfectant

A large number of tooth cleaning disinfectants are used in periodontal therapy. Oral rinse made by the use of such disinfectant reduces inflammation and control bleeding. In an experiment conducted to evaluate the effects of Triphala as a mouthwash in comparison with chlorhexidine (antibacterial and anti plaque agent) it was observed that Triphala when used, suppresses the activity of collagenase enzymes well within the safety profile of toxicological studies.[86] Triphala has antibacterial, anti-inflammatory and antiseptic properties and as a mouthwash showed significant reduction in periodontal indices and find its use as an oral disinfectant. [87,88]

Triphala as radioprotector

With the realization of the need for a safeguard against the military use of atomic weapons the search for radioprotectors started. It was also realized that normal tissue protection in radiotherapy is equally important as destruction of cancer cells. Thus, the focus of protection from radiation became more herbal therapy oriented and Triphala has been reported to have radio-protective effect in mice when exposed to gamma radiation. Triphala, and its constituents are reported to possess antimicrobial activity. [89-91] This activity of Triphala extract prevents the localization of pathogenic microbes or bacterial infection in the gastrointestinal tract and, thus lead to radioprotection. Triphala showed radio-protective effect in mice when exposed to gamma radiation. [1,43,45,92] According to Dixit et al. (2013)[93] *Terminalia chebula* extract significantly reduced radiation effects such as cellular DNA damage and gastrointestinal cell death. The experiment clearly suggested the role of *T. chebula* against γ-irradiation induced oxidative stress. Thus, it can be considered as a probable radio protector.

Triphala as novel laxative

Triphla, a better laxative as compared to many other natural laxatives. Unlike other natural laxatives, Triphala has a higher nutritional content of vitamin C as well as other essential amino acids. Triphala plays a dual role, helping the body to achieve maximal nutritional intake while simultaneously aiding in proper elimination. Ayurvedic practitioners have successfully used Triphala to treat constipation and other related health problems. [94]

Triphala against HIV

Triphala showed potential immunostimulatory effects on cellular immune response, mainly on cytotoxic T and natural killer cells. An increase in the number of these cells provides a novel adjuvant therapy or herbal formulation for HIV/AIDS positive people in terms of immunological improvement.[95] The extract obtained from the fruits of *T. bellerica* showed significant inhibitory activity on HIV-1 reverse transcriptase. [96] In *in vitro* conditions the four lignans present in Triphala (termilignan, thannilignana, hydroxyl-3,4-(methylenedioxy), flavan, anolignan B) showed anti-HIV-1 activity. [39] The growth inhibitory activities of Triphala were also observed against some common bacterial isolates from HIV infected patients.[97] Similar work was carried by Safiullah et al. (2011)[98] where they investigated the aqueous and ethanolic extracts of Triphala and its individual plant component showed antibacterial effect against common bacterial isolates from HIV infected patients.

Triphala against ageing

Gallic acid, a major polyphenol of Triphala, has a strong antioxidant property. The antioxidant properties combined with its analgesic, antipyretic, chemo preventive, antidiabetic, antimutagenic and wound healing properties play a vital role in the prevention, cure and repair of many of the age-related diseases.[79]

Immunomodulatory activity

The immunomodulatory property help in increasing the body's defence system resulting in the enhancement of the body resistance against the diseases. [1,8,99] Now days, immune system activation is considered an effective and protective approach against emerging infections. Better the immune system is, better the longevity of the human system. The immunomodulatory activities of Triphala on various functions of neutrophil such as adherence, phagocytosis, avidity index (A.I.) and nitro blue tetrazolium (NBT) test were assessed. It was observed that these changes were significantly reduced and prevented by oral administration of Triphala. Neutrophil functions in case of immunized rats and stress induced suppression in the neutrophil functions were significantly prevented by Triphala.[100]

Others

Triphala is also known for its other valuable medicinal properties which make it a 'Wonder Drug' in the field of medicines. Triphala is known to promote our appetite, ensures good digestion, increases number of red blood cells and haemoglobin content, and helps in removal of

undesirable fat.[79] The chemical constituents of Triphala are known to create a favourable chemical environment for the growth and proliferation of beneficial intestinal bacteria and an unfavourable environment for death and decay of non-beneficial intestinal bacteria. Triphala, a bowel regulator is considered as safe as food even if taken on a daily basis. It is a tonic, cleanser and blood purifier, and therefore is considered beneficial in various ailments related to eyes, such as cataracts, conjunctivitis and glaucoma. Triphala can be used to wash eyes regularly, to strengthen vision, counteract several eye defects and reduce their redness. Triphala is useful in curing headache, dyspepsia, constipation, liver conditions and leucorrhoea.[43,101]

CONCLUSION

We, the human system are exposed to diverse environmental conditions, causing variations in the stress and response generated thus leading to disruption in normal cellular mechanism. Ayurveda the traditional Indian system of medicine holds a different class of herbs which have been responsible for rejuvenating the whole functional dynamics of the human body. Triphala a wonder drug for the field of medicines has proved its therapeutic potential in all types of medicinal systems. Regular intake of triphla is recommended to safeguards us from a large number of chronic diseases. The Tripla has a proven record of being used in all systems of medicines however, the herb still hold the potential to be used for some other unknown diseases and disorders which need to be explored.

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