

## REVIEW OF AMALAKI (EMBELICA OFFICINALIS) FOR ITS PHARMACOLOGICAL PROPERTIES

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### ABSTRACT

Amalaki is one of the most frequently used Ayurvedic tree. It is fruit of *Phyllanthus embellica*, also called as *Embellica officinalis*. The fruit is similar in appearance to the common gooseberry which is botanically unrelated to amla. However due to similar appearance to fruit cluster it is usually called as Indian gooseberry. A review of research work done regarding ancient and Ayurvedic properties of amalaki i.e. *Embellica officinalis* is mentioned here. The study showed that Amalaki is possessing various pharmacological properties. According to *Ayurveda* it is *Tridoshghna*, *Rasayan*, *Vaysthapan*, *Shophaghna*, *Raktpittaghna*, *Pramehghna*, *Arshghna*, *Vrushya*, *Chakshushya*, *Hrudya*, *Stridoshjeet*, *Jwarghn*, Immunomodulatory. According to modern it has Anticancer, Antiinflammatory, Antimicrobial, Immunomodulatory, Antioxidant, Hepatoprotective, Gastroprotective, and effective medicine for many other diseases like Cataract, Osteoarthritis.

**KEY WORDS:** Amalaki, *Phyllanthus embellica*, *Embellica officinalis*.

## INTRODUCTION

Amalaki is most important drug mentioned in Ayurveda, Amalaki is gift of nature to mankind. The Sanskrit name Amalaki translates sustainer or fruit where the goddess of prosperity resides. Amla is known as Divya and Amrut or Amrit phala in Sanskrit which literally means fruit of heaven. Amalaki fruit is one of the richest source of vitamine c.

In ayurvedic literature also it is one of the mostly used fruit. In charak samhita chikitsasthana first chapter, Amalaki has described as *Vaysthapan*. Ayurvedas important goal is to prolong life and to promot perfect health and to eradicate the disease and disfunction of body. Hence the description of Amalaki is described in first chapter of *Chikitsasthan* . A review of work done regarding ancient and ayurvedic properties of Amalaki i.e embellica officinalis is mentioned here.<sup>[1]</sup>

Sr.no	Name Of Samhita and Nighantu	Properties And Uses
1	<i>Charak Samhita</i>	<i>Gulmhar , Udarhar, Uhophhar , Jwarahar, Panduhar, Atisahar, Pramehahar, Kamalaraghar, Krimihar, Rasayana</i> <sup>[1]</sup>
2	<i>Sushrut samhita</i>	<i>Raktpithar, Chakshushya, Vrushya</i> <sup>[2]</sup>
3	<i>Bhavprakash Nighantu</i>	<i>Vrushya Raktpitthar , Gulmhar, Rasayan , Pramehar ,</i> <sup>[3]</sup>
4	<i>Dhanvantari nighantu</i>	<i>Vrushya Jwarahar Rasayana Stridoshjeet,</i> <sup>[4]</sup>
5	<i>Raja Nighantu</i>	<i>Raktapittahar , Visthambhar , Adhamanahar,</i> <sup>[5]</sup>

### Vernacular names:

**English:** Emblic myrobalan, Indian Goose berry

**Sanskrit:** *Aamalaki*

**Hindi:** Amla

**Kannada:** Nelli Kayi

**Marathi:** Amla

**Gujarati:** Ambla

**Malayalam:** Nelli Kayi

**Tamil:** Nelli

**Telugu:** Usirikaya

**Kashmir:** Aonl

### **BOTANICAL DESCRIPTION**

A small to medium sized deciduous tree, 8-18 meters height with thinlight grey bark exfoliating in small thin irregular flakes, leaves are simple, sessile, closely set along the branchlets, light green having the appearance of pinnate leaves; flowers are greenish yellow, in axillary fascicles, unisexual, males numerous on short slender pedicels, females few, sessile, ovary 3-celled; fruits globose, fleshy, pale yellow with six obscure vertical furrows enclosing six trigonous seeds in 2-seeded 3 crustaceous cocci.<sup>[6]</sup>

### **PHARMACOLOGICAL ACTIONS**

#### **ANTIOXIDANT**

Vasudha shukla *et al.*, demonstrated Aqueous and alcoholic extracts of amalki (*Embolia officinalis*), spirulina and wheatgrass were prepared and analyzed for antioxidant vitamin content (vitamin C and E), total phenolic compounds. Antioxidant status, reducing power and effect on glutathione S-transferase (GST) activity were evaluated *in vitro*. Vitamin C content of crude amalaki powder was found to be 5.38 mg/g, while very less amount 0.22 mg/g was detected in wheat grass. Amalki was rich in vitamin E like activity, total phenolic content, reducing power and antioxidant activity. Total antioxidant activity of aqueous extract of amalki, spirulina and wheat grass at 1mg/ml concentration were 7.78, 1.33 and 0.278 mmol/l respectively. At similar concentrations the total antioxidant activity of alcoholic extract of amalaki, spirulina and wheat grass was 6.67, 1.73 and 0.380 mmol/l respectively. Amalki was also found to be rich source of phenolic compounds (241mg/g gallic acid equivalent). Alcoholic extract of wheat grass showed 50 % inhibition in FeCl<sub>2</sub>- ascorbic acid induced lipid peroxidation of rat liver homogenates *in vitro*. Both aqueous and alcoholic extracts of amalaki inhibited activity of rat liver glutathione S-transferase (GST) *in vitro* in dose dependant manner. Since GST acts as powerful drug metabolizing enzyme its inhibition by amalaki offers possibility of its use for lowering therapeutic dose of herbal preparations. The aqueous extracts of both amalki and spirulina also showed protection against t-BOOH induced cytotoxicity and production of ROS in cultured C6 glial cells.<sup>[7]</sup>

Reddy *et al.*, suggested that the amelioration of alcohol-induced oxidative stress might be due

to the combined effect of phytochemicals such as tannins, flavonoid compounds and vitamin C.<sup>[8]</sup>

Shivananjappa *et al.*, demonstrated that *E. officinalis* aqueous extracts have potency to modulate basal oxidative markers and enhance endogenous antioxidant defenses using a hepatocyte cell line (HepG2). Substantial reduction in the levels of lipid hydroperoxide and reactive oxygen species (ROS) was observed in the study that incubated *E. officinalis* for 24 h. Moreover, *E. officinalis* increased the levels of GSH, antioxidant capacity and activities of antioxidant enzymes (SOD; CAT; GSH peroxidase; GSH reductase; and GSH S-transferase).<sup>[9]</sup>

Additionally, when administered once daily for 7 days the active tannoids of *E. officinalis* induced a rise in both frontal cortical as well as striatal SOD, CAT and GSH peroxidase (GPX) activity, with associated reduction in lipid peroxidation in these brain areas. The results also specify that the antioxidant activity of *E. officinalis* may reside in the tannoids of the fruits of the plant, which have vitamin C-like properties, rather than vitamin C itself.<sup>[10]</sup>

### HEPATOPROTECTIVE

Hepatoprotective activity of *Emblica officinalis* and *Chyavanaprash* Hepatoprotective activity of *Emblica officinalis* (EO) and *Chyavanaprash* (CHY) extracts were studied using carbon tetrachloride (CCl<sub>4</sub>) induced liver injury model in rats. EO and CHY extracts were found to inhibit the hepatotoxicity produced by acute and chronic CCl<sub>4</sub> administration as seen from the decreased levels of serum and liver lipid peroxides (LPO), glutamate-pyruvate transaminase (GPT), and alkaline phosphatase (ALP). Chronic CCl<sub>4</sub> administration was also found to produce liver fibrosis as seen from the increased levels of collagen-hydroxyproline and pathological analysis. EO and CHY extracts were found to reduce these elevated levels significantly, indicating that the extract could inhibit the induction of fibrosis in rats.<sup>[11]</sup>

Tasduq *et al.*, demonstrated the hepatoprotective property of a 50% hydroalcoholic extract of the fruits of *E. officinalis* (fruit) (EO-50) against anti-tuberculosis drugs-induced hepatic injury. The hepatoprotective activity of EO-50 was found to be due to its membrane stabilizing, antioxidative and Cytochrome (CYP) 2E1 inhibitory effects.<sup>[12]</sup>

Arsenic, a significant human toxin, is naturally present in groundwater. The protective role of the fruits of *E. officinalis* was investigated in adult Swiss albino mice against arsenic-induced

hepatopathy. Pre- and post-supplementation of EFE considerably reduced arsenic-induced oxidative stress in liver. Combined treatment of *E. officinalis* and arsenic (pre and post) decreased the serum transaminases and LPO content in liver. *E. officinalis* caused a significant increase in SOD, CAT, GST and serum alkaline phosphatase activities. EFE had ameliorated karyolysis, karyorrhexis, necrosis and cytoplasmic vacuolization induced by NaAs O (2) intoxication as demonstrated in liver histopathology.<sup>[13]</sup>

The effect of *E. officinalis* fruit extract (EFE) against alcohol-induced hepatic damage in rats was explored by Damodara Reddy et al., EFE possesses antioxidant as well nitric oxide (NO) scavenging activity as per *in vitro* studies. *In vivo* administration of EFE to alcoholic rats significantly brought the plasma enzymes towards near normal level and also significantly reduced the levels of lipid peroxidation, protein carbonyls besides restoring both the enzymatic as well as non-enzymatic antioxidants level. This observation was supported by histopathological examination in liver. Thus, this data suggests that the tannoid, flavonoid and NO scavenging stress in rat hepatocytes of animals with alcohol-induced liver injury.<sup>[14,15]</sup>

## ANTICANCER

Plant products of *Phyllanthus emblica* Linn. are traditionally consumed for its immense nutritive and medicinal values. However, the molecular mechanism(s) by which it exerts its effects is less understood. In this study, Mahata S et al., demonstrated mechanism of action of *P. emblica* fruit extract (PE) by studying its effect on activator protein-1 (AP-1) activity and human papillomavirus (HPV) transcription that are essential for tumorigenicity of cervical cancer cells. PE resulted in a dose- and time-dependent inhibition of DNA binding activity of constitutively active AP-1 in both HPV16-positive (SiHa) and HPV18-positive (HeLa) cervical cancer cells. PE-induced AP-1 inhibition was found mediated through downregulation of constituent AP-1 proteins, c-Jun, JunB, JunD, and c-Fos; however, the kinetics of their inhibition varied in both the cell types. Inhibition of AP-1 by PE was accompanied by suppression of viral transcription that resulted in growth inhibition of cervical cancer cells. Growth inhibitory activity of PE was primarily manifested through induction of apoptotic cell death. These results suggest that *P. emblica* exhibits its anticancer activities through inhibition of AP-1 and targets transcription of viral oncogenes responsible for development and progression of cervical cancer thus indicating its possible utility for treatment of HPV-induced cervical cancers.<sup>[16]</sup>

Jose JK et al., demonstrated Aqueous extract of *Emblica officinalis* (E.O) was found to be cytotoxic to L 929 cells in culture in a dose dependent manner. Concentration needed for 50% inhibition was found to be 16.5 microg/ml. E.O and chyavanaprash (a non-toxic herbal preparation containing 50% E.O) extracts were found to reduce ascites and solid tumours in mice induced by DLA cells. Animals treated with 1.25 g/kg b.wt. of E.O extract increased life span of tumour bearing animals (20%) while animals treated with 2.5 g/kg b.wt. of chyavanaprash produced 60.9% increased in the life span. Both E.O and chyavanaprash significantly reduced the solid tumours. Tumour volume of control animals on 30th day was 4.6 ml where as animals treated with 1.25 g/Kg b.wt. of E.O extract and 2.5 g/kg b.wt. of chyavanaprash showed a tumour volume of 1.75 and 0.75 ml, respectively. E.O extract was found to inhibit cell cycle regulating enzymes cdc 25 phosphatase in a dose dependent manner. Concentration needed for 50% inhibition of cdc 25 phosphatase was found to be 5 microg/ml and that needed for inhibition of cdc2 kinase was found to be >100 microg/ml. The results suggest that antitumour activity of E.O extract may partially be due to its interaction with cell cycle regulation.<sup>[17]</sup>

Zhong ZG et al., has isolated Progallin A from the acetic ether part of the leaves of *Phyllanthus emblica* L. with column chromatography. The proliferation of spleen lymphocytes and the viability of BEL-7404 cells were assessed with MTT assay. Inverted microscope, light microscope and fluorescence microscope were utilized to observe the morphological changes of BEL-7404 cells respectively. AnnexinV/PI double labeling and TUNEL assay were used to detect early apoptosis and DNA fragmentations of BEL-7404 cells respectively. In addition, cell cycle distribution was analyzed by using flow cytometry (FCM). Bax and Bcl-2 protein levels were determined by immunofluorescence staining and western blot respectively. The results showed that Progallin A had low immune toxicity and the proliferation of BEL-7404 cells was strongly inhibited by Progallin A in a time- and dose-dependent manner and that the characteristics of apoptosis of BEL-7404 cells were observed. The results also showed that apoptosis rates and the number of apoptotic cells significantly increased with prolongation of the action time. The results of flow cytometry (FCM) indicated that Progallin A induced significant G1/M and G2/M arrest of BEL-7404 cells. Immunofluorescence staining and western blot showed that the expression of Bax was found to be noticeably up-regulated and the expression of Bcl-2 was down-regulated significantly.<sup>[18]</sup>

Pyrogallol, a catechin compound, is an active component of *E. officinalis* extracts and has an anti-proliferative effect on some human cancer cell lines. Yang *et al.*, investigated the beneficial effect of pyrogallol on human lung cancer cell lines-H441 (lung adenocarcinoma) and H520 (lung squamous cell carcinoma). Results from both *in vitro* and *in vivo* studies together indicate that pyrogallol can be developed as a likely anti-lung cancer drug, particular for the non-small cell lung cancer.<sup>[19]</sup>

Ngamkitidechakul *et al.*, tested the potential anticancer effects of aqueous extract of *E. officinalis* in four ways,<sup>[20]</sup> against cancer cell lines,<sup>[21]</sup> *in vitro* apoptosis,<sup>[22]</sup> mouse skin tumourigenesis and *in vitro* invasiveness. The *E. officinalis* extract at 50-100 microg/mL significantly inhibited cell growth of six human cancer cell lines, A549 (lung), HepG2 (liver), HeLa (cervical), MDA-MB-231 (breast), SK-OV3 (ovarian) and SW620 (colorectal).

However, the extract was not toxic against MRC 5 (normal lung fibroblast). These results suggest *E. officinalis* exhibits anticancer activity against selected cancer cells, thus warrants further study as a possible chemopreventive and antiinvasive agent.<sup>[24]</sup>

#### **ANTIINFLAMMATORY, ANTIPYRETIC, ANALGESIC**

Anti-pyretic and analgesic activity of ethanol (EEO) and aqueous (AEO) extracts of *Emblica officinalis* fruits in several experimental models. A single oral dose of EEO and AEO (500 mg/kg, i.p.) showed significant reduction in brewer's yeast induced hyperthermia in rats. EEO and AEO also elicited pronounced inhibitory effect on acetic acid-induced writhing response in mice in the analgesic test. Both, EEO and AEO did not show any significant analgesic activity in the tail-immersion test. These findings suggest that extracts of *Emblica officinalis* fruits possessed potent anti-pyretic and analgesic activity. Preliminary phytochemical screening of the extracts showed the presence of alkaloids, tannins, phenolic compounds, carbohydrates and amino acids, which may be responsible for anti-pyretic and analgesic activities.<sup>[25]</sup>

Albino rats were divided randomly in three groups of six rats each. Group 1 (control) received distilled water orally, Group 2 (test) received *Emblica officinalis* extract in dose of 600 mg/kg orally and Group 3 (standard) received Pentazocine in dose 10 mg/kg intraperitoneally.

## RESULTS

*Emblica officinalis* extract did not produced statistically significant ( $p>0.05$ ) analgesia when compared with the control group in hot plate latency, but produced a statistically significant reduction in 6% NaCl induced abdominal writhing ( $p<0.05$ ). Conclusions: Since the plant extract significantly reduced the number of writhes in abdominal writhing model, but do not increase hot plate latency, the commercially available crude extract of *Emblica officinalis* exhibit analgesic activity involving peripheral mechanisms.<sup>[26]</sup>

## ANTIMICROBIAL

Antimicrobial potential of aqueous infusions and aqueous decoctions of *Emblica officinalis* (amla) and *Coriandrum sativum* (coriander) against 186 bacterial isolates belonging to 10 different genera of G +ve bacterial population and 2 isolates of *Candida albicans* isolated from urine specimens. The well diffusion technique was employed. Aqueous infusion and decoction of *Emblica officinalis* exhibited potent antimicrobial activity against *Staphylococcus aureus* (80), *S. haemolyticus* (8), *S. saprophyticus* (65), *Micrococcus varians* (12), *M. lylae* (6), *M. roseus* (3), *M. halobios* (1), *M. sedenterius* (2), *Bacillus subtilis* (8), *B. megaterium* (1) and *Candida albicans* (2). The aqueous infusion and decoction of coriander did not show any antimicrobial activity against G -ve urinary pathogens as well as against *Candida albicans*.<sup>[27]</sup>

The in vitro antimicrobial activity of *Sapindus mukorossi* and *Emblica officinalis* fruit extracts were studied against *Streptococcus mutans*, *Staphylococcus aureus*, *Lactobacillus acidophilus*, *Candida albicans* and *Saccharomyces cerevisiae*. The acetone, ethanol, methanol, hot water and cold water extracts of *S.mukorossi* exhibited antimicrobial activity against one of the tested microorganisms i.e. *S.cerevisiae*. All the five extracts of *E.officinalis* showed inhibitory activity against *S.mutans* while the acetonic, hot and cold aqueous extracts showed inhibitory activity against *S.aureus* also. The largest zone of inhibition was obtained with the acetonic extract of *S.mukorossi* against *S.cerevisiae* (29.65mm) and hot water extract of *E.officinalis* against *S.aureus* (40.32mm). Minimum inhibitory concentrations (MIC) of the extracts were also determined against the selected microorganisms showing zones of inhibition  $\geq 8$ mm. This study depicts that the fruits of *Sapindus mukorossi* and *Emblica officinalis* possess very good antifungal and antibacterial activities respectively and can be used as a potential source of novel antimicrobial agents used to cure dental caries,<sup>[28]</sup> Saini *et al.*, evaluated the effect of *E. officinalis* administration on the vulnerability of

experimental mice to respiratory tract infection induced by *K. pneumoniae*. These results suggest that dietary supplementation with *E. officinalis* protects against bacterial colonization of lungs on long-term feeding in an experimental model. Further studies need to be conducted to understand the actual mechanism.<sup>[28,29]</sup>

Thaweboon *et al.*, demonstrated that *E. officinalis* ethanolic extract interferes with the adhesion of *C. albicans* to BECs (human buccal epithelial cells) and denture acrylic surfaces *in vitro*.<sup>[30]</sup>

The chloroform soluble fraction of the methanolic extract of *E. officinalis* displayed significant antimicrobial activity against some gram-positive and gram-negative pathogenic bacteria with a strong cytotoxicity having a LC50 (lethal concentration) of  $10.257 \pm 0.770$  microg mL<sup>-1</sup>.<sup>[31]</sup>

Avneesh Kumar *et al.*, investigated antimicrobial potential of aqueous (infusions, decoctions) and methanolic extracts (1:2 and 1:5 concentrations) of *Emblica officinalis* (amla) against seven pathogenic bacteria namely *Staphylococcus aureus*, *Staphylococcus saprophyticus*, *Escherichia coli*, *Enterococcus faecalis*, *Enterococcus cloacae*, *Proteus vulgaris* and *Klebsiella pneumoniae*. Methods: The well diffusion technique was employed. The minimum inhibitory concentration (MIC) was determined using micro-broth dilution methods and phytochemical screening was done as per standard procedures. Results: Aqueous infusion extract of amla exhibited potent antimicrobial activity against *E. cloacae* followed by *E. coli*. Preliminary phytochemical analysis of *E. officinalis* aqueous extracts (infusions and decoctions) only showed presence of tannins, saponins, flavanoids, Terpenoids and phenols. MIC of aqueous extract of *E. officinalis* was most active against *K. pneumoniae*. Whereas MIC of methanol extract of *E. officinalis* shows maximum activity against *E. coli*. Conclusion: *Emblica officinalis* definitely possesses potent antimicrobial activities and this can serve as an important platform for the development of inexpensive, safe and effective medicines.<sup>[32]</sup>

### GASTROPROTECTIVE

An ethanol extract of 'Amla' *Emblica officinalis* Gaertn. was examined for its antisecretory and antiulcer activities employing different experimental models in rats, including pylorus ligation Shay rats, indomethacin, hypothermic restraint stress-induced gastric ulcer and necrotizing agents (80% ethanol, 0.2 M NaOH and 25% NaCl). Oral administration of Amla

extract at doses 250 mg/kg and 500 mg/kg significantly inhibited the development of gastric lesions in all test models used. It also caused significant decrease of the pyloric-ligation induced basal gastric secretion, titratable acidity and gastric mucosal injury. Besides, Amla extract offered protection against ethanol-induced depletion of stomach wall mucus and reduction in nonprotein sulfhydryl concentration. Histopathological analyses are in good agreement with pharmacological and biochemical findings. The results indicate that Amla extract possesses antisecretory, antiulcer, and cytoprotective properties.<sup>[33]</sup>

### CNS

The effects of Anwala churna (*Embllica officinalis* GAERTN.), an Ayurvedic preparation, on memory in rats was demonstrated by vasudevam m et al . Anwala churna was administered orally in three doses (50, 100 and 200 mg/kg) for 15 days to different groups of young and aged rats. The elevated plus-maze and Hebb-Williams maze served as exteroceptive behavioral models for testing memory. Diazepam-, scopolamine-, and ageing induced amnesia served as the interoceptive behavioral models. Anwala churna (50, 100, and 200 mg/kg, *p.o.*) produced a dose-dependent improvement in memory scores of young and aged rats. Furthermore, it reversed the amnesia induced by scopolamine (0.4 mg/kg, *i.p.*) and diazepam (1 mg/kg, *i.p.*). Based on these results, Anwala churna may prove to be a useful remedy for the management of Alzheimer's disease due to its multifarious beneficial effects such as memory improvement and reversal of memory deficits.<sup>[34]</sup>

### EYE DISORDER

Cataract is clouding of the eye lens that reduces the amount of incoming light and results in deteriorating vision. Blindness is thought to reach 75 million by 2020. Of these, unoperated cataract may be expected to account for at least 35 million. Thus, the burden of cataract is increasing remorselessly. *Embellica officinalis* is reported to have a very good antioxidant property and thus we hypothesized that it could be a good candidate in treatment of cataract. Hence, the aim of this study was to investigate the effect of aqueous extract of *Embellica officinalis* on selenite induced cataract in rats. For the purpose of this study, cataract was induced in young suckling (on the 10(th) day of life) albino wistar rats using sodium selenite (a single dose of sodium selenite; 20µM/kg; subcutaneously). After induction of cataract, the test drug (*Embellica Officinalis*) and the reference standard (ascorbic acid) were administered orally for 18 days. The progression or disappearance of cataract was observed with the help of an ophthalmoscope (OM-18, Takagi resolution 1.6). At the end of this study the alterations

in the levels of total protein, soluble protein, reduced glutathione and malondialdehyde were estimated in the lens homogenate. Results showed that treatment with *Embelica officinalis*, as well as ascorbic acid, produced a significant decrease ( $p < 0.05$ ) in malondialdehyde and a simultaneous increase in lens glutathione levels ( $p < 0.05$ ). The malondialdehyde content was decreased by 48% in animals treated with *Embelica officinalis*. Similarly, lens glutathione was increased by 82.5% in animals treated with *Embelica officinalis*. There was also a significant ( $p < 0.05$ ) increase in protein content (total protein = 59.36% and soluble protein = 105.78%) in animals treated with *Embelica officinalis*, indicating improvement in cataractogenic condition in the selenite induced cataract model. At the end of the treatment, disappearance of cataract was observed in test and standard treated animals. In conclusion, it could be said that aqueous extract of *Embelica officinalis* delayed the progression of cataract in sodium selenite induced cataractogenic rats.<sup>[35]</sup>

### IMUNOMODULATORY

pranoti belapurkae *et al* worked on *Triphala* and its three constituents, for its immunomodulatory effect, *Terminalia bellerica*, *Terminalia chebula* and *Embelica officinalis*. The role of *Triphala* and its extract has been emphasized in stimulating neutrophil function. Under stress condition such as noise, *Triphala* significantly prevents elevation of IL-4 levels as well as corrects decreased IL-2 and IFN- $\gamma$  levels. Under the condition of inflammatory stress its immunosuppressive activity is attributed to its inhibitory action on complement system, humoral immunity, cell mediated immunity and mitogen-induced T-lymphocyte proliferation. The aqueous and alcoholic extracts of the individual constituents reportedly enhance especially the macrophage activation due to their free radical scavenging activity and the ability to neutralize reactive oxygen species. This study thus concludes the use of *Triphala* and its three individual constituents as potential immunostimulants and/or immunosuppressants further suggests them to be a better alternative for allopathic immunomodulators.<sup>[36]</sup>

The cytoprotective and immunomodulating properties of *Embelica officinalis* (Amla) against chromium (VI) induced oxidative damage are reported. Chromium (VI) at 1  $\mu\text{g/mL}$  concentration was highly cytotoxic. It enhanced free radical production and decreased reduced glutathione (GSH) levels and glutathione peroxidase (GPx) activity in macrophages. The presence of Amla resulted in an enhanced cell survival, decreased free radical production and higher antioxidant levels similar to that of control cells. Further, chromium (VI)

treatment resulted in decreased phagocytosis and gamma-interferon ( $\gamma$ -IFN) production while Amla inhibited chromium induced immunosuppression and restored both phagocytosis and  $\gamma$ -IFN production by macrophages significantly.<sup>[37]</sup>

**These properties can be compared as follows**

Sr.No.	Ayurvedic Properties	Morden Properties
1.	<i>Vaysthapan</i>	Anti-aging
2.	<i>Panduhar</i>	Antioxidant
3.	<i>Rasayana</i>	Immunomodulatory/Anticancer
4.	<i>Shofhar, Shothhar</i>	Anti-inflammatory/Analgesic
5.	<i>Krimihar</i>	Anti-microbial
6.	<i>Chakshushya</i>	Eye disorder
7.	<i>Kamlahar</i>	Hepatoprotective

## DISCUSSION

The Ayurvedic references shows that the fruit *Amalaki* possesses *Vaysthapan, Rasayan, Pramehhar, Udarhar, Panduhar, Chakshushya, Hrudya* etc properties . Modern studies state that properties of *Amalaki* as Antioxidant, Immunomodulatory, Antimicrobial, Antiinflammatory, Hepatoprotective, Gastroprotective, Anticarcinogenic.

## CONCLUSION

The literary study of fruit *Amalaki* from Ayurvedic texts and modern researches concludes that fruiti.e *Embelica officinalis* has following properties according to Ayurveda, *Rasayana, Vrushya, Chakshushya, Panduhar, Krimihar, Udarhar, Vaysthapana, Pramehhar, Kamalahar, and* according to modern Antioxidant, Anti-inflammatory, Antimicrobial, Analgesic, Anticancer, Hepatoprotective, Gastroprotective, Anticarcinogenic.

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