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AN UPDATED REVIEW ON THE THERAPEUTIC POTENTIAL OF *PRUNUS ARMENIACA*

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ABSTRACT: Excessive drug therapy, environmental pollutants, hepatic cancer and alcoholic intoxicants are the main causes of liver disorders. The hepatic disorders/toxicity can occur by several mechanisms like cytochrome P450 activation, lipid peroxidation, induction of nitric acid synthase, mitochondrial dysfunction, activation of pro-inflammatory mediators and bile acid-induced liver cell death. In spite of consistent human effort and drug discovery, the modern drug has very little to offer. (*Prunus armeniaca*) is commonly known as Khubani or moon of the faithful or Egg of the sun, which is used as folk medicine in traditional Indian medicinal system as well as worldwide medicinal system, belongs to the family Rosaceae. *Prunus armeniaca* fruit is the rich source of vitamin, carbohydrate, thiamine, niacin, iron, organic acids, phenols and volatile compounds *viz.* benzaldehyde, esters, norisoprenoids, terpenoids and minerals. The seed of *Prunus armeniaca* contain very small amount toxic hydrogen cyanide amygdalin, present in bitter prunus armeniaca kernels which are prescribed as anticancer drug, in asthma, cough and constipation. *Prunus armeniaca* is having some reported activities like anticancer, anti-inflammatory, anti-tubercular properties and antimicrobial properties. Children consume *Prunus armeniaca* in form of candy and sauces. This review is an attempt to summarize the phytoconstituents, pharmacological action, drug interactions encountered and safety profile with use of *Prunus armeniaca* as a preventive and therapeutic aid to various ailments including hepatic and dental disorders.

INTRODUCTION: Liver diseases are still a global health problem may be classified as acute or chronic hepatitis (inflammatory liver diseases), hepatosis (non inflammatory diseases) and cirrhosis (degenerative disorder resulting in liver fibrosis). According to WHO (1993) [1], about 80% of the world population rely on the use of traditional medicine which is predominantly based on plant materials. Unfortunately, treatments of choice for liver diseases are controversial because conventional or synthetic drugs for the treatment of these diseases are insufficient and sometimes cause serious side effects [2].

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Traditional medicines using herbal drugs exist in every part of the world. Global estimates indicate that over 3th/4 of the 5 billion world population cannot afford the products of Western Pharmaceutical Industry and rely upon the use of traditional medicines derived from plants [3]. It is estimated that about 7,500 plants are used in various ailments in rural and tribal villages of India. Out of these, the real medicinal value of over 4,000 plants is either little known or hitherto unknown to the mainstream population.

The classical systems of medicine such as Ayurveda, Siddha, Amchi, Unani and Tibetan use about 1,200 plants. A detailed investigation and documentation of plants used in local health traditions and pharmacological evaluation of these plants and their taxonomical relatives can lead to the development of invaluable plant drugs for many dreaded diseases. Random screening of plants has not proved economically effective [4].

Liver Diseases and Medicinal value of *Prunus armeniaca:* Liver has a pivotal role in regulation of physiological processes. It is involved in several vital functions such as metabolism, secretion, and storage. Furthermore, detoxification of a variety of drugs and xenobiotics occurs in the liver. The bile secreted by the liver has an important role in digestion [5]. Liver diseases are mainly caused by toxic chemicals (certain antibiotics, chemotherapeutics, peroxidised oil, flatoxin, carbon-tetrachloride, chlorinated hydrocarbons, *etc*.), excess consumption of alcohol, infections and autoimmune/disorder.

Most of the hepatotoxic chemicals damage the liver cells, mainly by the inducing lipid peroxidation and other oxidative damages in liver. Enhanced lipid peroxidation produced during the liver microsomal metabolism of ethanol may result in hepatitis and cirrhosis [6]. According to WHO (1997) [7], it has been estimated that about 90% of the acute hepatitis is due to viruses. The major viral agents involved are Hepatitis A, B, C, D (delta agents), E and G. Among these, Hepatitis B infection often results in chronic liver diseases and cirrhosis of liver. Primary liver cancer has also been shown to be produced by these viruses. It has been estimated that approximately 14-16 million people are affected with this virus in South East Asia region and about 6% of the total population in the region are carriers of this virus. A vaccine has become available for immunization against the Hepatitis B virus. Hepatitis C and Hepatitis E infections are also common in countries of the South East Asia region.

The *Prunus armeniaca* (apricot) is a member of the *Rosaceae* family, having genus *Prunus* which are comprises around 98 species having significant importance. All the stone fruits are included in this group. It belongs to subgenera namely *Prunophora* (plums and prunus armeniacas) is the major species of *Prunus* which are more commonly found as a *Prunus persica, Prunus armeniaca, Prunus salicina, Prunus domestica, Prunus americana, Prunus avium, Prunus cerasus, Prunus dulcis, Prunus ceracifera, Prunus behimi, Prunus cornuta, Prunus cerasoides, Prunus mahaleb, etc.* [8]. Prunus armeniaca is also known as "moon of the faithful" and the ancient Persians referred it as "Egg of the sun [9].

Prunus armeniaca fruit, being a rich source of vitamins and minerals, is one of the most familiar crops worldwide. *Prunus armeniaca* trees are not ubiquitous since they can only grow in certain regions where the environmental conditions are favorable. The *prunus armeniaca* has been used in folk medicine as a remedy for various diseases. A decoction of the plant bark has functioned as an astringent to soothe irritated skin. Other uses for *Prunus armeniaca* in folk medicine include treatment of hemorrhages, infertility, eye inflammation, and spasm. *Prunus armeniaca* kernel paste can heal vaginal infections.

The kernel oil has been used in cosmetics and as a pharmaceutical agent (laxative and expectorant). In very small amounts, the toxic hydrogen cyanide present in bitter *Prunus armeniaca* kernels has been prescribed for asthma, cough and constipation [10]. The fresh *Prunus armeniaca* fruit contains carbohydrates, vitamins C and K, β-carotene, niacin and thiamine. Organic acids, phenols, volatile compounds, esters, terpenoids have also been isolated [11]. *Prunus armeniaca* kernels contain a substantial amount of dietary protein [12] along with significant amounts of oil and fiber [13]. In a previous study, [14] reported that sweet *Prunus armeniaca* kernels contain more oil than bitter kernels and that oleic acid and linoleic acid correspond to approximately 92 g/100 g of the total fatty acids present. *Prunus armeniaca* kernels, depending on the variety, contain the toxic cyanogenic glycoside amygdalin [15]. Amygdalin can be hydrolyzed to form glucose, benzaldehyde, and hydrocyanic acid.

Enzymatic release of cyanide occurs in the presence of β-glucoronidase, an enzyme found in the human intestine [16]. Numerous reports concerning the physicochemical characteristics of *Prunus armeniaca* seed oils are available in the literature [17,] but little information is available. The plant is known in different languages by different names like Urumana, Zardalu (Sanskrit), Malhoi (Assamese), Khubani fal (Bengali), Jardalu (Gujarati), Khubani, Zardalu (Hindi), apricot (Kannada), Jardaloo (Marathi), apricot (Malayalam), Khubani badam (Oriya), apricot (Tamil), apricot pandlu (Telugu), Khurmani (Punjabi), Khubaani (Urdu).

FIG. 1: *PRUNUS ARMENIACA*

Geographical Distribution of *Prunus armeniaca*: *Prunus armeniaca* is a deciduous plant of continental region with cold winters, which can tolerate temperature as low as -30 ºC. It is mostly grown in the Mediterranean countries, Central Asia, Russia, USA, Iran, Iraq, Afganistan, Pakistan, Syria and Turkey. Turkey ranks first in the world in fresh and dried *Prunus armeniaca* production and has an important potential due to its genetic *Prunus armeniaca* resources and ecological conditions [19] while United States produces almost 90% of the world's *Prunus armeniaca* crop [17, 18].

In Turkey, prunus armeniaca is grown in a wide range of climatic conditions. Weathers are very cold during winter and very arid during summer in main *Prunus armeniaca* growing areas. *Prunus armeniaca* grown in these provinces are damaged frequently by late spring frost. Hatay, which is located in the eastern Mediterranean coast of Turkey, has the most suitable ecological conditions for growing *Prunus armeniaca* [19, 20]. Most common cultivated variety in Turkey was Hacihaliloglu (85-90%) but with the new plantations in recent years, Kabaasi is also being used common. Hasanbey, Sekerpare (Shekar-pareh).cv. Shalak (Salak) and cv. Tabarzehare is the other varieties, which is cultivated in various parts of world [21]. The plant is best grown in deciduous climatic condition with low temperature [22], [23] Kaya *et al.*, [2018]. In India, it is mainly cultivated in North West Hills Region, Himalayas particularly in the valleys of Jammu & Kashmir (especially Ladakh), Chenab; Kullu and Shimla regions of H.P. and Garhwal hills of Uttrakhand at altitudes up to 3000 m. In Kumaon region, *Prunus armeniaca* is found in all the three districts of Nainital, Almora and Pithoragarh Pithorgarh district has maximum density of prunus armeniaca tree in the Kumaon region and in North Eastern Hills Region comprising the state of Arunachal Pradesh, Nagaland, Meghalaya, Sikkim and Manipur. Varieties of Prunus armeniaca locally found in India are 'Halman and Rakchaikarpo' which are reported in Leh Laddakh area of J & K state [23, 24.]

Plant Profile: *Prunus armeniaca* are deciduous plants, which grow up to 10-15 m tall with a reddish brown bark [25]. The leaves are oval to round, approximately 5-9 cm long and finely serrated with 5-petale, flowers are solitary, white or pinkish, about 2.5 cm across, growing together in clusters, fruits are around 1.5-4.0 cm across or more and hairy when young but nearly smooth-skinned at maturity. The appearances of the fruits are yellowish with light red cheek and nearly glabrous. The flesh is yellow or yellowish orange to firm and sweet. Stone is smooth with a thickened furrowed edge. The fruit's color varies from yellow to orange to deep purple and ripens in late summer [26].

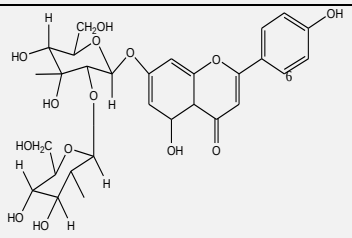
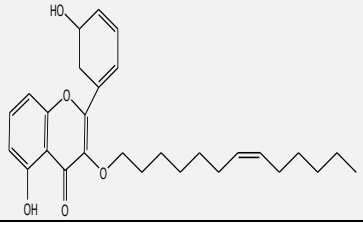
It is usually grown under rainfed conditions and being a hard plant and tolerant to dry atmosphere, no additional irrigation is required [27.] It requires well-drained alkaline and saline soil for the best cultivation. *Prunus armeniaca* is planted during the dormant season (December-end to mid-March) [28, 29], Ba but early planting gives better establishment of plants. It is mostly propagated through seeds and rarely by a vegetative method such as grafting and budding. The seed should be kept moist during the period of stratification. The germination of seed can be hastened by removal of shell from kernel after stratification. The multiplication through cuttings is also rarely done [30, 31].

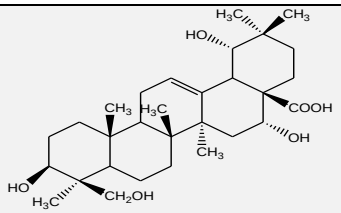
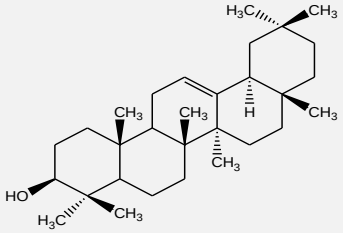
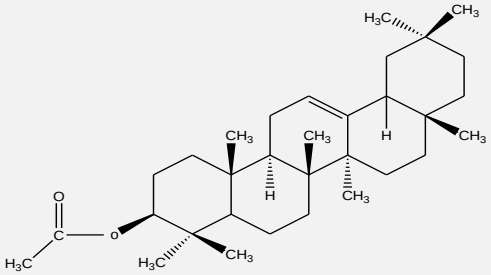
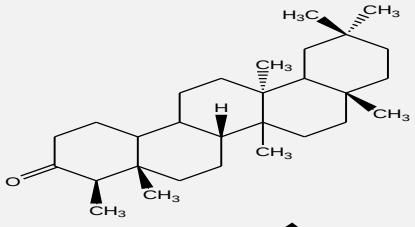
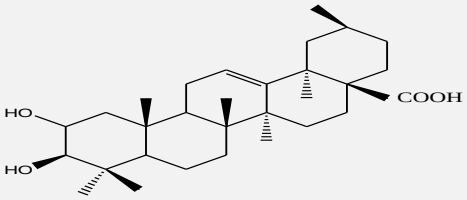
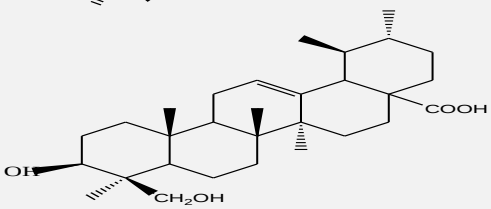
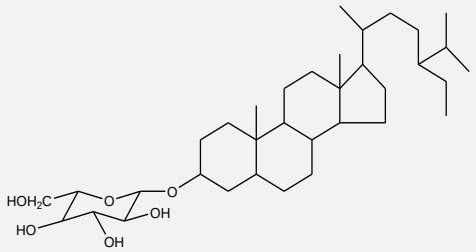
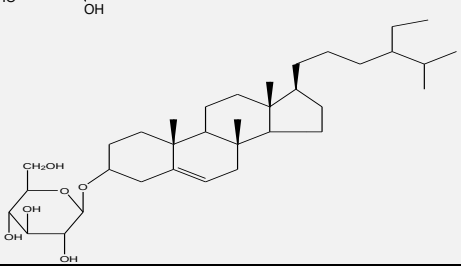
Prunus armeniaca fruits generally start maturing from last week of May and continue up to August end depending upon altitude and location [32]. They are harvested manually by shaking the tree branches, and no mechanical harvesting is practiced. The fruits should be harvested in morning hours and direct exposure of fruits to sun should be avoided during grading and packaging [33]. One more investigation carried on roots growth *of Prunus armeniaca* showed the significant effect of iron and copper spraying on the root length of seedlings.

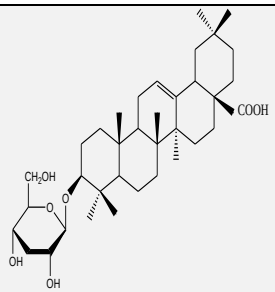
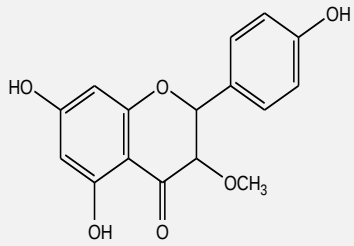
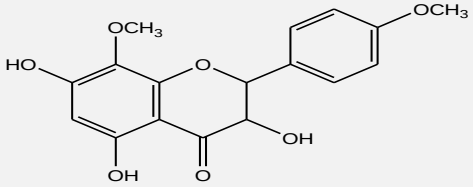
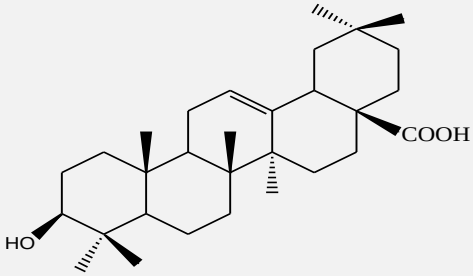
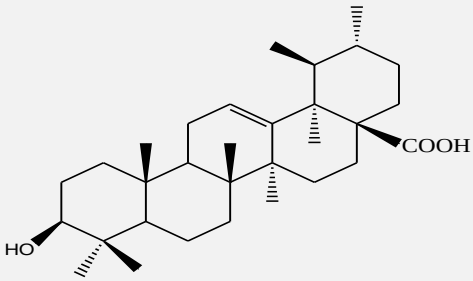
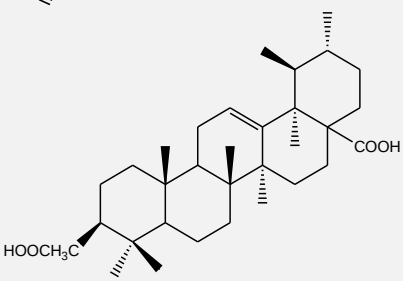
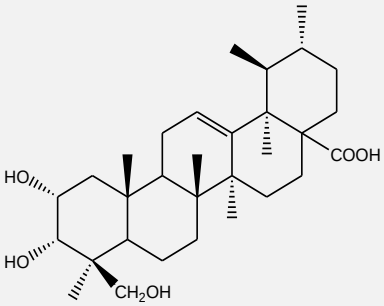
As per the study, the treatment of iron at the concentration of 60 mg. l -1 showed the highest rate of 46.33 cm while Seedlings in control treatment gave the lowest rate of 36.44 cm. it might be occurred due to the influence of iron in the formation of chlorophyll, which enhances the efficiency of carbon and then stimulates the growth rates, specifically as it facilitated the formation of cell walls and then enhance the root length. Spraying of Copper also had a vital effect on the rate of the root length of seedlings, copper at the concentration 40 mg.l -1 showed the highest rate in seedling approx 43.33 cm, while treatment in control was lowest found at 39.67 cm. it might be the influence on light reactions on the carbon metabolism and in the formation of enzymes which regulate the growth indicators such as the root length of the plant [34]. In another study, 26 wild apricots and cv. Apricoz was grown in Kagizman district in Aras valley. Tree growth, harvest date, habit, fruit shape, fruit firmness, fruit weight, fruit color, aroma, kernel taste, flash/seed ratio, soluble solids content, acidity, vitamin C, maturity index, total phenolic, antioxidant capacity and total carotenoid found out as parameters. Result showed the wild-grown apricots exhibited a wide variation on most of the fruit morphological and biochemical characteristics. Total antioxidant capacity, total phenolic content was the highest in most of wild apricot fruits than cv. Apricoz. Result indicated that there is capability to endorse the wild apricot fruit from particular geographical areas because they had the higher amount of the antioxidant poyphenolic compound[35].

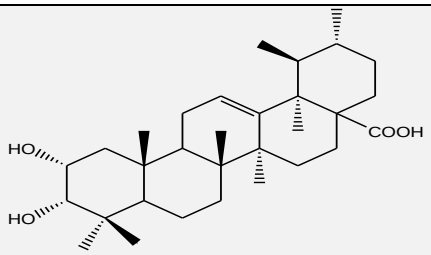
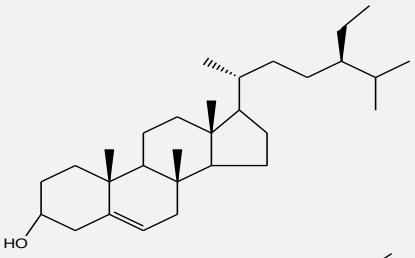
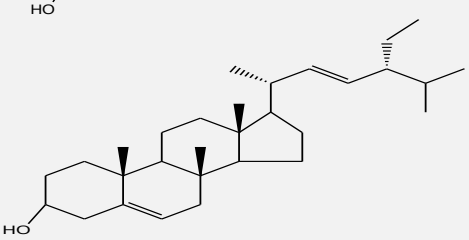
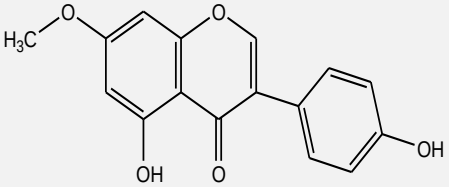
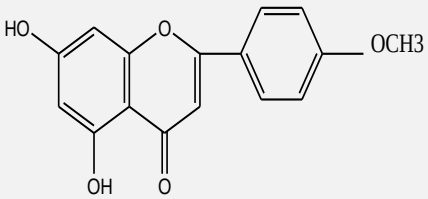
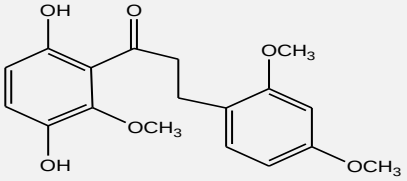
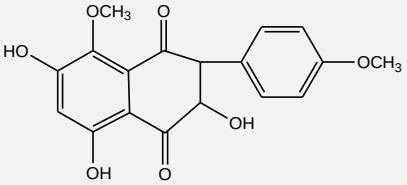
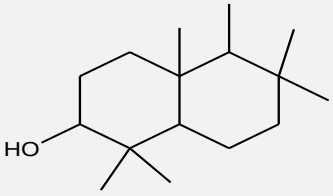
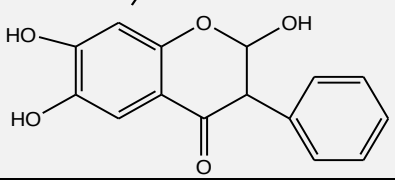
Active Vhemical Ingredients found in *Prunus armeniaca*: Earlier study reported that in seed oil of *Prunus armeniaca* is rich source of Phosphorous, Calcium, Magnesium, Iron and Copper, which makes it suitable for edible and commercial oil. Gas chromatography (GC) of seed oil revealed that it contains oleic acid (73.58%), linoleic acid (19.26%), palmitic acid (3.31%), myristic acid (1.18%) and stearic acid (2.68%) [32]. Proximate values of the protein, fiber, oil and carbohydrate (both mono and polysaccharides) [33], polyphenols [34, 35], carotenoids (β-carotene) [36], vitamins C and K, thiamine, niacin, iron, organic acids, phenols, and volatile compounds viz ,Benzaldehyde (90.6%), (Antimicrobial agent) mandelonitrile (5.2%) and benzoic acid (4.1%) [37], esters, norisoprenoids, and terpenoids [38]. The kernels also reported to contain the cyanogenic glycoside amygdalin (vitamin B_{17}), due to which if eaten, they are hydrolyzed by enzyme β-glucuronidase in the alkaline environment of the small intestine into glucose, benzaldehyde, and hydrocyanic acid, and with emulsification, it's absorbed quickly and circulates in the body and thus can be responsible for its toxic effects [39]. This is more common in children due to children's lower body mass and thus children's high gastric acidity than that of adults. Ripe fruit pulp contains total solids (12.4-16.7%), insoluble solids (2.1-3.1%), acids as malic acid (0.7-2.2%), total sugar as invert sugar (5.3-8.6%), glucose (3.2-4.8%), fructose (1.4-4.25%), sucrose (1.4-5.4%) and tannins (0.06-0.10%) [15, 16, 40, 41, 42] **Table 1**.

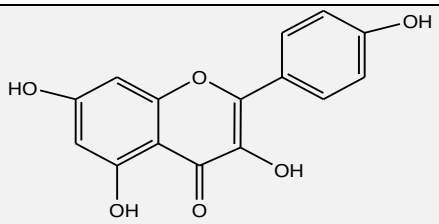
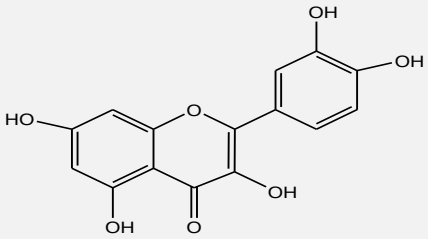
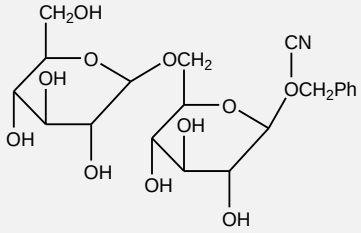
TABLE 1: NAME AND CHEMICAL STRUCTURE OF THE ACTIVE CONSTITUENTS PRESENT IN *PRUNUS ARMENIACA*

S. no.	Active Constituents	Chemical Structure	References
1	3,4,5,7-tetrahydroxy-3',5'dimethoxyflavone3-o-[ὰ-L-rhamnopyranosyl (1 '''6'')]-β-galactopyranosi~~de.~~►		43
2	5,2'-Dihydroxy 3-O-tridecyl 7-ene flavones		

3	3β,16α,19α,24-Tetrahydroxyloleane-12-ene-28-oic acid		44
4	3β-Hydroxyoleane-12-ene		
5	3β-Acetoxyoleane-12-ene		45
6	3-OXO D:A-fridooleanane		
7	2α,3β-Dihydroxyloleane-12-ene-28-oic acid		46
8	3β,24-Dihydroxyurs-12-ene-28-oic acid		
9	B-Sitosterol 3-O-β-D-glucopyranoside		47
10	3-O-β-D-glucopyranosyl-stigmasterol		

11	3-O-β-D-glucopyranoside-olecane-12-ene-28-oic acid		48
12	5,7,4'-Trihydroxy-3-methoxy flavanone		
13	3,5,7-Trihydroxy-4',8-dimethoxy flavanone		49
14	β-Hydroxyoleane-12-ene-28-oic acid		
15	3β-Hydroxyurs-12-ene-28-oic acid		50
16	β-Acetoxyurs-12-ene-28-oic acid		
17	2α,3α-Dihydroxyurs-12-ene-28-oic acid		51

18	2α,3α-24-Trihydroxyurs-12-ene-28-oic acid		52, 53
19	24®-Stigmast-5ene-3β-ol		
20	Stigmasta-5,22-diene-3β-ol		
21	Prunetin		
22	Dihydro Kaemferide		
23	Cerasin		
24	Produmestin		
25	3-hydroxytriterpenes		54
26	Prunin		55

27	Kampferol		56
28	Quercetin		
29	Amygdalin		
30	Linalool		

Adulterants: *Prunus armeniaca* oil is widely adulterated with almond oil which can be detected by determination of to choferol by mainly three methods *viz* biber test, gas chromatography, and colorimetry [57, 58].

Cautions with *Prunus armeniaca*: Consumption of *Prunus armeniaca* kernels or Laetrile™ (an alternative cancer drug marketed in Mexico and other countries outside of the United States, derived from amygdalin [59, 60] is not recommended in pregnant or breast-feeding women because of potential risk of birth defect [61]. Infants born to mothers exposed to cyanide and thiocyanate during pregnancy have exhibited thyroid disease [62]. *Prunus armeniaca* kernels may also cause decrease in blood pressure and therefore may interact with blood-pressure-lowering herbs and supplements. Urticaria and rashes had also reported. Fresh *Prunus armeniaca* cannot be recommended for the patients who are suffering from gastrointestinal ulcers, gastritis with high acidity, pancreatitis, and liver pathologies. In case of diabetes, the fruit is also show the contraindication due to presence of large amount of sugar. Eating large quantities of these fruits per day can cause diarrhea. Abuse of dried and fresh fruits cause, respiratory deviations, heart rate problems and dizziness [63, 64].

Traditional uses: The *Prunus armeniaca* has been used in folk medicine as a remedy for various diseases. The bark is used as an astringent to soothe irritated skin. Kernel paste is used to heal vaginal infections and its oil is used in cosmetics to protect the skin from UV radiation and as a pharmaceutical agent (laxative and expectorant). *Prunus armeniaca* are delicious when eaten fresh or can be used - in desserts, poached, stewed or pureed in jam (25 % wild *Prunus armeniaca* +75 % apple) chutneys, pickles, compotes, salads or sorbets. The oil can be used for cooking, lighting prayer lamps and for cosmetic uses like hair oil, body oil, production of biodiesel etc [65, 66]. A good quality sauce using wild *Prunus armeniaca* pulp and tomato pulp in the ratio of 1:1 has been prepared, while chutney of good acceptability prepared from wild *Prunus armeniaca* pulp (100 %) has also documented. Preparation of *Prunus armeniaca*-soy protein-enriched products like Prunus armeniaca-soya leather, toffee and fruit bars has been reported, which are reported to meet the protein requirements of adult and children as per the recommendations of ICMR [67]. Besides these processed products, preparation of alcoholic beverages like wine, vermouth and brandy from wild *Prunus armeniaca* fruits has also been reported by various researchers.

Strained baby foods from pulp of *Prunus armeniaca* are nutritious and a good source of calcium, phosphorus, and iron. It is used in the preparation of a fruit bar. The oil of the seed is edible, and oil cake can be used as organic manure. It is also reported to be used in asthma, constipation, and cough [68].

Pharmacological Reports:

Antituberclousis Activity (Ethnolic and Aqueous Fruit Extract): Sehgal J *et al.*, 2010 [69] demonstrated that oral administration of (400, 200 and 100 µg/ml) ethanolic and aqueous extracts from fruits of *Prunus armeniaca*. Ethanolic extract showed the zone of inhibition 22 mm,12 mm, 00 mm respectively, Aqueous extract showed the zone of inhibition 18 mm, 10 mm, 0 mm respectively as compared to standard drug (Rifampicin 100 µg/ml) 27 mm by using cup plate method. The results of this study reveals the significant antitubercular effect of aqueous and ethanol extract from fruit of *Prunus armeniaca* and the mechanism of this activity, which might prove important and improved therapies for the treatment and prevention of tuberculosis.

Anti-inflammatory Activity (Ethanolic Extract of Kernel): Minaiyan M *et al.*, 2014 [70] demonstrated that administration of (100,200,400 mg/kg) ethanolic extract orally and (100, 200, 400mg/kg) extract/oil (i.p.) from kernel of *Prunus armeniaca*. Prednisolone 5 mg/kg (i.p.) was used as a reference drug. In this study we evaluated the effects of *Prunus armeniaca* kernel extract and oil on ulcerative colitis in rats. Rats fasted for 36 h before the experiment. Colitis was induced by intra-rectal instillation of 50 mg/kg trinitrobenzene sulfonic acid in male Wistar rats. Treatments were started 6 h after colitis induction and continued every 24 h for 5 days. On day 6, colon tissue was removed, and macroscopic and pathologic parameters were evaluated. Ulcer index and total colitis index as representative of macroscopic and histologic parameters respectively showed ameliorating effects in experimental groups especially those treated by intraperitoneal administration route. Results also demonstrated that oil fraction was not able to potentiate the effects of the extract. Earlier study reveals that the TNBS play an important role in the Ulcerations of the mucosa, edema, and influx of inflammatory cells during colitis and the increased level of Th1 cytokines, interferon-gamma (IFN-γ), activation of macro-phages, production of tumor necrosis factor (TNF-α), IL-1β also play important role of causing agents for the Ulcerative colitis [Ten Hove T *et al.*, 2001, Guang-Bijin H *et al*., 2002. Amygdalin present in the prunus armeniaca kernel can inhibit TNF-α and IL-1β. In this study, the dose of 100 mg/kg, showed that intraperitoneal treated groups demonstrated better outcomes than those treated orally which can be attributed to the higher bioavailability of active components after intraperitoneal injection. By comparing the results of groups treated with extract and extract/oil fraction, it is concluded that oil fraction did not exhibit ameliorating effect whilst it was safe and did not interfere with beneficial anti-inflammatory and antiulcerative effects of the extract. The *Prunus armeniaca* kernel extract 100 mg/kg i.p showed the maximum inhibitory effect against Ulcerative colitis disease [71].

Antimutagenic Activity (Hexane Seed Extract): Yamamoto K *et al*., 1993 [72] demonstrated the antimutagenic effect of the hexane extract of Armeniacae semen (*Prunus armeniaca* seed). Hexane extracts of Armeniacae inhibited the mutagenicity of benzo[a]pyrene (B[a]P). The mutagenicities of 3-amino-1, 4-dimethyl-5H-pyrido [4,3-b] indole (Trp-P-1) and 2-(2-furyl)-3-(5-nitro furyl) acrylamide (AF-2) were also inhibited by the extracts of Armeniacae semen. The presence of contents oleic acid and linoleic acid were 0.7 and 0.4% in the hexane extract of Armeniacae semen also reported in this study.

Anthelmintic Activity (Water Extract and Methanolic Extract of Fruit): Kumar D *et al.*, 2016 [73] demonstrated that the *Prunus armeniaca* water extract 30% shows the maximum antimicrobial activity. *Prunus armeniaca* methanolic extract shows the highest peak of components Tangerarin (3.35) and Resveratrol (12.54) respectively with respect to retension time. The present study was carried out to evaluate the antihelmintic activity of fruit extract of *Prunus armeniaca* act as vermicidal using Indian earth warms.

Antinoceceptive activity (Aqueous extract of semen (Seed): Hwang H J *et al*, 2008 [74]

investigated the antinociceptive activity of amygdalin prepared from an aqueous extract of armeniacae semen in rats with formalin-induced pain. Amygdalin is a compound containing a cyanogenic glycoside. It consists of two molecules of glucose units, one is benzaldehyde and the other is hydrocyanic acid (HCN).

Amygdalin is anti-nociceptive in the rat formalin test and inhibited c-Fos expression in the spinal cord and the gene expression of TNF-a and IL-1b in the skin of the hind paw induced by formalin injection.

The intramuscular injection of amygdalin significantly reduced the formalin-induced tonic pain in both early (the initial 10 min after formalin injection) and late phases (10-30 min) following the initial formalin injection). Results showed that the, amygdalin was effective at alleviating infla-mmatory pain and could be used as an analgesic based on its anti-nociceptive and anti-inflammatory properties.

Antimicrobial Activity (Water and Methanolic Extracts of Seeds): Both bitter and sweet kernel of *Prunus armeniaca* showed the antibacterial activity against the Gram-positive bacteria *Staphylococcus aureus* and Gram-negative bacteria *Escherichia coli* and antifungal activity against *Candida albicans* and *Candida glabrate* [75.] The fruits showed maximum inhibitory activity against the *Micrococcus luteus* however, no antimicrobial activity has been reported from essential oil of *Prunus armeniaca*.

Antioxidant Activity (Water and Methanolic Extracts of Seeds, Methanolic Extract of Leaf): Most of phenolic compounds (determined by measuring absorbance of the extract solutions after incubating them with Folin-Ciocalteu reagent) occurring in fruits exhibit antioxidant activity [76]. Both methanolic and water extracts of sweet kernels showed good antioxidant activity, while bitter kernel extracts showed negligible antioxidant activity. The highest phenolic content (7.9 ± 0.2 μg/mL) and lowest phenolic content (0.4 ± 0.1 μg/mL) were detected in the water extract of a sweet prunus armeniaca and bitter prunus armeniaca kernel, respectively. The methanolic extract of leaf also shows good antioxidant activity when determined by enzyme analysis, pigment analysis and protein extraction parameters [77].

Anticancer Activity (From the *Prunus armeniaca* Seed Oil): Due to presence of cyanogenic glycosides (mainly amygdalin) in seeds it is reported to be used as a medicament for the treatment of cancer [78]. Laetrile, a purported alternative treatment for cancer, has also been extracted from prunus armeniaca seeds. In England, *Prunus armeniaca* seed oil is in use against tumors'swellings, and ulcers even from the seventeenth century. It has been also revealed by scientists in the Republic of Korea (2005) that treating human prostate cancer cells with amygdalin induces programmed cell death and it was concluded by that amygdalin offer a valuable option for the treatment of prostate cancers.

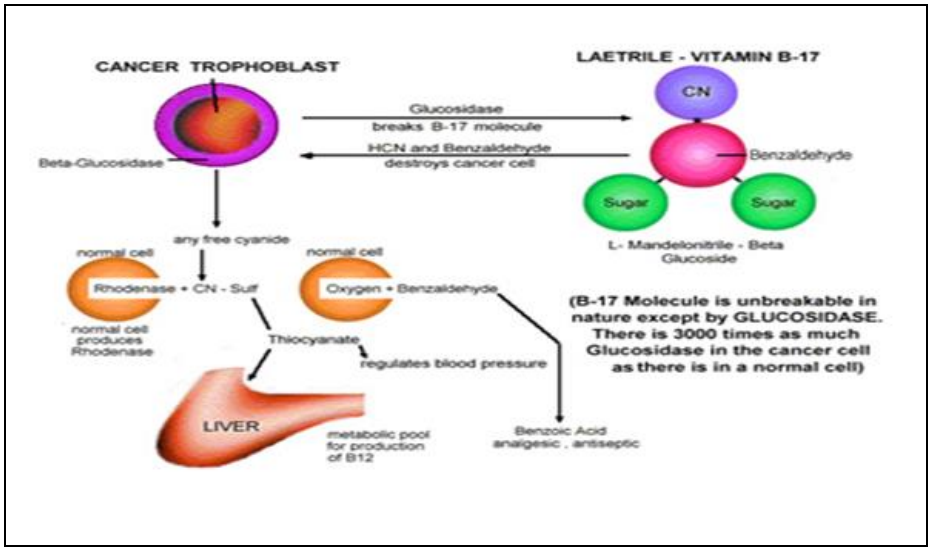


FIG. 2: EFFECTIVENESS OF LAETRILE IN TREATMENT OF CANCER78

Protective Effect from Radiation (By *Prunus armenica* Diet Feeding): Kurus M *et al*., 2013 [79] demonstrated the regular dietary intake of, *Prunus armenica*, which has established antioxidant potency, is beneficiary against undesired effects of radiation in the lungs. Ugras MY *et al*., 2010 [80] also hypothesized the *Prunus armeniaca* rich diet significantly ameliorated the oxidative status and prevented the damage in tubular histology in testis of Sprague- Dawley rats. In this research, they also reveals that detrimental effects of low-dose irradiation on testis tissue are due to the natural antioxidant activity of *Prunus armenica* and the high total antioxidant capacity of the *Prunus armenica* deserves further investigation.

Hepatoprotective Activity (By *Prunus armenica* Kernel Feeding Diet): Rahman A *et al* (2011) [81] reported hepatoprotective activity of *Prunus armeniaca* kernels delay the dimethylnitrosamine induced hepatotoxic rats.

In this study, the *Prunus armeniaca* kernel was used as a food supplement in a diet of rats in different doses (0.5, 1.0, 1.5) mg/kg/BW/rat respectively; research demonstrated that 1.5 mg/kg/BW/rat was effectively improved the liver fibrosis which was induced by dimethylnitrosamine. Sun sulphilated dried *Prunus armeniaca* also showed the hepato-protective activity against the ethanol-induced oxidative stress in rats, During, this study various parameters were studied and results showed that the *Prunus armeniaca* was play the important role against the oxidative stress of liver which was further responsible for the liver toxicity.

Cardio Protective Activity (By *Prunus armenica* Diet Feeding): H. Parlakpinar *et al* (2009) [82] reported that the *Prunus armenica* is considered as a good source of dietary antioxidant, with its content of flavonoids and carotenoids. Flavonoids are a large group of polyphenolic antioxidants that exhibit a wide range of biological activities including the inhibition of lipid peroxidation, capillary permeability, and platelet aggregation.

This study indicated the beneficial effects of the diet supplemented with dried *Prunus armenica* against Myocardial ischemia-reperfusion (I/R) injury in an *in-vivo* study in rats. The result of this study was concluded on behalf of histological determination including electron microscopic (EM) examination and biochemical analysis. 10% or 20% dried *Prunus armenica* during 3 months before the beginning of I/R studies. Infarct sizes were found significantly decreased in of 20% *Prunus armenica* -fed group after I /R.

Enzyme Inhibition Property and Anti-hypertensive Activity (By *Prunus armenica* Diet): Stated that in one recent study, *Prunus armenica* almond meal was hydrolyzed simultaneously with neutrease and N120 protease. The hydrolysate almond peptide was fractionated into three ranges of molecular weight (AP-I, AP-II, AP<III) using an ultrafiltration membrane bioreactor system. The result suggested that the peptide derived from *Prunus armenica* almond protein may have potential applications as functional food [83].

Hypocholestolemic Activity (By *Prunus armenica* Kernel): The present investigation was aimed to study the effect of detoxification on the nutrients and antinutrients of wild *Prunus armenica* kernel followed by its hypocholesterolemic effect in male Wistar albino rats. The quality parameters of kernel oil indicated no adverse effects of detoxification on free fatty acids, lipase activity, acid value, and peroxide value, which remained well below the maximum permissible limit. Blood lipid profile demonstrated that the detoxified *Prunus armeniaca* kernel group exhibited significantly ($p < 0.05$) increased levels of HDL-cholesterol (48.79%) and triglycerides (15.09%), and decreased levels of total blood cholesterol (6.99%), LDL-C (22.95%) and VLDL-C (7.90%) compared to that of the raw (untreated) kernel group and ascorbic acid is used as a standard in this procedure [84].

Marketed Products: Due to its various uses, many products which contain *Prunus armeniaca* as the main ingredient are available like, Himalaya *Prunus armeniaca* scrub, Himalaya apricot cleansing milk, apricot powder, apriocot milk, apricot mask, apricot Bar, apricot facial cream, Stieves apricot cream, apricot sorbet, apricot candy, apricot jam, apricot lipstick, apricot gentle exfoliating daily face wash, in preparation of wine, Almond- apricot massage cream, apricot Gel, Kadi apricot oil, etc. are available in the market [85].

TABLE 2: CHEMICAL CONSTITUENTS ARE REPORTED IN *PRUNUS ARMENIACA*

S. no.	Parts	Chemical Constituents	Activity	Reference
1	Leaves & Branches	Kaempferol, Quercetin, adtragalin, Palmitic acid (Fatty acid 46.65%, linolenic acid 17.06%, stearic 7.12%, linoleic acids 6.52%)	Antioxidant activity	[86, 87, 88, 89, 90]
2	Cell wall	Pectin , arabinose 36.7-47.3%, galactose 8.7-13.3%		[91, 92]
3	Fruit	Total sugar 5.3-8.6%, saccharose 6.36-6.90%, glucose 3.2-4.8%, fructose1.4-4.2%,Rhamnose 4.2-6.6%, Xylose 12.0-16.0%, Mannose 4.7-6.0%, sucrose, tannins, maleic acid, citric acid, quinic, calcium , aminoacids, sorbitol	Antioxidant activity, Antimicrobial activity, Cardioprotective activity,	[93, 94, 95, 96, 97, 98, 99, 100]
		Total solids (12.4-16.7%), insoluble solids (2.1-3.1%), Cabohydrates, vitamin C and K, oil, soluble sugars, provitamin A, fiber	Antitubercular activity,	[101, 102, 103, 104]
		Limonene, p-cymene, α-terpineol, terpinoline, linalool, γ-octalactone, linalool, γ-decalactone and γ-dodecalactone	Hepatoprotective activity	[105, 106]
		β-carotene, γ-carotene, lycopene, phenolics compound, catechin 73.4% and epicatechin 82.6%, Phytofluence, lycopene, β-carotene, lutein, α-cryptoxanthin, Quercetin, Rutin and Kamferol		[103, 100, 107]
		Vitamin C and K, carbohydrate, soluble sugar, oil, provitamin A		[108, 104]
		Chlorogenic acid, protocatechuic acid, narigenin -7-glucoside, orchlorogenic acid, gallic, procumaric, caffeic, ferrulic acids, pruning, photocatechuic acid, procynadine B2, B3 and C1		[109]
		Limonene, terpinolene, myrecene, trans -2- heenol, linalool, geranial, α- terpineol, , 2 methylbutyric, γ-octalectone,lactones, γ-decalactone, γ-dodecalactone, hexanal, C6 lipid peroxidation, β-ionone, E-2-noneal, α-terpinolene, α (E, E)-farnesene, megastigma-4,6,8-triene		[110, 111, 112]
		Ocinienol, nerol, cis and trans -linalool oxide, ethyl cinnamate, hexyl acetate, ethyl acetate, β-cyclocitral, 6-methyl-5-hepten-2-one, (E)-hexen-2-al, menthone, Dgalactopyranoside, 3,4'5,7–tetrahydroxy- 3',5'-di-methoxy flavones 3-O-[α-L- rhamnopyranosyl (1 6)]- β-Dgalactopyranoside and 4,5,7- trihydroxy flavones-7-O-[β-D- mannopyranosyl (1''' 2'')-β-D-allopyranoside		[113, 114, 11, 116, 117, 118, 119
4.	Root	Epiafzelechi-3-O phyroxybenzoate-(4α 8, 2α O 7)-epiafzelechin, ent-epiafzelechin – (4α 8, 2α O 7)-afzelechin		118, 119
		4-O-glycosyloxy-2-hydroxy-6-methoxyacetophenone		[119]
5	Seed	Glucose (37.5%), glucuronic acid (12.5 %) and Mannose (50%)	Antioxidant activity, Antimicrobial activity, Anti cancer activity, Hepatoprotective activity, Anti-inflammatory and Antinociceptive activity	[117, 9, 118, 119, 120]

CONCLUSIONS: More studies should be conducted to elucidate the molecular mechanism of interaction of various parts of these plant-based drugs with human body in different diseases. In the present study, we reviewed that *Prunus armeniaca*, is the worldwide deciduous plant which having manifold uses. Mostly all parts of the plant are being used in Pharmacological and Cosmetic preparation. Several therapeutically and industrially useful preparations and compounds have also been marketed, generating enough encouragement among scientists to explore more information about this medicinal plant. An extensive research and development work should be undertaken on *Prunus armeniaca* and its products for their better economic and therapeutic utilization.

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