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PHYTOCHEMISTRY AND PHARMACOLOGICAL ACTIVITY OF PEAR (*PYRUS COMMUNIS* LINN) : A REVIEW

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Abstract

Pyrus communis L. (pear) is an important medicinal plant that has been commonly used since prehistoric times. The pear is known as 'Amritphale' due to its immense effect in health care system of human. Different compounds have been detected in various parts of *Pyrus communis* L. like arbutin, kaempferol, quercetin, fredielin, isoquercitrin, sterols, ursolic acid, astragalin, sorbitol, phloridzin and tannins that are responsible for various activities of pear such as anti-oxidant, anti-microbial, anti-cancer, cholesterol-lowering, skin-whitening, anti-diabetic, wound healing effect, action on urinary system, immune booster and weight loss effect.

Key words : pharmacological activity; Environmental; medical plants; Phytochemistry.

Introduction

Pear (*Pyrus communis* L.) belongs to family Rosaceae of dicotyledonous plant (Arzoo and Parle M, 2017; Parle M and Arzoo, 2016), native to Western Europe,China, North Africa, Pakistan and Asia (Imam S *et al.,* 2018; Hussain S *et al.,* 2013; Sha S *et al.,* 2011). It is among the most important economically fruit tree crops in temperate regions (Velmurugan C and Bhargav A, 2013; Khare CP, 2007). Pears described by ancient Greek poet Homer as one of the 'gifts of God' (Velmurugan C and Bhargav A, 2013). Among cultivated fruits, it fills 2nd rank in nutrition after apple (Arzoo and Parle M, 2017; Sharma K *et al.,* 2015). It is usually named as common pear (in English), european pear, bagu gosha (in Hindi), Nakka and it is known as (Amritphale) in Sanskrit due to its immense effect in the care of human health (Parle M and Arzoo, 2016; Sharma K *et al.,* 2015; Arzoo and Parle M, 2017). Pear is an important medicinal plant that has been commonly used since prehistoric times. It contains many antioxidants that provide several health benefits and combat different degenerative disorders (Imam S *et al.,* 2018). All parts of Pear tree have big nutritional value and many medicinal properties like sedative, anti-inflammatory, antioxidant, antipyretic, hypolipidemic, anti-aging, hypoglycaemic, analgesic, anti-tussive, spasmolytic, anti-diarrheal, anti-microbial, wound healing and hepatoprotective (Arzoo and Parle M, 2017; Parle M and Arzoo, 2016). As its good source of quercetin, copper and vitamin C, which prevent cell damage by free radicals (Arzoo and Parle M, 2017; Sharma K *et al.,* 2015). Fire blight is one of the main diseases of pear and caused by *Erwinia amylovora* bacterial pathogen (Chizzali C *et al.,* 2016; Deckers T and Schoofs H, 2008). Dibenzofurans and biphenyls (inducible defense compounds) (Kokubun T and Harborne JB, 1995) are formed as phytoalexins (antibactreial metabolites) in response to the infection (Vrancken K *et al.,* 2013).

Botanical description of pear (Arzoo and Parle M, 2017; Parle M and Arzoo, 2016)

Taxonomy

Kingdom : Plantae

Division : Magnoliophyta

Class : Magnoliopside

Order: Rosales

Family: Rosaceae

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Subfamily: Amygdaloideae

Tribe : Maleae

Sub-tribe: Malinae

Genus : *Pyrus* L.

Species *: Communis* Linn.

Description

Pear is a sweetly juicy fruit with buttery and glitter texture (Arzoo and Parle M, 2017; Kaur R and Arya V, 2012). It is tree of medium-sized, 1-4 cm in diameter and 10-17 m height with an elongated basal part. Leaves of it are simple, 2-12 cm long, glossy green, alternately arranged and broad oval in shape. The pulp is aromatic, white, sweet and embedded with it, few small brown seeds. It is eaten fresh, canned, as dried, and juice (Sharma K *et al.,* 2015; Gibson AR and Clancy RL, 1978). Fruit is a pyriform pome with deciduous or persistent calyx, 4-12 centimeters long, dry, gritty and greenish colored as shown in figure (1). The fruit can be consumed raw, in jellies or jams, and as salads (Ajilore B *et al.,* 2016; Orwa C *et al.,* 2009).

Fig. 1: Photo of *pyrus communis* plant.

Traditional Uses

Aerial and flowering parts of *Pyrus communis* are a source of folk medicine as they show anti-inflammatory effects (Zahid K *et al.,* 2019; Velmurugan C and Bhargava A, 2014). Pears are stimulate bowel peristaltic movement and digestion, affect blood pressure, low in calories, and show antipyretic, diuretic, and antitussive activities (Chizzali C *et al.,* 2016; Konarska A, 2013; Reiland H and Slavin J, 2015). Its bark and leaves can be used in healing of wound. Among the Arabs, buds, bark, and leaves of the tree are domestic remedies for their astringent effect (Velmurugan C and Bhargav A, 2013; Nadkarni KM and Nadkarni AK, 2005). The pear flowers are used in traditional medicine as components of spasmolytic and analgesic drugs (Sharma K *et al.,* 2015; Rychlinska I. and Gudej J., 2002).

Pear prevents the birth defects development in babies and maintains level of folic acid during pregnancy. When taken regularly, pear is useful in dysmenorrhea. Pear also have favorable neuroprotective properties thereby prohibiting the neurodegenerative diseases from development like Huntington's disease, Parkinsonism and Alzheimer's disease. The regular pear consumption reduces the danger of age-related macular degeneration, which is the main reason of loss of vision in older adults (Arzoo and Parle M, 2017; Parle M and Arzoo, 2016). As pear has small content of acid, it is used for weaning babies, because it is not too harsh on the digestive system of baby. Pear can significantly decrease your blood level of alcohol and hangover symptoms if it is eating before a big drinking session. In our body, Pear affect certain enzymes in such a way that metabolized alcohol rapidly (Arzoo and Parle M, 2017; Kaur R and Arya V, 2012).

Many studies have been found that increasing pear consumption could lower the risk of diabetes, obesity and heart disease. It promotes tissue repair and wound healing, and increases the cognitive ability. It also, regulates the fluid levels of body, boosts the immune system, increases the energy levels and metabolism etc (Imam S *et al.,* 2018; Kaur R and Arya V, 2012).

Phytochemical composition

Pyrus communis contain many active constituents such as glycosides, minerals, vitamins, amino acids, flavonoids,fatty acids, alkaloids, tannins and polyphenols (Arzoo and Parle M, 2017; Parle M and Arzoo, 2016; Li X *et al.,* 2012).

Study show that in ethanolic extract of *Pyrus communis*, the nature of active constituents present are carbohydrates, tannins, alkaloids, phenolics, glycosides and flavonoids. The nature of active constituents truant in ethanolic extract are proteins, amino acids, fixed oils, triterpenoids, steroids, saponins, mucilage and gums (Y. Suryasree and P. Amudha, 2019).

Different parts of pear such as flowers, leaves, bark and roots use as anti-inflammatory agents against disorders. The leaves contain many active compounds such as arbutin, sorbitol, isoquercitrin, ursolic acid, tannin and astragalin (Khare CP, 2007; Sharma K *et al.,* 2015). The bark is source of bioactive compounds like epifriedelanol, friedelin and beta-sitosterol (Sharma K *et al.,* 2015; Rehder A, 1986). The fruit is a good source of phytonutrients like carotenoids, glycosides, flavonoids, carbohydrates,sterols and phenolic compounds such as epicatechin, arbutin, hydroxyl-phenolic acids and health promoting nutrients such as minerals, vitamin C,A, organic

acid,dietary fiber etc (Imam S *et al.,* 2018; Mahammad MU *et al.,* 2010). Its fruits help in maintaining balance of desirable acid in the body because they are excellent source of pectin (Velmurugan C and Bhargav A, 2013). Fruit also contains some essential element enough to meet with the allowances of recommended daily like phosphorus, calcium, sodium and magnesium (Ajilore B *et al.,* 2016; Mahammad MU *et al.,* 2010). The juice of *Pyrus communis* contains vitamins and carotenoids, that have neuroprotective and antioxidant property that prevent the apoptosis of neurons (Arzoo and Parle M, 2017; Kale MA *et al.,* 2015).

Although pears are contain small level of fat and protein but the contents of vitamin (C, E, and B complex) are high. It provide an excellent source of dietary fiber when the skin of pear is consumed along with the flesh (Öztürk A *et al.,* 2015; Ozcagiran R *et al.,* 2004).

Flavonoid glycosides have been detected like kaempferol 3-O-β-D (6"-O-α-L-rhamnopyranosyl)-glucopyranoside, quercetin 3-O-β-D glucopyranoside and quercetin 3-O-β-D-(6"-O-α- L-rhamnopyranosyl)-glucopyranoside. Triterpenes and sterols (α-amyrin and β-sitosterol). Coumarins and phenolics are present in the flowers of *Pyrus communis* L. Chlorogenic acid is also identified in the flowers of *Pyrus communis* L. In the stem bark of *Pyrus communis* L.**,** triterpenoids are identified (Kaur R and Arya V, 2012). Quercetin considered as a major flavonoid in *Pyrus communis* juice**,** having antithrombotic, antitumor, anti-inflammatory, antioxidant, and anti-apoptotic effects. Quercetin was reported to be effective in decreasing ischemia related brain swelling and brain injury and also neuroprotective in a zebrafish model (Arzoo and Parle M, 2017; Koppula S *et al.,* 2012).

Different tissues and organs of this plant, like flower bud, skin, young fruit, leaf bud, peel and flesh of fruit, have various content of phenolic compounds (Öztürk A *et al.,* 2015; Cui T *et al.,* 2005; Lin L and Harnly JM, 2008). The major phenolic compounds in pear are epicatechin, arbutin and chlorogenic acid (Spanos GA and Wrolstad RE, 1990; Oleszek W *et al.,* 1994) that acts as coloring factors in the fruit and their products https://www.tandfonline.com/doi/full/10.1080/10942912.2013.835821 (Amiot MJ *et al.,* 1995) or as antioxidants (Leontowicz H *et al.,* 2002) .

The phenolic compounds (chlorogenic acid, arbutin, (")-epicatechin, (+) catechin, p-coumaric acid, caffeic acid, rutintrihydrate and rutinhydrate) are detected in pear extract by high-performance liquid chromatography (HPLC) (Öztürk A *et al.,* 2015; Colaric M *et al.,* 2006; Schieber A *et al.,* 2001).

In HPLC, the flavonol glycoside derivates, rutin trihydrate (Quercetin-3-rutinoside-trihydrate) and rutin hydrate (Quercetin-3-rutinoside-hydrate) were identified as minor phenolic compounds, while chlorogenic acid and arbutin were identified as major phenolic compounds in the peel and flesh (Öztürk A *et al.,* 2015; Escarpa A and Gonzalez MC, 2000) . Chlorogenic acid is act as antioxidant, a potential chemopreventive agent, it may support the prevention of chronic diseases, such as cardiovascular disease and cancer, immune system enhancement, anticancer activity, decrease the toxicity of chemotherapy drugs (Öztürk A *et al.,* 2015; Morton LW *et al.,* 2000; Kris-Etherton PM *et al.,* 2002). The presence of chlorogenic acid in the fruit has been associated with enzymatic browning of pears and even though the extent of browning mostly depend on the maturity level (Öztürk A *et al.,* 2015; Galvis-Sanchez A *et al.,* 2003).

The another important phenolic compound in the fruit of pear is arbutin (Durkee AB *et al.,* 1968),act as antibacterial and human skin whitening agent, widely used in urinary therapeutics, and reduce melanin in the skin (Sharma K *et al.,* 2015; Velmurugan C and Bhargava A, 2014; Öztürk A *et al.,* 2015; Cinnasamy VM and Bhargava A, 2014). Chlorogenic acid content was lower than the arbutin in the flesh and peel (Öztürk A *et al.,* 2015).

Pyrus communis (L) contains 2-Furanmethanol, act as an ingredient in the preparation of several chemical products like adhesives, foundry resins, and wetting agents. The furfural derivatives reported to have strong bactericidal property (Sharma K *et al.,* 2015).

Gas chromatography-mass spectrometry (GC-MS**)** analysis of methanol fruit extract of *Pyrus communis* detected the presence of compounds possessing different applications such as squalene, isosorbide, 1-octadecdecanol (stearyl alcohol) and octadecanoic acid (stearic acid). The identified compounds have potent antioxidant and antimicrobial properties along with therapeutic effect and play an efficient role in development of drug and health supplements (Sharma K *et al.,* 2015).

Pharmacological activity of *Pyrus communis* L.

Anti-psychotic activity

The antipsychotic effect of juice of *Pyrus communis* L. was evaluated by using pole climb avoidance, Ketamine-induced stereotypic behaviour and swim-induced grooming behaviour model in rats. The fresh *Pyrus communis* L. juice was given orally for 21 days to

rodents. *Pyrus communis* L. juice (PCJ) was reduced ketamine induced turning, falling, weaving and head-bobbing counts. Ketamine (dissociative anaesthetic), specifically inhibit NMDA receptors producing social withdrawal and schizophrenia-like psychosis (stereotyped behavior) in both humans and rats, thereby producing the schizophrenia symptoms. The hypoactivity of glutamatergic transmission in the brain result in Schizophrenia. In pear, glycine and glutamic acid probably stimulated NMDA receptors and by GABA-mediated indirect pathway, the dopaminergic transmission is reduced. This effect of Pear can be useful in relieving bizarre symptoms of psychosis (strange behaviour, hallucinations, hostile behaviour and irrational statements). In Cook's pole climb apparatus, PCJ delayed the latency time given to the animals to climb the pole (Arzoo and Parle M, 2017).

Within mesolimbic system,hyperactivity of dopamine causes cognitive dysfunction and bizarre symptoms (Parle M and Arzoo, 2016). PCJ significantly decreased swim induced grooming behavior and reduced the levels of dopamine in brain (Ingale SP and Kasture SB, 2012). This proved that pear juice have promising antipsychotic effect probably supported through its blocking of dopamine D2 receptor.

The anti-psychotic activity of Pear can be due to the presence of flavonoids, Vitamin E, Vitamin C, polyphenolic compounds and glutathione as antioxidants, that protect cells of brain from the oxidative stress. PCJ significantly enhanced levels of reduced glutathione in the rat brains, thereby enhanced free radicals scavenging and prevent psychotic attack from occurrence. Both, presence of choline (precursor for acetylcholine) in Pear and inhibition of activity of AChE by chronic pear consumption stimulated cholinergic transmission in the rodent brains, which can be responsible for inverting cognitive dysfunctions (Arzoo and Parle M, 2017).

Hepatoprotective activity

As a result of exposure to environmental toxicants, incidence of liver dysfunction is increasing globally (Landis WG *et al.,* 2000). One of the liver functions is the synthesis of the haptoglobin and protein (Yoshioka M *et al.,* 2002). Haptoglobin act as an antioxidant attributed its ability to bind with hemoglobin forming complex (haptoglobin-hemoglobin), thereby protect from the oxidative damage that may be supported by free hemoglobin. The hepatoprotective activity of methanol extract of seeds of *Pyrus communis* L. was evaluated in heavy metal induced liver damage in rats (Ajilore B *et al.,* 2016) .

Treatment with cadmium (heavy metal) depressed synthesis of proteins including a C-reactive protein, haptoglobin (Ajilore BS and Ayannuga OO, 2012) and serum antioxidant and caused severe liver damage in rat.

Treatment with methanol seed extract of *Pyrus communis* L. improved haptoglobin synthesis and other proteins in both rats that are administered with *Pyrus communis* L. extract alone and pre-treated rats. The significant decrease in total albumin and protein levels and significant elevation of same in the serum seen in rat treated with cadmium may be as a result of oxidative damage by reactive oxygen species (ROS) on the membrane components of cells of liver and causing intracellular contents escaping into the circulation (Ajilore B *et al.,* 2016). Cadmium enhance ROS production in liver cells which attack intracellular constituents such as lipids, nucleic acids and proteins, and also attack membrane (Ajilore BS and Ayannuga OO, 2012). In rats treated with cadmium, the significant increase in serum AST and ALT activities and significant reduce in liver activities of these enzymes is a an indication of release of the enzymes into the circulation and loss of functions and structure of hepatocyte membrane.

The normal histo-architecture of liver and near normal levels of total protein, haptoglobin, sera and liver AST and ALT in rats treated with *Pyrus communis* seed extract exhibited that this plant is hepatoprotective (Ajilore B *et al.,* 2016). This may be due to antioxidant and anti-inflammatory properties of the phytoconstituent present in *Pyrus communis* seed extract (Sharma K *et al.,* 2015). So methanol extract of seeds of *Pyrus communis* L. restored haptoglobin expression and protected against severe heavy metal-induced liver injury (Ajilore B *et al.,* 2016).

Anti-obsessive compulsive activity

Obsessive–compulsive disorder (OCD) is a mental disorder characterized by recurrent,uncontrollable and absurd thoughts (obsessions) that producing anxiety, that are followed by compulsions (repetitive behaviour) aimed at decreasing anxiety (Stein DJ, 2000).

Serotonin (neurotransmitter) involved in appetite, mood, pain,sleep control, and cerebral activation (Boileau B, 2011). Only potent serotonin reuptake inhibitors were found to be efficient in relieving compulsions and obsessions in patients. The main cause of the obsessive–compulsive disorder is serotonin imbalance, in addition to environment factors (Stein DJ, 2000).

The anti-OCD activity of fruit of *Pyrus communis* L. investigated by used marble-burying behavior and flickering light induced OCD model in mice. The results

shown that oral administration of fresh juice of *pyrus communis* L. to mice decreased the marble burying behaviour. The effect of fresh juice of *Pyrus communis* was found to be identical to effect of fluoxetine (Arzoo and Parle M, 2017).

In flickering light induced OCD model, *Pyrus communis* juice is decreased the number of thermocol pieces gnawed. The juice of *Pyrus communis* L. contains important precursor of serotonin which is tryptophan. So the biosynthesis of serotonin will be enhanced, thereby promoting the anti-compulsive activity (Arzoo and Parle M, 2017; Madhura TK, 2015). Also GABA (inhibitory neurotransmitter) may be play an important role in the OCD pathogenesis. It has been found that GABA reduced the obsessive- compulsive behavior and hyperactivity in laboratory animals (Fava L, 2014). Also there are a remarkable elevated in the GABA levels, which have further assisted in anti-obsessive compulsive activity of juice of *Pyrus communis* L..

Pyrus communis juice is rich source of anti-oxidants such as polyphenols, flavonoids, vitamin C and quercetin etc. Thence, the juice of *Pyrus communis* L. preventing occurrence of obsessive-compulsive behaviour by enhanced scavenging of free radicals in the brain. all these findings meditate the anti-obsessive compulsive effect of fresh juice of *Pyrus communis* L (Arzoo and Parle M, 2017).

Anti-diabetic and hypolipidemic activity

The hypolipidemic and hypoglycemic activity of ethanol and ethyl acetate extracts of *Pyrus communis* fruits was investigated by dexamethasone-induced diabetic rats. Glucocorticoid-induced hyperglycemia is attributed to increase insulin resistance of peripheral tissues and hepatic glucose production. Diabetic rats have high levels of blood sugar,lower body weight as compared to normal rats. The oral administration of ethanol and ethyl acetate extracts of *Pyrus communis* significantly reduced the level of blood glucose due to potentiation of the plasma insulin effect by increasing its release from bound insulin or the pancreatic insulin secretion from existing β-cells of Langerhans islets. The hypoglycemic effect of extract produced by independent mechanism from the insulin secretion, it may be by inhibit absorption of intestinal glucose or by inhibit production of endogenous glucose or may also be due to enhanced utilization of glucose by peripheral tissues (Velmurugan C and Bhargav A, 2013).

In diabetes, the abnormalities in lipid profile associated with atherosclerosis is the main cause of cardiovascular disease. In addition to glycemic control, ideal management of diabetes should have a proper effect on lipid profiles. The extract of *Pyrus communis* fruit show favorable effects on blood glucose level as standard. It also decrease the elevation of biochemical parameters like low density lipoprotein (LDL), triglycerides (TGL), total cholesterol (TC),and very low density lipoprotein (VLDL), maintains body weight and elevated the reduced level of high density lipoprotein (HDL) (Velmurugan C and Bhargav A, 2013).

Pyrus communis L. has possible role to prevent coronary heart disease and formation of atherosclerosis. The secondary metabolites like flavonoids, saponins, triterpenoids,and phenolic compounds have hypolipidemic and anti-hyperglycemic effect (Leontowicz H *et al.,* 2002; Ogawa H *et al.,* 2005). Hence, the hypolipidemic and antidiabetic effect of ethanol and ethyl acetate extracts is probably due to the presence of various active hypoglycemic principles and their synergistic properties. So *Pyrus communis* fruit could be useful in treatment of diabetes accompany with lipid abnormalities (Velmurugan C and Bhargav A, 2013).

Wound healing activity

Wounds define as breaking or loss of cellular and functional or anatomic continuity of living tissue. Wounds are classified as acute and chronic wound (Patil MB *et al.,* 2011). The healing of wound is a complex dynamic process that producing the restoration of function and anatomic continuity (Jaswanth A *et al.,* 2001).

The wound healing effect of ethanol and ethyl acetate extracts of *Pyrus communis* fruits was evaluated by different models of wound healing in normal rats like incision, dead space and excision wound model. This study exhibited that ethanol and ethyl acetate extracts of *Pyrus communis* fruits was efficient in all wound healing activity models. In excision model, the study showed that *Pyrus communis* L. reduced scar area and epithelization, and increased the wound contraction. The elevated collagen levels via increased cross linking of collagen fibers causing increase in skin breaking strength (Cinnasamy VM and Bhargava A, 2014). Also, elevate in the weight of dry and wet granulation tissue proved the presence of higher content of protein (hydroxyproline) (Manjunatha BK, 2006).

Flavonoids are promote processes of wound healing primarily due to their astringent and antimicrobial properties, which may be responsible for elevated epithelization rate and contraction of wound (Pesin U *et al.,* 2011). Tannins are facilitated healing of wound through various cellular mechanisms: increasing the formation of fibroblasts and capillary vessels,scavenging of reactive oxygen species and free radicals, and

promoting the wound contraction (Choudhary GP, 2008). The wound healing activity of *Pyrus communis* extracts could be attributed to the interaction of the combination of these phytochemicals(tannins, flavonoids, phenolic compounds, alkaloids) with various wound healing phases such as angiogenesis, inflammation, proliferative, remodeling and repair (Cinnasamy VM and Bhargava A, 2014).

Antiradical activity

Ethanol, methanol (Bark/Leaves/Fruit) (Zahid K *et al.,* 2019) and ethyl acetate leaves extract (Zbiqniew S *et al.,* 2014) of *Pyrus communis* was tested for radical scavenging activity by using 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay.

Antioxidant activity reported to be better in ethanol extract than methanol extract (Zahid K *et al.,* 2019), and ethyl acetate extract produce strongest radical scavenging activity (Zbiqniew S *et al.,* 2014). *Pyrus communis* exhibited potent antiradical effect as compare to the drugs used i.e. quercetin, ascorbic Acid, vitamin E and butylated hydroxytoulene (Zahid K *et al.,* 2019).

Antioxidant effect of methanol fruit extract of *Pyrus communis* L. also tested by using FRAP (Ferric reducing antioxidant power) and ABTS (2, 2-azinobis-3-ethylbenzothiazoline-6-sulfonic acid) assay. The results that produced from different assays shown strong antioxidant effect of the extract even at small concentrations, which is in the best correlation with total flavonoids and phenolic content (Sharma K *et al.,* 2015).

This activity of pear is due to the presence of phytochemicals in plant. Pear are good source of phytoconstituents such as phenolics, alkaloids, terpenoids, flavonoids and tannins. *P. communis* L. is potent antioxidant for the treatment of various diseases such as cancer, neurological disorders like Alzheimer or Dementia and diabetes (Zahid K *et al.,* 2019).

Anti-arthritic Activity

Rheumatoid arthritis (RA) is a long-term autoimmune disease of unknown etiology (George M *et al.,* 2016) in which joints are mostly affects. Arthritis symptoms (Mahdi HJ *et al.,* 2018) such as stiffness, reduced ability to move the joint, especially in the morning, disability, difficulty performing daily activities, long term (chronic) pain, low-grade fever, weight loss, and fatigue, etc (Jitta SR *et al.,* 2019).

The anti-arthritic effect of the ethanol extract of fruits of *Pyrus communis* L. was investigated by Complete Freund's Adjuvant (CFA) induced rheumatoid arthritis in rats (Y.Suryasree and P.Amudha, 2019). CFA consist of dried and inactivated *Mycobacterium tuberculosis* (Billiau A and Matthys P, 2001).

The oral administration of *P. communis* fruit extract for rat producing anti-arthritic activity that show increasing in locomotor activity but reducing in body weight and paw edema volume of animals. The anti-arthritic activity is demonstrated by inhibition of protease, a reduction in percentage of protein denaturation and total protein. *Pyrus communis* extract has exhibited significant protection versus bony destruction by show less narrowing of joint spaces and less soft tissue swelling as compared with the negative control. The anti-arthritic effect of *Pyrus communis* extract is evidenced by X-ray radiography and histopathological analysis of ankle joints. Upon treatment with the ethanolic extract of *Pyrus communis* fruit, the ability of the bones to re-form specified by histopathological analysis. In X-ray radiography analysis, the earlier radiographic sign is swelling of soft tissue, whereas prominent radiographic signs such as narrowing of joint spaces and bony erosions can be shown only in the final stages of arthritis (Y.Suryasree and P.Amudha, 2019). Thus, it may be concluded that *Pyrus communis* fruits shown significant anti-arthritic effect in CFA-induced rats.

Anxiolytic activity

The hydroalcoholic extract of *Pyrus communis* fruit was investigated for the anxiolytic effect by using the animal model (forced swim test (FST) and open field test (OFT)). The administration of *P.communis* fruit extract for rat orally exhibited anxiolytic activity. The frequency of rearing, the number of sectional crossings, center square entries and duration were higher between the control group and the treated groups in the OFT while in the FST, treatment with either fruit extract of *P. communis* or escitalopram decreased depressive like behavior. When compared with escitalopram,the fruit extract show the good anxiolytic activity in OFT and FST (Imam S *et al.,* 2018).

Flavonoids have indirectly or directly effect on nor adrenaline, GABA, serotonin neurotransmitters and on CNS and are potentially useful to relieve the disorders of mood (Adebiyi OE *et al.,* 2016; Abidemi J *et al.,* 2012). In addition, antioxidants such as zeaxanthin, quercetins, kaempferol and lutein decrease the oxidative stress by reducing the reactive oxygen species (ROS) and reactive nitrogen species (RNS) production, and decrease the risk of different diseases such as cancer, diabetes and Alzheimer's disease (Li X *et al.,* 2011; Manzoor M *et al.,* 2013).

Finally, in the fruit extract,the presence of one or

mixture of phytochemicals can be responsible for its anxiolytic activity (Imam S *et al.,* 2018).

Anti-microbial activity

Aqueous extract of leaves and fresh juice of *P. communis L.* exhibit antibacterial effect versus E.coli and Staphylococcus due to the presence of arbutin. Arbutin converted in body into hydroquinone (Parle M and Arzoo, 2016; Kaur R and Arya V, 2012; Guven K *et al.,* 2006) that have anti-microbial effect, operates defense mechanisms versus bacteria invasion and promote biochemical processes. Also aqueous extract of Pear young shoots exhibited antimicrobial effect due to the presence of hydroquinone (Parle M and Arzoo, 2016; Jin S and Sato N, 2003).

Ethyl acetate leaves extract of *P. communis* L. shows higher anti-bacterial effect than other extracts. There are positive correlation between the antibacterial activity of extract against all tested bacterial strains and their contents of hydroquinone. *Saccharomyces cerevisiae* and *Candida albicans* (fungi strains) are completely resistant to the ethyl acetate extract (Zbiqniew S *et al.,* 2014)**.**

Conclusion

This review demonstrated the presence of several bioactive compounds in pear (*Pyrus communis* L.), which could be responsible for different medicinal, pharmacological and nutritional uses of pear (*Pyrus communis* L.). In addition to the phytoconstituents report in pear, this study has also revealed the biological activities of various parts of this plant. In order to explore other potential pharmacological properties and proved its medical uses, other studies need to be happen on pear (*Pyrus communis*).This plant could consider as excellent source of active compounds for drug development and future pharmacological studies.

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