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PHYTOCHEMICAL ANALYSIS, MEDICINAL AND TRADITIONAL USES OF *CAPPARIS DECIDUA*

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Abstract

Capparis decidua is a shrubby plant and indigenously in Pakistan and other regions like Africa, Asia and Saudi Arabia, related to *Capparidaceae* family. Its common name is different in different areas even in Pakistan it is known for many names like “Kair” and “karir” in Punjab area whereas it is known with changed name in other regions. This plant has great therapeutic effects along with great nutritional value. Largely, the fruit of *C. decidua*, when done proximate compositional analysis showed that it had great nutritional value due to which can be used as livestock feedstuff and for food. All the parts of plant are used for different purposes. It covers the two major aspects of human life i.e. use for nutritional and treatment purpose. *C. decidua* can be used in curative numerous ailments and for food in many nations. In the old-style therapeutic system of India and Pakistan, it has an exceptional position as therapeutic plant. However, the formula and method of use against various afflictions shifts as per the region and culture. The medical specialty of this plant is having anti-atherosclerotic, anti-inflammatory, anti-bacterial, hepatoprotective, anti-fungal, analgesic, anthelmintic, hypolipidemic, anti-tumor, anti-giardial, anti-nociceptive, anti-diabetic, anti-rheumatic, antioxidant and anti-convulsant activities. Due to these attributes, this plant contains many important phytochemicals in an extensive range including phenolics, alkaloids (capparisinine, capparisine, stachydrine, isocodonocarpine), flavonoids, fatty acids and sterols. Different parts of plant consist of different composition of protein, carbohydrates, fatty acids, traces metals and compounds. It can also be use as appetizer, aphrodisiac, carminative and emmenagogue. This review emphases on the medicinal uses by folk, phytochemistry and pharmacological activities of this multiuse plant. Furthermore, we also enclosed the efficacy of plant as food (functional) and Nutra-pharmaceutical.

Keywords: *Capparis decidua*, Anti-inflammatory, ntibacterial, Hepatoprotective, Anti-fungal, Analgesic.

1. INTRODUCTION

Many potential drugs are present in plants (Fabricant & Farnsworth, 2001; Muhammad, Hussain, Jantan, & Bukhari, 2016; Yadav & Agarwala, 2011). Since the ancient times, medicinal plants plays important role in nutrition and treatment of people (Ashraf, Muhammad, Hussain, & Bukhari, 2016; Shad et al., 2014; A. Shah et al., 2013). Till the time, people has great attraction towards herbal treatment (Joseph & Raj, 2010) due to low cost and minimal adverse effects (Nasir et al., 2015). No doubt there is lack of knowledge about the utility of therapeutic plant (Hossen et al., 2015). In developing countries, about 80% of population use phytomedicines for the treatment of many ailments (WHO, 2009). During last decades, medicinal plants use, increasing in developed countries specially in metropolitan areas (Harnack, Rydell, & Stang, 2001). About 6000 species of medicinal plants have been reported in Pakistan (Shinwari, Gilani, Kohjoma, & Nakaike, 2000).

Capparis decidua is shrubby and bushy plant (Fig. 1.1) with spinous branches found in arid and dry areas, capparidaceae family from which it belong and this family consists of 250 species of plants (Mabberley, 1997). It is known with hundreds of name Karyal, Kari, Caper, Kair, Delha, Hanbag, Kabra, Karil, etc (Dhakad, Sharma, & Kumar, 2016).

It is locally present in Egypt, Arabia, Sind, Baluchistan, Western and Central India and Pakistan (Abra & Ali, 2011; D. S. Kumar, Shukla, Choudhury, & Singh, 2015). It is copiously present in Tropical Africa, Tibesti, Sudan and Arabian peninsula, (Abra & Ali, 2011) Western Rajputana, Deccan, Punjab, Gujarat, and Tinnevelly. (Nazar, Hussain, Khan, Muhammad, & Tahir, 2020).

It is about 4-5 meters in height, leafless and glossy green branches about 1-3mm in width and 4-12mm in length. Spike shaped and narrow leaves reduce the water loss while transpiration. The stem become light grey or yellow when it matures (KRBB Kirtikar & Basu, 1935). It has ability to uptake water around 4m from ground and secondary root system which is near ground, help to absorb water on surface (D. Singh & Singh, 2011). Red-veined and pink color flowers, in small cluster, attached with leafless shoots, appeared in November to January and ready in May and October (Joseph & Jini, 2011; Nazar et al., 2020). The unripen fruit is green in color, become pink berry and acicular in shape- become dark when it is in dried (Khan, Mehmood, Khan, & Khan, 2013). In Pakistan, fruits mature or ripe in May and July but in some regions such as Morocco and Egypt, March to April while before monsoon season, flowering is at its peak (D. Singh & Singh, 2011; Warrier, 1993).

Traditionally, this plant has been used against many diseases like pyorrhea, constipation, asthma, diarrhea, cough, lumbago, rheumatism, febrifuge, dysentery, ulcer, toothache, piles, liver infections, renal disorders, skin diseases and cardiac troubles (Mann, Chaudhary, & Gupta, 2013; Zia-Ul-Haq, Ćavar, Qayum, Imran, & Feo, 2011).

Figure 1: *Capparis decidua*

Plant has different properties as purgative, potherb, analgesic, aphrodisiac, carminative, tonic and emmenagogue, alexipharmic and enhancement of appetite (D. Singh & Singh, 2011; Tripathi, Singh, Anjum, & Srivastava, 2015; Zia-Ul-Haq et al., 2011). The plant is admired by its anti-oxidant (K Dangi & Mishra, 2011; Zia-Ul-Haq et al., 2011), antibacterial (Gull, Sultana, Bhatti, & Jamil, 2015; Keymanesh, Hamedi, Moradi, Mohammadipanah, & Sardari, 2009), antifungal (Gull, Sultana, et al., 2015), anthelmintic (Khan et al., 2013; P. Rathee, Rathee, Rathee, & Rathee, 2012; S Rathee, Mogla, Sardana, Vats, & Rathee, 2010; Raza, Younas, & Schlecht, 2016; Vaishnav, Agrawal, & Sandeep, 2015) anti hemolytic (Vaishnav et al., 2015), anti-gout (R. Upadhyay, 2012a), antirheumatic (Kamal et al., 2016), anesthetic (incited anesthesia) (Mann et al., 2013) and antidiabetic activities (Zia-Ul-Haq et al., 2011). The secondary metabolites are helpful in treatment of different ailments (Russell & Duthie, 2011). Moreover it has many pharmacological attributes which are termiticidal (R. Upadhyay, 2012b; R. K. Upadhyay, Jaiswal, & Ahmad, 2010), insecticidal (S Rathee et al., 2010; R. Upadhyay, 2012b), antiviral (against viruses) (M. Mohammed, Khalid, Muddathir, Siddiqui, & Ali, 2012), anti-microbial, anti-arthritis (M. Mohammed et al., 2012), anti-aging (Jadoon et al., 2015), antiplatelets (against platelets accumulation) (M. S. Mohammed et al., 2014), anti-atherosclerotic (Purohit & Vyas, 2006), anti-inflammatory (Vaishnav et al., 2015), nociceptive (D. S. Kumar et al., 2015), analgesic (Chahlia, 2009; Vaishnav et al., 2015) and hypolipidemic (D. Singh & Singh, 2011), Apart from pharmacological activities, it contain essential nutrients and minerals like iron, calcium, potassium, zinc etc. which can also be used for livestock feed (Alrasheid, El Tigani, & Yagi, 2018; Gull, Sultana, et al., 2015).

LITERATURE REVIEW

1.1. Phytochemicals

Medically and nutritionally important compounds are present in *C. decidua*. A large amount of glycosides, fatty acids, alkaloids, and terpenoids has been found (Sushila Rathee, Rathee, Rathee, Rathee, & Kumar, 2010). All the parts of plant have different bioactive compounds, some of them may same but actual quantity is different. Two aliphatic constituents that are butyl acetoacetate (butyl-3-oxoeicosanoate) and other one 25-oxooctosan-1, 20-diol. 24-b-methylcholest-7-ene-22-one-3 β-ol and 24-β-methylcholest-9 (11)-ene-22-one-3a-ol are the two diverse β-sitosterols, 9-(11,15,15-trimethylcyclohex-11-ene-13-one-yl)-one-6-hydroxymethylene-7-one-yl, 40-Methyl heptanoate which is a diterpenic ester and One diterpene alcohol which Is 3-methyl-7-hydroxymethylene-10-(12, 16, 16-trimethylcyclohex-11-enyl)-dec-9-ene-5-one-8-ol), had been found from Root bark (Ahmad, Arif, AZIZ-UR-RAHMAN, Usmanghani, & Miana, 1985; Rai, 1987; Sushila Rathee et al., 2010). Compounds isolated from root bark are 14-N-acetyl isocodonocarpine (Fig. 2.3) (Fig. 2.1), cadabicine (Fig. 2.6), 15-N-acetylcapparisine (Fig. 2.2) (Ahmad, Arif, Amber, & Fizza, 1987), codonocarpine (Fig. 2.6) (Ahmad, Ismail, Arif, & Amber, 1992), capparisine (Fig. 2.1) (Gaind & Juneja, 1970) and stachydrine (Gaind, Juneja, & Jain, 1969). It also contain spermine and spermidine which helps in growth, proliferation and development of cells of mammal and promote hair growth (FUJISAWA & KADOMA, 2005; Soda, 2010). In addition, molecules also act as anti-allergenic, anti-arteriosclerotic, and antioxidant (de la Peña, Sosa-Melgarejo, Ramos, & Méndez, 2000; Gugliucci & Menini, 2003; Ramot et al., 2010; Ramot et al., 2011).

Two acyclic terpenoids, two lupine terpenoids, two sterols, one shikimate derivative and four fatty acids when Arial part is pass through chromatography. Stem also have two alkaloids, stachydrine (2-carboxy-1,1-dimethylpyrrolodine) (Fig. 2.8) and n-triacontanol. Stachydrine, alkaloid which is water soluble, extracted from root bark, fruit husk, flowers and fruit pulp (J. Gupta & Ali, 1997; Sushila Rathee et al., 2010). The methanolic extract of Arial part contains germacr-3b-ol-12-ene-6,14-olide-15-oic acid (MW-11) and germacr-3b-ol-7,9-dien-6,14-olide-15-oic acid (MW-6) which are sesquiterpene lactones two in number (M. S. Mohammed et al., 2014).

Seed extract done by methanol, gives glucocapparin and methyl isothiocyanate (having anti-cancer activity) (S Rathee et al., 2010; Sushila Rathee et al., 2010; Tesoriere, Butera, Gentile, & Livrea, 2007; Zhang, 2004). Non-saponifiable fraction of seed and fruit husk contain β-carotene, β-sitosterol and N-pentacosane (Ahmad, Arif, et al., 1987; Ahmad et al., 1985; Ahmad, Fizza, Amber, & Arif, 1987).

Ali and Abrar reported the composition and isolated structures of fatty acids of seeds are Myristic acid 0.6%, Palmitic acid 21.1%, Linoleic acid 11.4%, Arachidic acid 2.0%, Stearic acid 7.7%, Oleic acid 57.2% (Abra & Ali, 2011). Muhammad et. al reported the seed composition in which tocopherols, steroids like cholesterol, brassicasterol, campesterol, etc, are present (Zia-Ul-Haq et al., 2011).

Hydrocarbons extracted from flowers are triacontane and nonacosane. phthalic acid (1 mg/kg), 1190 mg/kg of Ascorbic acid, oxalic acid and phytic acid (680 mg/kg) (Fig. 2.10) examined in the fruit husk and flowers (Mishra, Tomar, & Lakra, 2007; S Rathee et al., 2010; Sushila Rathee et al., 2010). Ketones (C28 and C32), two in number and saturated, aliphatic in nature, β-sitosterol new isomer, n-nonacosanol and β-D-glucoside. Two new glucocapparin, glucocappasalin, free sugars (two in number), glycoside, and pelargonidin-3-galactoside, D-galactose and D-glucose are the phytochemicals which exist in flowers (Rai, 1987).

Carotene is present in large amount in fruits and husk of fruit (210mg/kg) (Mishra et al., 2007). vanillic acid (Fig. 2.13), protocatechuic acid (Fig. 2.11), P-hydroxybenzoic acid, syringic acid (Fig. 2.12), sinapic acid (Fig. 2.14), salicylic acid, gentisic acid (Fig. 2.9), and 2-hydroxy-6-methoxybenzoic acid are present in leaves (Abra & Ali, 2011; Daniel & Sabnis, 1977). It was reported that leaves contain flavonoids, phenols and flavanols in different concentrations when extracted through acetone, aqueous and n-hexane (Baghiani et al., 2012; Mann et al., 2013).

Table 1: The table show es the phytochemical composition of different parts of *C. decidua*

Parts of Plant	Phytochemicals	References
Fruit	Carotene and stachydrine.	(Ahmad, Arif, et al., 1987; Ahmad, Fizza, et al., 1987; Mishra et al., 2007)
Leaves	Phenolic components and Flavonoids	(Abra & Ali, 2011; Baghiani et al., 2012; Daniel & Sabnis, 1977; Gaind et al., 1969; J. Gupta & Ali, 1997; Mann et al., 2013)
Flowers	Hydrocarbons, sugars, stachydrine and sterol	(Ahmad, Arif, et al., 1987; Ahmad, Fizza, et al., 1987; Mishra et al., 2007; Rai, 1987)
Root bark	Sitosterols, Heterocyclic compounds and Alkaloids (Stachydrine)	(Ahmad et al., 1985; Ahmad & Ismail, 1989; Ahmad et al., 1992; Gaind et al., 1969; Rai, 1987; S Rathee et al., 2010)
Roots	Cappariline, Capparine and Capparinine are Alkaloids	(Ahmad et al., 1992; S Rathee et al., 2010; Sushila Rathee et al., 2010; P. Singh, Mishra, Srivastava, Jha, & Khosa, 2011)
Seeds	N-pentacosane, methyl isothiocyanate, Glucocapparin, β-sitosterol, Fatty acids and β-carotene.	(Abra & Ali, 2011; Ahmad, Arif, et al., 1987; Ahmad, Fizza, et al., 1987; S Rathee et al., 2010; Sushila Rathee et al., 2010)
Aerial parts	Terpenoids and sesquiterpenes lactone	(J. Gupta & Ali, 1997; Kamal et al., 2016; M. S. Mohammed et al., 2014)

1.2. Extraction of phytochemicals

The plant contains many important phytochemicals. Their extraction is done by the methods related to chemical given below:

2.1.1. Extraction of Alkaloid:

Alkaloids which are four in number, isocodonocarpine (465 Da), codonocarpine (465 Da), capparidisinine (495 Da) and cadabicine (435 Da), extracted from the bark of root of *C. decidua* where Aqueous methanol (1:1, w/v) used and concentrated, identified through thin layer and column chromatography (Forster, Ghaffar, & Bienz, 2016, 2017). Ahmad et al reported three

alkaloids isolated from roots through ethanol and using chloroform-methanol in different concentrations which are (90:10, 80:20, 50:50, and 20:80), on neutral alumina column, drawing capparinine (melting point 229 ºC), cappariline (melting point is 188 ºC) and capparine (melting point 236 ºC) (Ahmad et al., 1992). Plant material with the removal of fatty content after roughly ground, treated with alcohol (Ethanol) using Soxhlet Apparatus (Continuous hot Extraction) after which content from alcohol isolated through vacuum and a semi-solid formation occur which was filtered after suspension of residue in distilled water (400ml) and two hours shaking (Gaind et al., 1969).

2.1.2. Extraction of *Saponins*

The plant material was grounded and combined it with aqueous ethanol (20%). The suspension over hot water bath at 55 ºC for four hours with continuous stirring, the resultant residue was again treated with fresh 50ml aqueous ethanol (20%). The extract then heated at 90 ºC over water bath and then made two fractions such as diethyl ether and aqueous fractions with the help of separating funnel. N-butanol (15ml) added into the recovered aqueous layer. Aqueous sodium chloride (NaCl) 10ml of 5%, used in washing two times to the combined n-butanol extract. The saponins were obtained from the heating to the solution, remained (Obadoni & Ochuko, 2002).

2.1.3. Isolation of Tannins

The sample of fruit was taken in distilled water (50ml) and stirred it through a shaker for one hour. Then filtered it and filtrate was diluted with distilled water (50ml). 5ml filtrate was blended with 3ml of 0.008 M potassium ferrocyanide, 0.1M HCl and 0.1M iron chloride ($FeCl_3$). At 605nm, the absorbance of solution taken for 10 minutes and repeat it with blank. Tannin acid used as standard (Van Buren & Robinson, 1969).

2.1.4. Isolation of phenolic compounds

McDonald et al. reported detection of total phenols, the Folin Ciocalteu (FC) method used (McDonald, Prenzler, Antolovich, & Robards, 2001). 100µl of fruit (aqueous extract) and shook it with 1.150ml of distilled water, add FC reagent (250µL) and then 20% Na_2CO_3 (1.5ml) added. The 2ml of water (distilled) was added with the solution and after 2 hours, noted the absorbance at 765nm. Calibration preparation, 0–100 µg/mL Gallic acid was used and phenolic (total) amount were indicated related equivalent to gallic acid (mg g^{-1} of dry extract).

Markham set up a method for the drawing of phenolic compounds (Markham, 1982). 85:15 v/v of methanol-water solution (1000ml) was mixed with plant material dried with air which is 100g. The mixture was let in dark for 24 hours and after that filter it with Buchner Funnel and to obtain crude extract, rotatory evaporators were used to concentrate whereas lipid content was removed through hexane. The different fractions other than water like ethyl acetate and hexane were made, evaporated them and got dry content. Then plant extract of 0.1 ml was blend with distilled water (2.5ml) and FC stock reagent, left them for 5 minutes. 20% sodium carbonate (Na_2CO_3) of 0.1 ml was further mix into mixture and left for one hour at room temperature. Through the use of spectrophotometer, the absorbance measured at 760nm wavelength. The standard gallic acid curve and gallic acid equivalent value showed the polyphenol content (dry extract mg/g) (Baghiani et al., 2012).

2.1.5.Isolation of Flavonoids

Flavonoids can be determined through colorimetric Aluminum chloride (AlCl3) method (Chang, Yang, Wen, & Chern, 2002). 250µL of fruit essence, diluted with 4.5ml distilled water and 0.5%, 0.3ml of $NaNO_3$ was added. 1M of NaOH, of which 2ml solution was added to solution after six minutes of having a total 10ml on addition of distilled water in it. The absorbance of solution measured at 510nm whereas standard is rutin (Behnaz, Davood, & Atena, 2013). Baghiani et. al reported to quantify flavonoids related to quercetin whereas Aluminum trichloride ($AlCl_3$) reagent,

through UV spectroscopy, used for the measurement of flavonoids (Baghiani et al., 2012; Bahorun et al., 1996). Aerial extract (1ml), root extract (1ml) and Aluminum chloride (1ml) mixture was prepared in methanol and let it for 10 minutes at room temperature. The solution absorbance was measured at 430nm wavelength whereas in another study, hot 80% ethanol was used to extract flavonoids from powdered leaves for 24 hours on water bath (Subramanian & Nagarajan, 1969).

Filtrate of extract and again extract petroleum ether, ether and ethyl acetate in sequence. For 2 hours, the ethyl acetate fraction treated with H_2SO_4 where through the use of vacuum, ethyl acetate fraction dried. The mixture after in concentrated form put on Thin layer chromatography plates (TLC) where it was managed with system of solvent, n-butanol, water and acetic acid (4: 5: 1). On plate, the quercetin and kaempferol was spotted which was withdraw through preparative plates (Kapoor & Mishra, 2013).

2.1.6. Flavanol (Total) Determination

250µL of extract of fruit was blend with one ml of ethanol after that addition of 2% of one ml Aluminum chloride. For two and half hour of incubation after the addition of 5% sodium acetate ($NaCOOCH_3$) of 3ml at 20ºC, the absorbance was measured using rutin for calibration and standard. Rutin equivalent dry weight of sample (per gram) the flavanol content expressed (Miliauskas, Venskutonis, & Van Beek, 2004).

2.1.7. Extraction of Lipid compounds

The bark of *C. decidua* was dried through air and then make rough powdered. The powdered is then treat against acetone, ether, ethanol, petroleum ether and chloroform solvents and then the solvent was evaporated from the solution to obtain extract. Saponifiable and non-saponifiable contents were separated from extract through saponification. From alumina Column, non-crystalline, brown in color matter was passed and made 30 elutes fraction. The first five were done through petroleum ether and then through benzene till 9^{th}. After 9^{th} elution a combination of benzene with ether in 4 ratio 1 are used till 18^{th} elution. From 19^{th} to 28^{th}, the dry ether used and in the end use merely absolute ethanol. During benzene and ether mixture, the elution fraction at 11-17 contained some crystal substances having 78-79 ºC melting point and combustion data reported H-14.01, C-81.98 and calculated as $C_{30}H_{62}O$. A compound obtained, its acetate derivative melted at 68 ºC, corelated with n-triacontanol. In fraction 19-26, another crystalline product obtained during dry ether elution. Liebermann, Liebermann-Burchard and Hesse's tests gave positive results with this product and having 136 ºC to 137 ºC melting point whereas its optical rotation of acetate derivative, related with β-sitosterol (Gaind et al., 1969).

Upadhyay et al reported that the stem contained triacontanol. The powder of stem was treated with successively with MeOH/$CHCl_3$ (1:1), cold methanol and hot methanol. Using column chromatography technique, bioactive components were separated from resultant dry extract. Silica gel in column chromatography, along with petroleum ether were used as adsorbent. chloroform/methanol, chloroform and petroleum ether/chloroform mixtures of increasing polarity are used for elution. Isolation of triacontanol done and characterized (R. K. Upadhyay, Jaiswal, Ahmad, Khanna, & Jain, 2012).

1.3. VALUE OF NUTRITION:

The serious problem in Pakistan is related to food. Malnutrition takes many lives each year specially babies. A survey reported about 38% of children in Pakistan from 6 months to 5 five years are under-weight in Pakistan (Gull, Sultana, et al., 2015). No doubt, malnutrition is the major cause of ailments. This plant is a handsome source of vitamins, carbohydrate, protein, lipids and minerals. Due to these properties, primitive people of dry and semi-dry regions use the fruit of this plant in pickle (A. Gupta & Tandon, 2004; M. Özcan, 2005; Romeo, Ziino, Giuffrida, Condurso, & Verzera,

2007). Good nutritional quality let the branches of this plant is used as fodder for livestock (Younus, Nouman, Zubair, Manzoor, & Ashraf, 2016). Ayat et. al reported the nutritional composition of fruits as through using (AOAC) methods.

Table 2: The analytical results of fruits of *C. decidua*

Components	Amount in Percentage
total oil percentage	6.02±0.02
crude protein	14.32±0.2
total ash	6.34±0.06
Moisture	5.18±0.01
crude fiber	6.19±0.5
total sugar	0.42±0.1
total carbohydrates	61.95±0.03

(Alrasheid et al., 2018; Helvich, 1990).

Table 3: The GC-FID analysis (Christie, 1990) shows the fruit contain:

Fatty Acid Components (methyl ester derivative)	Presence in Percentage
Tri decanoic acid	0.3035
Myristic acid	45.7910
Arachidonic acid	0.3080
Linolelaidic acid	0.2080
Lauric acid	0.5851
Cis-11-Eicosenoic	3.9941
Palmitic acid	46.0220
Tricosanoic acid	0.4307
Lamda-Linolenic	0.6700
Erucic acid	1.6876

Table 4: the mineral analysis showed in the table

Mineral composition	Amount (mg $100g^{-1}$)
Potassium	2969.6
Sodium	26.9
Manganese	Not detectable
Calcium	14.1
Iron	81.8

(Alrasheid et al., 2018).

C. decidua fruits contained potassium 140-480 mg/100g, Manganese 0.1-0.12mg/100g, iron 12-17 mg/100g, calcium 15-21 mg/100g and sodium 60-150 mg/100g (Iqbal, Anwar, Nadeem, Sultana, & Mushtaq, 2014).

Muhammad Zia-ul-Haq et. al reported the proximate analysis of seed composition that it contained.

Table 5: Proximate analysis of *C. decidua*

Seed Composition	Percentage ± Standard Deviation (SD)
Ash	3.03 ± 0.52
Total lipids	29.11 ± 1.07
Crude protein	27.71 ± 1.39
Moisture	4.29 ± 0.14
Crude fiber	10.44 ± 0.09
Total carbohydrates	25.42 ± 0.26

Table 6: Amino acid composition

Amino acids	Percentage ± Standard Deviation (SD)
Leucine	6.41 ± 0.22
Isoleucine	4.03 ± 0.19
Lysine	6.02 ± 0.54
Tryptophan	0.88 ± 0.05
Aspartic acid	11.91 ± 0.14
Methionine	0.75 ± 0.62
Alanine	4.99 ± 0.45
Arginine	3.46 ± 0.66
Phenylalanine	5.51 ± 0.11
Valine	6.89 ± 0.24
Threonine	3.64 ± 0.07
Glycine	4.86 ± 0.39
Serine	4.40 ± 0.46
Glutamic acid	24.01 ± 0.56
Cysteine	0.34 ± 0.01
Tyrosine	2.58 ± 0.95
Proline	4.71 ± 0.53
Histidine	4.05 ± 0.29

Table 7: fatty acids composition of seeds

Fatty acid Composition	Percentage ± Standard Deviation (SD)
Arachidic acid (20:0)	0.78 ± 0.11
Linolenic acid (18:3)	1.07 ± 0.35
Palmitic acid (16:0)	9.15 ± 1.06
Oleic acid (18:1)	33.19 ± 0.19
Eicosenoic acid (20:1)	0.52 ± 0.38
Stearic acid (18:0)	3.89 ± 0.34
Palmitoleic acid (16:1)	4.07 ± 0.23
Linoleic acid (18:2)	47.33 ± 1.04

(Zia-Ul-Haq et al., 2011).

Flowers contain 14% oil, sugar 1.7%, protein and β-carotene(Mishra et al., 2007). Overall, nutritional composition of *C. decidua* was Hemicellulose 11.45%, Cellulose 8.91%, Total carbohydrates 73.48%, Lignin 7.62%, Ash 5.96%, Digestible carbohydrates 59.41%, Starch 15.28%, Fats 7.43%, Soluble Carbohydrates 18.03%, Protein 14.88%, Neutral fiber 30.48%, Crude fiber 12.32%, some compounds present in mg/100g were Proline 11.76,Sodium 160, β-carotene 5.4, Phosphorous 179, Ascorbic acid 120, Magnesium 49.16, Calcium 90, Zinc 1.6, Copper 1.1 and Iron 3.5 (Chauhan, Duhan, & Bhat, 1986; S. Kumar, Sharma, Kumar, Vyas, & Rathore, 2013). Its handsome nutritional quality and presence of minerals, can be use as feed both for human and animals(Chadda, 2008; Duhan, Chauhan, & Punia, 1992; KO Soetan, CO Olaiya, & OE Oyewole, 2010). The structure of some fatty acid is present below:

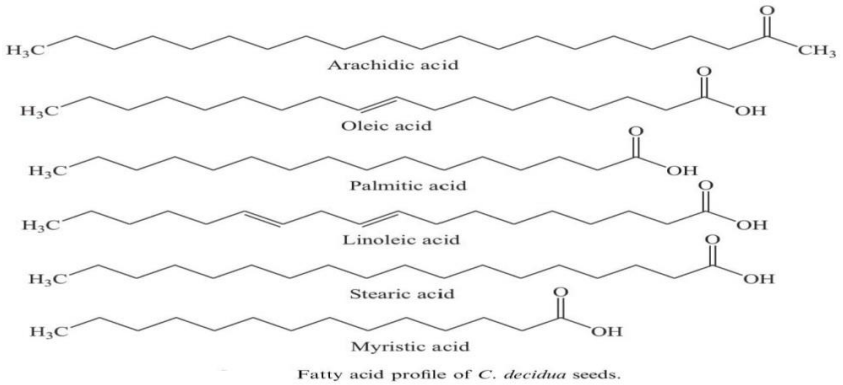

Figure 2: Fatty Acid Present in Seed

2.3.1. Compositional analysis

C. decidua (Flowers and fruits) are a good source of vital mineral of electrolyte i.e., potassium (K) which plays essential role in balancing the body blood pressure control and fluidic balance. A handsome amount of minerals (essential), particularly, Zn and Fe were also spotted in promoting the potential uses of this species to manage with the lack of these minerals (essential) in human diet**.** The compositional analysis is given below:

2.3.2. Proximate composition

Dry matter (DM) ranged from 12.19-73.62% in April and September, in different parts of *C. decidua* collected. The dry matter in different seasons were different whereas the dry matter was noted maximum in the month of April from bark of stem which was 73.62% and followed by roots and shoots. In September the dry matter was maximum present in root and then stem bark, flower shoot and lastly fruit (67.25, 65.02, 25.81, 47.99, 12.19%, respectively). In different seasons, the harvesting *C. decidua* contain different moisture content (12.19-73.62%). The moisture content maximum in fruit about 87.81% in September while in the month of April, the moisture content of fruit was 78.06%, after that flower, stem bark, shoot and roots. Furthermore, digestible dry matter was greatly found in flowers and fruits in the month of September (73.58% and 78.77%, respectively) while flowers in April (78.25%) though minimum DDM was noted in roots (42.16% September and 41.90 April) (Gull, Mahmood, et al., 2015). Dahot (1993) described the DM contents in fruits and flowers of plant (27.55% and 26.6, respectively) (Umar Dahot, 1993) which were somewhat more than dry matter (DM) contents reported by Gul et al (Gull, Mahmood, et al., 2015).

Crude protein (CP) and True protein (TP) contents were found through nitrogen digestion, quantification and distillation through micro Kjeldhal method (Helrich, 1990). The amount of non-protein nitrogen (NPN), true protein (TP) and crude protein (CP) were noted maximum in fruits (17.72%, 14.36 and 35.09, respectively) in the month of September whereas lowest amounts of TP, NPN and CP were noted in root in April (7.95%, 7.29% and 12.13%, respectively) (Gull, Mahmood, et al., 2015). Ozcan (2005) also described the capper fruits contained high amount of CP (Ozcan, 2005). The berries of caper (fruit) are also used as pickle in North Western India, Pakistan and Afghanistan because to its high CP contents (M. Özcan, 2005). CP deficiency chiefly account to low feed intake, reduce appetite and poor food efficiency, subsequently in deprived development and growth (Holechek, Pieper, & Herbel, 1995).

In roots of the plant high content of ADF and CF were found (66.33% and 30.96, respectively) while NDF in stem bark was higher (83.66%) in the month of April samples. The minimum level of CF, ADF and NDF contents were noted in the month of September, in fruits of *C. decidua* sample collected. There is a noteworthy change present in the proximate composition of *C. decidua* samples collected in September and April months (Gull, Mahmood, et al., 2015). Yu et al. (2004) informed that high CP constituents with fewer ADF and NDF constituents in parts of plant, marked it a good plant for the feeding of livestock and improve their digestive system (Yu, Christensen, & McKinnon, 2004).

From three regions such as Jhang, Layyah and Sarghodha samples, the content of moisture of fruits and flowers of *C. decidua* ranged from 55.40% to 70.31% and 58.3% to 73.11 %, respectively. The moisture from Jhang, in flower was 70.31 to 73.11which was higher than Sarghodha about 55.40 to 60.71 % and Layyah was 56.12 to 58.30%. two parts of plant i.e. fruit and flowers when compared, there were no major difference found in content of moisture (Iqbal et al., 2014).

Additionally, the mean content of moisture in *C. decidua* determined by Iqbal et. al is (62.32 %) (Iqbal et al., 2014) but 73.40% determined by Dahot from Sindh (Umar Dahot, 1993).

Ash value noted by Iqbal et al in flower and fruits were 3.90-5.40 % and 4.90-7.80%, respectively, when samples taken from three regions (Layyah, Jhang and Sargoda). The contents of ash in fruits and flowers taken from Layyah were pointedly more (5.4 % and 7.8%) as compared to Sarghodha and Jhang samples. Due to high mineral level in the Layyah region, the ash content is high. The ash

content of flower and fruit is (3.9-7.8 %)(Iqbal et al., 2014) which is higher than haq et al (3.03%) (Zia-Ul-Haq et al., 2011) and Chinedu et al. reported (0.87%) (Chinedu et al., 2011).
Three regions of Punjab Sarghodha, Jhang and Layyah, the value of crude fiber in the fruit and flower of *C. decidua* from was noted to be16.27-19.41% and 15.03-16.64, respectively. The constituent of fiber in fruits and flowers of Layyah region were significantly higher (19.41% and 16.64 %). Haq et al. reported the crude fiber(CF) as 10.44%(Zia-Ul-Haq et al., 2011) is significantly lower than the value reported by Iqbal et al. 15-19% from different parts of plant (Iqbal et al., 2014).
The amount of CP in of *C. decidua* (flower and fruits) from three different regions of Punjab as given 21.88-23.75% and 24.06-33.90 %, respectively. The protein value changed in different regions of Punjab is due to geographical and agroclimatic conditions (Iqbal et al., 2014).

2.3.3. Mineral Analysis

Plant mineral profile is an important factor in assessing food suitability of a plant. For the nutritional requirement of people, the first source is plant then animal and products. A healthy, socially and economically stable society needs a good food supply. Animal and their products like milk, meat, cheese and butter, particularly, are expensive for the people who are below the poverty line. Such condition demands the need of plant source which should be easily availed and provide proper nutrition (KO Soetan, CO Olaiya, & OE Oyewole, 2010).
C. decidua parts exhibits different composition of mineral, mainly when change in seasons. Many cellular process are regulated by calcium and vital in structural regulation (Cashman, 2002; Friday, James, Olusegun, & Gabriel, 2011), Constituent of bones and teeth, Involved in blood coagulation and intracellular communication (De la Guardia & Garrigues, 2015).

Table 8: Amount of Calcium in parts of *C. decidua*

Parts of Plant containing Ca	Amount of calcium (mg kg^{-1})	References
Fruit	317.72 in the month of September 322.50 in the month of April 13.3 to 32.9	(Gull, Mahmood, et al., 2015) (Iqbal et al., 2014)
Stem bark	164.9±9.7	(Gull, Mahmood, et al., 2015)
Root	249.6±13.7	(Gull, Mahmood, et al., 2015)
Shoot	211.8±12.3	(Gull, Mahmood, et al., 2015)
Flower	313.5±19.8 15.2 to 35.1	(Gull, Mahmood, et al., 2015) (Iqbal et al., 2014)

Potassium (K) is also found in fruit, shoot and flowers with difference in amount in different seasons (Gull, Mahmood, et al., 2015). K and Na jointly ensure smooth blood flow and both are interrelate due to which they improve Cardiovascular system (Gailer et al., 2000), also sodium regulates the transmits nerve impulse, osmotic pressure, balance the water content and relaxes muscles within the body (Ahmed & Chaudhary, 2009; RI, Magbagbeola, Akinwande, & Okunowo, 2010). From different regions of Punjab, 80-237 and 140-480 mg/100g in flower and fruit of *C. decidua* to be, is the average potassium content, respectively.

Table 9: K and Na analysis of *C. decidua*

Parts of Plant containing Na	Amount of Na (mg kg^{-1})	References	Amount of K (mg kg^{-1})	References
Flowers	916.6 (September)	(Gull, Mahmood, et al., 2015)	80-237 5813.0±20.1	(Iqbal et al., 2014)(Gull, Mahmood, et al., 2015)
Fruit	675.00 (Fruit)	(Gull, Mahmood, et al., 2015)	140-480 11690.0±78.9	(Gull, Mahmood, et al., 2015)
Shoot	154.2±7.9	(Gull, Mahmood, et al., 2015)	5139.0±15.8	(Gull, Mahmood, et al., 2015)
Root	232.5±17.5	(Gull, Mahmood, et al., 2015)	3588.0±11.9	(Gull, Mahmood, et al., 2015)
Stem bark	273.3±18.7	(Gull, Mahmood, et al., 2015)	1496.0±23.2	(Gull, Mahmood, et al., 2015)

Zn deficiency impairs human development and delays sexual maturity (Johnson, Wiederholm, & Rosenberg, 1993). Dur to different climate, humidity and temperature causes the different amount of Zn in C. Decidua and plant (Nouman et al., 2013; M. M. Özcan, Ünver, Uçar, & Arslan, 2008).
Manganese (Mn) is a mineral which helps in activation of several enzymes, metabolism of vitamin B1 and E. Moreover, it helps in production of energy and catabolism of amino acids (RI et al., 2010). Deficiency of Mn can cause blindness, aging, deafness, loss of hearing, paralysis, digestive problems, loss of hearing and dizziness in infants(Friday et al., 2011). Average Mn requirement is 2.3 mg/day (Caballero, 2005).
Iron (Fe) and zinc (Zn) are minerals (essential) for nutrition. These two elements are deficient in the human diet. Due to the good nutritional quality and presence of minerals in *C. decidua*, complete the body mineral requirement (Gull, Mahmood, et al., 2015). Iron aids in enzymatic and metabolic functions e.g. production of hemoglobin and the Fe possessing enzymes participate in the redox reactions and electron transportation. Iron deficiency is the most common malnutrition around the globe. In pregnant woman, infants and children, major cause of anemia. Iron deficiency anemia is related to cognitive impairment and delayed mental development in children (Borgstahl et al., 1992). 43.25 mg $100g^{-1}$ average iron extracted from *C. Decidua* by Iqbal et al (Iqbal et al., 2014). Vyas et. al reported iron value which is 34.26 mg/100g (K Vyas et al., 2012). Zinc in biological environment helps in metabolic, enzymatic, physiological and biochemical processes. Lack of zinc in body causes white spots on finger nails, prolonged healing of wounds, delayed sexual maturity, decreased alertness, susceptibility to infections and hair growth (Bhowmik, Chiranjib, Tripathi, & Kumar, 2010; El-Husseiny, Abd-Elsamee, Omara, & Fouad, 2008). Iqbal et al reported the amount of zinc in *C. decidua* about 0.17 to 0.23 mg/100 g.
Nickle, cobalt and cadmium, in all parts of *C. decidua*, for the food products, were found at very small amount that could be beneficial. while maximum Copper contents were recorded in shoots and roots (9.55 and 11.67 mg kg-1) later stem bark and flowers (3.62 and 4.26 mg kg-1, respectively) (S Rathee et al., 2010). In another study, mean copper is 1.44mg/100g (Iqbal et al., 2014) whereas Vyas et al reported 2.04mg/100g(RI et al., 2010). Adequate and safe intake of copper per day is 1.5-3.0 mg for adults. Copper lack raises uric acid, cholesterol, blood pressure, impairs glucose tolerance, and has adverse effects (promotes thrombosis), to which females' response differently than male. Cu is main part of digestive enzymes, helps in oxidation of vitamin C and conversion of iron to hemoglobin. Lacks of Cu may consequence in anemia, general weakness, skin soreness and impaired respiration (Ahmed & Chaudhary, 2009; Borgstahl et al., 1992; Moscow & Jothivenkatachalam, 2012).
Calcium and phosphorus in combination, essential for the bones formation, teeth and cells of nerve It is constituent of RNA and DNA, also of energy bearing catalyst (Ruan et al., 2007; Sarker & Karmoker, 2011), Component of teeth and bones, Maintenance of pH, Component of some lipids, transfer and Storage of energy and nucleotide synthesis. Energy reserve as ATP and Creatinine phosphate (CP). (De la Guardia & Garrigues, 2015). 626 mg/100 g mean amount of phosphorus present in *C. decidua* by Iqbal et al (Iqbal et al., 2014) whereas Vyas et al reported the 108-360 mg g^{-1} 100 of phosphorous in *C. decidua* (K Vyas et al., 2012).

Table 10: Mineral analysis of *C. decidua*

Minerals present in Plant	**Amount (mg kg^{-1})**	**Reference**
Iron	196.1±4.8 (Mean)	(Gull, Mahmood, et al., 2015)
	76.11 ± 3.20	(Iqbal et al., 2014)
	306.04 (Flowers)	(Gull, Mahmood, et al., 2015)
	260.4 (Fruits)	(Gull, Mahmood, et al., 2015)
Manganese	17.3±3.7	(Gull, Mahmood, et al., 2015)
	0.35 ± 0.01	(Iqbal et al., 2014)
	38.2 (Flower)	(Gull, Mahmood, et al., 2015)
	21.4 (Fruit)	(Gull, Mahmood, et al., 2015)

Cobalt	0.31 ± 0.01	(Gull, Mahmood, et al., 2015)
Zinc	60.8±2.5 0.27 ± 0.01 173.67 (stem bark) 57.59 (root)	(Gull, Mahmood, et al., 2015) (Iqbal et al., 2014)
Copper	7.78 ± 0.31 2.10 ± 0.084	(Gull, Mahmood, et al., 2015) (Iqbal et al., 2014)
Nickel	1.96 ± 0.08	(Gull, Mahmood, et al., 2015)
Potassium	5656.0±14.7 480.36 ± 19.2	(Gull, Mahmood, et al., 2015) (Iqbal et al., 2014)
Cadmium	0.18 ± 0.001	(Gull, Mahmood, et al., 2015)
Sodium	440.3±12.8 190.21 ± 7.15	(Gull, Mahmood, et al., 2015) (Iqbal et al., 2014)
Calcium	260.8±8.8 21.50 ± 0.4	(Gull, Mahmood, et al., 2015) (Iqbal et al., 2014)
Phosphorus	807.52 ± 32.34	(Iqbal et al., 2014)

1.4. MEDICINAL USES

Therapeutic plants, since the birth of humanity, have been utilized for the cureness of a few sicknesses (A. Shah et al., 2013). Indeed, they are the major treasure of therapeutic medicines (Hamburger & Hostettmann, 1991). The presence of bioactive components (Phytochemicals) such as flavonoids, alkaloids (polyamine), vitamins, glucosinolates, and phenolics are accountable for traditional therapeutic uses and make a multiuse plant candidate (Balick & Cox, 1996; B Sharma & Kumar, 2009). In the series of therapeutic plants, *C. decidua* abounded with lot of bioactive components which play a major role in nutraceutics, pharmaceutics, in Ayurvedic (R. Gupta, 2010) and Unani (R. Chopra, Nayar, & Chopra, 2006) systems of medicines. *C. decidua* shows laxative, emmenagogue, diaphoretic, and analgesic properties.

The product of *C. decidua* is fruits (green unripen berries), utilized in arrangements of food like pickles because of the conviction that it has activity against diabetic. In conventional system of medicine, for treatment of asthma and inflammation and cough, the bark has been demonstrated to be helpful while in temperature roots are used and against a boil treatment, buds are used. The leaves in Unani helps in cardiac troubles and act as appetizer whereas fruit use in the treatment of rheumatism, biliousness and fever (Dalziel, 1937). Shoots of *C. decidua* and shoots of *Peganum harmala* both can be use as anti-fertility drug. In pyorrhea and alveolaris, Crushed leaves and stem used. Bark of root is used as purgative and anthelmintic and for muscular injuries Wood coal used (R. N. Chopra, Nayar, & Chopra, 1956; KR Kirtikar & Basu, 1993; R. Sharma, 2003). The plant can be used against jaundice, infection of joints and swellings (Joseph & Jini, 2011). Cooked and pickled of unripen fruit of *C. decidua* can be used against digestive track disorder such as piles, killing intestinal worms and constipation (R. Goyal & Grewal, 2003; R. Gupta, 2010).

C. decidua (Barks, roots and leaves) have been declared to cure diversity of diseases such as intermittent fever, rheumatism and toothache (Dhar, Tewari, Tripathi, & Ahuja, 1972). The fine or grounded fruit is used in antidiabetic formulate (Poonam Yadav, Shubashish Sarkar, & Deepak Bhatnagar, 1997; P Yadav, S Sarkar, & D Bhatnagar, 1997), whereas the leafless shrub's bark is used treatment of inflammation, cough, acute pain and asthma (Ahmad et al., 1992). The thick syrup of bark and fruit can be used to be aphrodisiac and carminative, and in cure of stomach aches, cough, ulcer and asthma (Dalziel, 1937; Goodman & Ghafoor, 1992; Ilahi, 2008). The concentrated liquor made from powdered of two parts (leaves and stems), used for the cure of pyorrhea. The plant also suggested in cureness of paralysis of face and enlarged spleen (R. Gupta, 2010). Scurvy, phthisis, and heart diseases were effective treated through this plant (Shekhawat & Batra, 2006).

The fine powdered form of upper shoots, also delicate leaves is a cure to toxins and poisons. Also is applied to recuperate inflammation, boils, eruptions and blisters. Chewing relieves toothache (Nadkarni, 2009). purgative and anthelmintic properties present in root bark, and the alcoholic

extract showed noteworthy antifungal and antibacterial activities (M. S. Mohammed et al., 2014; D. Singh & Singh, 2011; P. Singh et al., 2011; Tlili et al., 2011). Paste made from the roots of *C. decidua* can be use against the scorpion bite while the grounded powder of stem coal helps in reparation of fractured or cracked bones (Meena & Yadav, 2010).

Table 11: Brief medicinal uses of *C. decidua*

Ailments/Disease	**Methods to use different parts of plants**
Pains	leaves, root, flower, Fruit: in dried form, through orally used only this plant lonely or with other therapeutic plant.
Asthma	Ground flowers: in honey or sugar are eaten
Joint pain	Flower, root, leaves, Fruit: Bark of dry root used against blister and leaves, fruits and flower, oral given
Appetizer	Fruits: unripe fruit and Fresh fruits, orally used, in pickle form
Wound	roots and bark of stem: Burnt roots and bark of stem in fine form applied outside.
Veterinary medicine	Whole parts of plant: give
Cough	Crushed Flower: in honey or sugar are eaten
Skin diseases	Stem bark: As mixture or Concoction
Piles	Leaves and Flower: Fresh leaves after medium heating on fire can be used as bandages
Stomach pain	Fruit and Root: Root bark in powdered form and dry or fresh fruits, taken orally
Hemorrhoidal treatments	flower and Fruit: Dry powder of both taken orally
Health tonic	flower and Fruit: in dry form of plant, orally administrated
liver diseases	Bark of root and Stem: both barks, in fine form are orally use with water.
Boils	Root bark: crushed root bark as orally taken
Diabetes	Fruit and Flower: root bark of dry, leaves, dry latex of plant in fine form outwardly applied on infected places, latex (latex) is transferred on sting place.
Pneumonia	Flower: A blend of flower with black pepper, orally taken
Paralysis	leaves and Flower: flowers and Dry leaves after grinding in fine form pasted outside as blebs.
Bleeding gums	Stem bark and Root bark: a concentrated liquor of dried root and stem bark used as gargle
Ear diseases	Flowers: Dry and powdered form outwardly applied
Anemia	Fruits: Fresh fruits, orally taken
Worms	Fruits: Dried fruits in shape of tablets taken orally
Diuretic	Root of plant: Dry grounded bark of root in shape of tablets, taken orally
Fractured bones	Complete plant: Coal powder of burned dry plant is used outside
Spleen enlargement	Flower and leaves: After drying, grounded in fine powder form, taken orally
Constipation	Shoot and Flower: in a jar both plant parts blend with sugar and put in sunlight for seven days and used orally

(Azhar et al., 2017)

2.5. Pharmacological features

C. decidua has many features and biological activities due to presence of many phytochemicals in different parts (P. Rathee et al., 2012; S Rathee et al., 2010; Sushila Rathee et al., 2010).

2.5.1. Anti-parasitic activity

In humans and animals parasites cause many problems (R. G. Mali & Mehta, 2008). In parasitic infection, worm infection is very common in humans. Helminthic infections directly and indirectly affect public health by negotiating immunity of animal and play role in diseases such as malnutrition, anemia, pneumonia and eosinophilia (Garedaghi, AP, Naghizadeh, & Nazeri, 2011; MacDonald et al., 1994). Synthetic anthelmintic are often overlooked due to high cost, lack of availability in background areas, adverse effects and not action by medicine due to parasitic resistance (Jabbar et al., 2006; Ji, Lu, Kang, Wang, & Chen, 2012; Saeed, Iqbal, & Jabbar, 2007). The efficacy of ethno-botanicals, in controlling or regulating parasites, has led to an extensive search for a safe and easy way. The use of plants to solve such problems is low cost (Ghotge et al., 2002) and none of adverse consequences due to which can use them an effective replacement of clinical anthelmintic (Chagas et al., 2008; Tetik, Civelek, & Cakilcioglu, 2013). The root of *Capparis decidua* ethanolic extract possessed anthelmintic activity which depends on dose and tested against *Pheretima posthuman* whereas fruit had also showed anthelmintic activity (Gaind et al., 1969; R. Mali, Hundiwale, Sonawane, Patil, & Hatapakki, 2004; R. G. Mali & Mehta, 2008; S

Rathee et al., 2010; Sushila Rathee et al., 2010). Giardia lamblia, in humans and other mammals caused diarrhea, eukaryotic parasite which colonize in small intestine (Adam, 2001). Several therapeutic plants had been described to have anti-giardial property (Elhadi, Koko, Dahab, El Imam, & El Mageed, 2013; Hassan, Koko, Osman, Dahab, & Sirat, 2011). N-butanol, chloroform, ethyl acetate, Petroleum ether extract of stem of *Capparis decidua* had great anti-giardial activity while the extract of petroleum ether had most effective anti-giardial activity (Abdalrahman, El Tigani, & Yagi, 2016).

2.5.2. Antidiabetic activity

In diabetes mellitus, cell is unable to metabolize to sugar (glucose). The patient might have acquired diabetes mellitus which is type-2 and noninsulin dependent or inherited disease which is known as type-1 diabetes mellites, insulin dependent (Abesundara, Matsui, & Matsumoto, 2004). Plants are the main focus of pharmacists to treat several diseases. Treatment of diabetes is done by reducing postprandial hyperglycemia by blocking enzymes (α-glucosidase and α-amylase) that cause breakdown of sugar in gastrointestinal tract (Jayasri, Radha, & Mathew, 2009). Therefore, plants with reasonable concentrations of α-glucosidase and α-amylase inhibitors can be used to treat diabetes. In plants like *C. decidua* is known as an anti-diabetic plant. The fruit extract of this plant has considerable inhibition on both enzymes, and also the extraction of leaves and flowers (Zia-Ul-Haq et al., 2011). 30% of fruit powdered along with alloxan which is 80mg per kg given orally to rats showed hypoglycemic activity in 3 weeks (Poonam Yadav et al., 1997; P Yadav et al., 1997). Sharma et al studied the antidiabetic activity of alkaloids extracted from *C. decidua* (Bhavna Sharma, Salunke, Balomajumder, Daniel, & Roy, 2010). It had found by Dangi and Mishra that 300mg/kg dose of methanolic extract of *C. decidua* has ability to reduce blood glucose level to normal in hyperglycemic rats (KS Dangi & Mishra, 2010).

2.5.3. Anti-aging

The changes occur on skin which is also known as dermatological changes due to ultraviolet (UV) radiations exposure or age, called aging (Gilchrest, 1989; Sander et al., 2002). Oxidative stress of skin which mainly in contact with ultraviolet radiation, which mainly involved in production of ROS, chiefly cause of nasal and cancer-related skin problems, the development of wrinkles and lesions (Masaki, 2010; Zima et al., 2001). The oxygen reactive species (ROS) which cause oxidative stress captured by exogenous antioxidant species of plant extracts (anti-aging process) (Jadoon et al., 2015; Jayasri et al., 2009; McArdle et al., 2002; Wang & Zheng, 2001). β-sitosterol, stachydrine, isothiocyanate glucoside, n-triacontane, glucocapparin and β-carotene are the bioactive compounds which are present in *Capparis decidua* (Zia-Ul-Haq et al., 2011). The activity of sebaceous gland in production of sebum could be less through the emulsion (water and oil) of alcoholic (methanol) extract of *Capparis decidua*. Ginkgetin and isoginkgetin are the active compounds responsible for antioxidant properties of *Capparis decidua* (uz Zaman et al., 2012).

2.5.4. Antioxidant

The process of oxidation causes the responsible of many chronic diseases. Antioxidant compounds disrupt the oxidation process by capturing different peroxide (O_2), lipid peroxyls (free radicals), hydroperoxide (HO) and ROSs and in this way the process of oxidation slows down (Choi, Lee, Hong, & Lee, 2012). Immediate changing of superoxide dismutase and enzymes (catalase) in heart, kidney and erythrocytes were treated by giving the fine form of *C. Decidua* fruit decreased damage caused by alloxans incited lipid peroxidation (oxidative stress) (Poonam Yadav et al., 1997; P Yadav et al., 1997). Stem extraction done by methanol, in diabetic rats, provides oxidation protection against lipid peroxidation and significantly decreases, blood glucose (K Dangi & Mishra, 2011).

2.5.5. Hepatoprotective activities

Conventionally, jaundice was treated by the *Capparis decidua* (D. Singh & Singh, 2011). The stem (aqueous and methanolic extracts) proved to have noteworthy protection against carbon tetrachloride (CCl_4)-incited hepatotoxicity in rats. The induction of hepatotoxicity in rats with giving carbon tetrachloride at the dose of 0.2ml/kg can be cured with methanolic and aqueous extract, dosage 400 and 200 mg kg^{-1} by weight of body for 10 days, administrated through mouth. Noteworthy reduction of serum alanine amino transferase, aspartate amino transferase, bilirubin and phosphatase (alkaline) was also seen. The hepatoprotection is because of tannins, sterols, flavonoids, cyanogenic glycosides, alkaloids, coumarins and saponins present (Aghel, Rashidi, & Mombeini, 2007; Ali, Al-Amin, Mohamed, & Gameel, 2009).

2.5.6. Anti-platelet activity

Thrombotic process is maintained by the platelets. In thrombotic process, the platelets play a major role with vascular wall and proteins present in plasma during injury (Saengkhae, 2008). The dysfunction of platelets causes cardiovascular diseases or disorders after coronary events (Hennekens, 1998; Juul-Moller et al., 1992; Verheugt & Smith, 2005). The extract done by methanol of aerial part, comprised of MW-6 (germacr-3b-ol-12-ene-6,14-olide-15-oic acid) and MW-11 (germacr-3b-ol-7,9-dien-6,14-olide-15-oic acid), two sesquiterpene lactones, which blocked, acid (arachidonic) incited accumulation of blood platelet, dose-dependent. These sesquiterpene lactones had Substantial antiplatelet activity is demonstrated by, in this way, more potent analogues can be developed (M. S. Mohammed et al., 2014).

2.5.7. Antirheumatic

Inflammation of joints cause the rheumatisms having such symptoms, being fatigue, low-grade, loss of energy, joints pain, muscle pain, fever and stiffness of muscles. The population of is facing rheumatism about 0.5% to 1% (Lawrence et al., 1998). Females are more susceptible to this disease than men as they grow older. Anti-rheumatic ability is present in plants. Soaking the flowers and fruits of in aqueous and the juice had potential against rheumatism (Kamal et al., 2016).

2.5.8. Anti-gout activities

The disease involved in the metabolism of purine cause the building up of uric acid near joints and nearby tissues, in the form monosodium urate crystals which activates the local immune systems and the cause of inflammation and this plant has ability to have anti-gout property (A. Kumar & Azmi, 2014).

2.5.9. Anti-inflammatory, Analgesic and anti-nociceptive activities

Reparation of tissue is related to inflammation and pain whereas the analgesic drugs acted on peripheral and central nervous system helps in relieving pain (Hunskaar & Hole, 1987). Since ancient times, traditionally or ethnic people use many herbal analgesics (D. S. Kumar et al., 2015). The bioactive compounds which are steroids, flavonoids, diterpenes, triterpenes, alkaloids and tannins, present in *C. decidua* plant extract done by ethanol, attributed the antinociceptive and analgesic. Extract (hydro-ethanolic) of *C. decidua* was found to be mediated peripherally by and through the method of central nervous and synthesis of prostaglandin inhibition, the control of pain occur (D. S. Kumar et al., 2015). Immemorial ethnic people always in the search of anti-inflammatory plants (Ratheesh & Helen, 2007; Yankauer, 1997). Chloroformed and methanolic extract of plant at the dosage of 200mg/kg of body weight exhibited noteworthy anti-inflammatory activity and have ability to about 65% and 64% respectively inhibition make it good agent use against edema (M. Mohammed et al., 2012).

2.5.10. Anti-atherosclerotic activities

Development of heart disease are due to atherosclerosis, significant reason for deaths around the globe (Pedersen, 2001). LDL and cholesterol contents high in blood are the major cause of cardiovascular maladies and atherosclerosis (Agarwal & Chauhan, 1988; Pai, Acharya, & Udupa, 2004; Pedersen, 2001). Extraction done by ethanol have ability to reduce cholesterol level by decreasing cholesterol reabsorption and also released cholesterol as neutral steroids through feces (Mehta, Balaraman, Amin, Bafna, & Gulati, 2003). The danger of coronary artery diseases rises with decrease in HDL (Boden & Pearson, 2000) due to the atrial walls cholesterol back effluence to liver through HDL help . In the rabbits, the ratio of cholesterol/HDL to total cholesterol reduced significantly when fed with arterodiet plus cholesterol. Anti-atherosclerotic activity had seen when the ethanolic extract (50%) fed to rabbits and brought back the values to normal (Purohit & Vyas, 2006).

2.5.11. Anti-tumor activity

Chemotherapy is common and practical solution for cancer treatment. (change, 2016). For the treatment of cancer, may anti-cancer plant had reported like *Podophyllum peltatum, Catharanthus roseus, Taxus brevifolia, Paeonia. emodii, Campototheca acuminata and Ochrosia elliptica* but very useful in inhibition of first stage of cancer (Kinghorn & Balandrin, 1993). All over the world, alkaloid which is stachydrine, present in the Capparis species (Mukhamedova, Akramov, & Yunusov, 1969; P. Rathee et al., 2012). The expression of chemokine receptors was inhibited by stachydrine which possessed cytotoxic effects on prostate cancer. The anti-invasive and antimetastatic nature of stachydrine made it perfect substance for the production of anti-cancer drugs (P. Rathee et al., 2012). From the seeds, Lectin which found in *Capparis* sp. that determines significant reverse transcriptase inhibition, anti-HIV-1 activity and also breast cancer MCF-7 and hepatoma HepG2 cells proliferation (Luecha, Umehara, Miyase, & Noguchi, 2009).

2.5.12. Hypolipidemic Activity

Around the globe cardiac disorders have become serious problems from last decade (Ogbonnia, Odimegwu, & Enwuru, 2008). The Phyto-material of *Capparis decidua* has ability to protect heart by lowering lipids level (Nancy, Manasi, & Varghese, 2011; Olas, Wachowicz, Stochmal, & Oleszek, 2005; Ram, Lauria, Gupta, Kumar, & Sharma, 1997; S. Sharma, Dwivedi, & Swarup, 1997). Various parts of the plant, extracted through the ethanol reduced the plasma cholesterol level when streptozotocin rats used as model, fruit and barks extracts had significant activity (Chahlia, 2009). By giving the fruit and flower extract, reduces the liver and cardiac cholesterol (Chahlia, 2009; Mutalik, Chetana, Sulochana, Devi, & Udupa, 2005). The plant contains tannins and saponins which helped in hypolipidemic activity by ceasing the absorption of lipid (hypolipidemic effect) (R. Goyal & Grewal, 2003). Chromatographic technique applied in the purification of stem extract, have ability to minimize Low density lipoprotein (LDL), triglycerides, total plasma cholesterol but high density lipoprotein (HDL) were high when tested on rat (diabetic) (KS Dangi & Mishra, 2010).

2.5.13. Antihypertensive activity

Capparis decidua extract through ethanol has ability to reduce diastolic, mean blood pressure and systolic blood pressure at the percentage of 20%, 30% and 47% dosage of 1mg kg^{-1}, 3mg kg^{-1} and 10mg kg^{-1} respectively (Eldeen & Van Staden, 2008). The non-specific mechanism of action of this plant on smoot and cardiac muscles making its bradycardia and antihypertensive effects (P. Singh et al., 2011).

About 3-100mg/kg dose of *C. decidua* intravenously to rats which had given anesthesia, the mean arterial blood pressure decreased. Moreover, blocking of calcium channels through high K+ (80 mM) and phenylephrine (1 µM) precontraction were blocked, in isolated aortic rings of rabbits by *C. aphylla* extract. Similarly, atrial contraction, its rate and force were suppressed in guinea pigs

through *C. aphylla* extract. The conclusion, the plant extract is cardiac depressant and vasodilator by decreasing B.P. (A. J. Shah & Gilani, 2011).

2.5.14. Antifertility activities

The extraction done by the ethanol of *C. decidua*, administered the albino rats caused the infertility or contraception in males. The infertility of spermatozoa is dose- dependent because at 100mg/kg of body weight, showed the slack movement of sperms while at the dose of 200mg/kg cause the total inhibition of sperms and cause infertility. The cytoarchitecture nature is completely disturbed by C. aphylla. Basically the sertolic cells was damaged by the *C. aphylla* which caused unnourished to developing sperm cell, showed infertility activity (Revathi et al., 2010).

2.5.15. Anticonvulsant

The Arial part of *C. decidua*, extracted with alcohol, showed the effect on CNS when CNS depressant (Barbiturate) results compared with the test in which pentylenetetrazole incited seizures, resulted in prolonged sleeping time and decrease seizers dependent on dose manners which exhibited the anti-convulsant and CNS depressant activity (M. Goyal & Sharma, 2009).

2.5.16. Antibacterial

With the excessive use of antibacterial drug, the resistance in bacteria occurred and it had become a major serious problem and because of this issue, the antibacterial plant extracts played a vital role and the antimicrobial potential plant are explored (Abirami, Gomathinayagam, & Panneerselvam, 2012; Chan, Lim, & Omar, 2007; Gull, Sultana, et al., 2015). Phytochemicals (gamma thionin, isoflavones and homoisoflavinoids) were used as antimicrobial, traditionally (Franco et al., 2006; Maheswara, Siddaiah, & Rao, 2006). In addition to phytochemicals, Sulphur are present in plants which shows possible antibacterial property (Azaz et al., 2002; İşcan, Kirimer, Kürkcüoğlu, Başer, & DEMIrci, 2002; Kalemba & Kunicka, 2003). *E. coli, S. aureus, P. multocida* and *Bacillus subtilis* are inhibited by the plant extract from different places (Gull, Sultana, et al., 2015).

A number of phenolics and flavonoid compounds present in the *C. decidua* made him a good antibacterial source (Imram, Zia-Ul-Haq, Calani, Mazzeo, & Pellegrini, 2014; Zia-Ul-Haq et al., 2011). Sharma and Kumar (2008) closely studied antimicrobial properties by taking the extract of *C. decidua* and *T. procumbens* and checked on were *S. aureus* (Gram-positive bacterium), *Proteus mirabilis* and *E. coli* (Gram-negative bacteria), and *Candida albicans* (Fungi). Through the broth dilution method, the minimum inhibitory concentration measured by subculture. The susceptibility of the microbes was noted to be *P. mirabilis S. aureus, E. coli* and *C. albicans*. It also exhibited antimicrobial property (R. Mali et al., 2004). In seeds, presence of Isothiocyanate aglycon which causes the gram negative bacterial growth reduction such as *V. inaba, V. eltor, V. ettor, V. ogava* and *Vibrio cholera* (Gaind & TR, 1972; Joseph & Jini, 2011; Juneja, Gaind, & Panesar, 1971).

2.5.17. Antifungal activities

Bark, seeds and wood of *C. decidua* when extracted through methanol showed antifungal activity against *A. flavus, Aspergillus niger, Fusarium moniliforme, Phytophthora sp., Penicillium sp., C. albicans and* moulds genus (Mucor) sp. *T. violaceum and Trichophyton mentagrophytes*. the zone of inhibition ranged from 17-22mm of *C. decidua* while the wood showed minimum and bark showed maximum inhibition (Abdalrahman et al., 2016; Tlili et al., 2011; Tripathi et al., 2015). The bacterial growth inhibition activities are present in flower and fruit extract which prevent the plaque formation on teeth (S Rathee et al., 2010; Sushila Rathee et al., 2010). the fruit of *Capparis decidua* has the properties of antitubercular activity (Abra & Ali, 2011; Bundeally, Shah, Bellare, & Deliwala, 1962).

Conclusion:

Capparis decidua is one of the best therapeutic plant which has potential to treat many diseases which include Joint pain, Wound, Cough, Pneumonia, Paralysis, Bleeding gums, Ear diseases, Anemia, Diuretic, Fractured bones etc. In addition to treatment of diseases, it possesses many pharmacological attributes like anti-atherosclerotic, anti-inflammatory, anti-bacterial, hepatoprotective, anti-fungal, analgesic, anthelmintic, hypolipidemic, anti-tumor, anti-giardial, anti-nociceptive, anti-diabetic, anti-rheumatic, anti-oxidant and anti-convulsant activities. The plant has very good nutritional value due to which it can fulfill the nutrition requirement. The good amount of carbohydrates, proteins, dietary fibers, minerals and lipid quantity make it good candidate for feeding purpose for human and animals. Lipid profile of seeds show the high amount of lipids. The presence of different kinds of chemicals in several parts of the plant like terpenoids- use against cancer, alkaloids, isoflavonoids, flavonoids, tannins, saponins, etc, makes it to have various kinds of therapeutic properties. The syrup made from plant can be use by the people having hyperglycemia to reduce glucose level and people having high amount of cholesterol and related diseases can be cured by this plant due to its different activities. Moreover, the anti-bacterial and anti-fungal activities of the plant, makes it a candidate use against bacterial and fungal infection and related diseases. In *Unani* system of medicines plant have been using for many years to treat number of diseases. Regarding this plant *Capparis decidua* is used in the field of drugs. For this purpose, Plants have been using for so many reasons. The root bark is used for removing worms and deficiency of blood. Herbs have been used for fire work and burring process. Flowers of plants help in the preventing the formation of plaque. The leaves of plant are used for curing different bails and blisters.

References

1. Abdalrahman, A. A., El Tigani, S., & Yagi, S. (2016). Biological activity of extracts from *Capparis decidua* L. twigs. *Journal of Medicinal Plants Research, 10*(1), 1-7.
2. Abesundara, K. J., Matsui, T., & Matsumoto, K. (2004). α-Glucosidase inhibitory activity of some Sri Lanka plant extracts, one of which, Cassia auriculata, exerts a strong antihyperglycemic effect in rats comparable to the therapeutic drug acarbose. *Journal of Agricultural Food Chemistry*, *52*(9), 2541-2545.
3. Abirami, P., Gomathinayagam, M., & Panneerselvam, R. (2012). Preliminary study on the antimicrobial activity of Enicostemma littorale using different solvents. *Asian Pacific journal of tropical medicine, 5*(7), 552-555.
4. Abra, H., & Ali, M. (2011). Phytochemistry and bioactivities of a harsh Terrain plant: *Capparis decidua* (Forsk.) Edgew. *Nat. Prod. Ind. J., 7*(4), 222-229.
5. Adam, R. (2001). Biology of Giardia lamblia. Clin Microbiol. In: Rev.
6. Agarwal, V., & Chauhan, B. (1988). A study on composition and hypolipidemic effect of dietary fibre from some plant foods. *Plant Foods for Human Nutrition, 38*(2), 189-197.
7. Aghel, N., Rashidi, I., & Mombeini, A. (2007). Hepatoprotective activity of Capparis spinosa root bark against CCl4 induced hepatic damage in mice.
8. Ahmad, V. U., Arif, S., Amber, A. U. R., & Fizza, K. (1987). Capparisinine, a new alkaloid from Capparis decidua. *Liebigs Annalen der Chemie, 1987*(2), 161-162.
9. Ahmad, V. U., Arif, S., AZIZ-UR-RAHMAN, A., Usmanghani, K., & Miana, G. A. (1985). A new spermidine alkaloid from Capparis decidua. *Heterocycles, 23*(12), 3015-3020.
10. Ahmad, V. U., Fizza, K., Amber, A.-u.-R., & Arif, S. (1987). Cadabicine and Cadabicine Diacetate from Crataeva nurvala and Cadaba farinosa. *Journal of Natural Products, 50*(6), 1186-1186.
11. Ahmad, V. U., & Ismail, N. (1989). Isocodonocarpine from Capparis decidua. *Phytochemistry, 28*(9), 2493-2495.
12. Ahmad, V. U., Ismail, N., Arif, S., & Amber, A.-u.-R. (1992). Two new N-acetylated spermidine alkaloids from Capparis decidua. *Journal of Natural Products, 55*(10), 1509-1512.

13. Ahmed, D., & Chaudhary, M. A. (2009). Medicinal and nutritional aspects of various trace metals determined in Ajuga bracteosa. *J Appl Sci Res, 5*(7), 864-869.
14. Ali, S., Al-Amin, T., Mohamed, A., & Gameel, A. (2009). Hepatoprotective activity of aqueous and methanolic extracts of *Capparis decidua* stems against carbon tetrachloride induced liver damage in rats. *J. Pharmacol. Toxicol, 4*, 167-172.
15. Alrasheid, A. A., El Tigani, S., & Yagi, S. (2018). Nutritional Composition and Fatty Acids Analysis of *Capparis decidua* L. Fruits. *American Journal of Applied Chemistry, 6*(2), 39-42.
16. Ashraf, M. U., Muhammad, G., Hussain, M. A., & Bukhari, S. N. (2016). Cydonia oblonga M., a medicinal plant rich in phytonutrients for pharmaceuticals. *Frontiers in pharmacology, 7*, 163.
17. Azaz, D., Demirci, F., Satıl, F., Kürkçüoğlu, M., Hüsnü, K., & Başerb, C. (2002). Antimicrobial activity of some Satureja essential oils. *Zeitschrift für Naturforschung C, 57*(9-10), 817-821.
18. Azhar, M. F., Aziz, A., Hussain, M., Pirzada, S. A., Ahmad, I., & Rasool, F. (2017). Ethnobotanical Studies Of *Capparis decidua* (Forsk.) With Special Reference To Cholistan Desert, Pakistan. *J. Agric. Res, 55*(4), 611-618.
19. Baghiani, A., Ameni, D., Boumerfeg, S., Adjadj, M., Djarmouni, M., Charef, N., . . . Arrar, L. (2012). Studies of antioxidants and xanthine oxidase inhibitory potentials of root and aerial parts of medicinal plant Capparis spinosa L. *American Journal of Medicine Medical Sciences, 2*(1), 25-32.
20. Bahorun, T., Gressier, B., Trotin, F., Brunet, C., Dine, T., Luyckx, M., . . . Pinkas, M. (1996). Oxygen species scavenging activity of phenolic extracts from hawthorn fresh plant organs and pharmaceutical preparations. *Arzneimittel-forschung, 46*(11), 1086-1089.
21. Balick, M. J., & Cox, P. A. (1996). *Plants, people, and culture: the science of ethnobotany*: Scientific American Library.
22. Behnaz, M., Davood, E. A., & Atena, A. (2013). Diurnal change in rutin content in Capparis spinosa growing wild in Tafresh/Iran. *Eur. J. Exp. Biol, 3*, 30-34.
23. Bhowmik, D., Chiranjib, Y. J., Tripathi, K., & Kumar, K. S. (2010). Herbal remedies of Azadirachta indica and its medicinal application. *J Chem Pharm Res, 2*(1), 62-72.
24. Boden, W. E., & Pearson, T. A. (2000). Raising low levels of high-density lipoprotein cholesterol is an important target of therapy. *American Journal of cardiology, 85*(5), 645-650.
25. Borgstahl, G. E., Parge, H. E., Hickey, M. J., Beyer Jr, W. F., Hallewell, R. A., & Tainer, J. A. (1992). The structure of human mitochondrial manganese superoxide dismutase reveals a novel tetrameric interface of two 4-helix bundles. *Cell, 71*(1), 107-118.
26. Bundeally, A., Shah, M., Bellare, R., & Deliwala, C. (1962). Antitubercular activity of Capparis fruits. *Journal of scientific industrial research. C, Biological sciences, 21*, 305.
27. Caballero, B. (2005). *Encyclopedia of human nutrition*: Elsevier.
28. Cashman, K. (2002). Calcium intake, calcium bioavailability and bone health. *British journal of Nutrition, 87*(S2), S169-S177.
29. Chadda, K. (2008). *Medicinal plants research in India.* Paper presented at the International Symposium Underutilized Plants for Food, Nutrition, Income and Sustainable Development.
30. Chagas, A., Vieira, L., Freitas, A., Araújo, M., Araújo-Filho, J., Araguão, W., & Navarro, A. (2008). Anthelmintic efficacy of neem (Azadirachta indica A. Juss) and the homeopathic product Fator Vermes® in Morada Nova sheep. *Veterinary Parasitology, 151*(1), 68-73.
31. Chahlia, N. (2009). Evaluation of hypolipidaemic activity of Capparis decidua. *International journal of biomedical science: IJBS, 5*(1), 70.
32. Chan, E. W. C., Lim, Y. Y., & Omar, M. (2007). Antioxidant and antibacterial activity of leaves of Etlingera species (Zingiberaceae) in Peninsular Malaysia. *Food chemistry, 104*(4), 1586-1593.
33. Chang, C.-C., Yang, M.-H., Wen, H.-M., & Chern, J.-C. (2002). Estimation of total flavonoid content in propolis by two complementary colorimetric methods. *Journal of food, 10*(3).

34. Chauhan, E., Duhan, A., & Bhat, C. (1986). Nutritional value of ker (Capparis decidua) fruit. *Journal of food science technology, 23*(2), 106-108.
35. Chinedu, S. N., Olasumbo, A. C., Eboji, O. K., Emiloju, O. C., Arinola, O. K., & Dania, D. I. (2011). Proximate and phytochemical analyses of Solanum aethiopicum L. and Solanum macrocarpon L. fruits. *Research Journal of Chemical Sciences, 1*(3), 63-71.
36. Choi, D.-Y., Lee, Y.-J., Hong, J. T., & Lee, H.-J. (2012). Antioxidant properties of natural polyphenols and their therapeutic potentials for Alzheimer's disease. *Brain research bulletin, 87*(2-3), 144-153.
37. Chopra, R., Nayar, S., & Chopra, I. (2006). Glossary of Indian medicinal plants, national institute of science communication and information resources. *New Delhi: CSIR*.
38. Chopra, R. N., Nayar, S. L., & Chopra, I. C. (1956). *Glossary of Indian medicinal plants* (Vol. 1): Council of Scientific & Industrial Research New Delhi.
39. Christie, W. (1990). Methylation of fatty acids. *Lipid Technol, 2*, 48-49.
40. Dalziel, J. M. (1937). The useful plants of west tropical Africa. *The useful plants of West Tropical Africa*.
41. Dangi, K., & Mishra, S. (2010). Antihyperglycemic, antioxidant and hypolipidemic effect of Capparis aphylla stem extract in streptozotocin induced diabetic rats. *Biol Med, 2*(4), 35-44.
42. Dangi, K., & Mishra, S. (2011). Antioxidative and β cell regeneration effect of Capparis aphylla stem extract in streptozotocin induced diabetic rat. *Biol. Med, 3*, 82-91.
43. Daniel, M., & Sabnis, S. (1977). CHEMOTAXONOMICAL STUDIES ON CAPPARIDA CEAE—CLEOMACEAE. *Current Science*, 472-474.
44. De la Guardia, M., & Garrigues, S. (2015). *Handbook of mineral elements in food*: John Wiley & Sons.
45. de la Peña, N. C., Sosa-Melgarejo, J. A., Ramos, R. R., & Méndez, J. D. (2000). Inhibition of platelet aggregation by putrescine, spermidine, and spermine in hypercholesterolemic rabbits. *Archives of medical research, 31*(6), 546-550.
46. Dhakad, P. K., Sharma, P. K., & Kumar, S. (2016). A review on ethnobiological and medicinal potential of Capparaceae family plant: *Capparis decidua* (Forssk.) Edgew. *Advances in Pharmacology Pharmacy, 4*(3), 27-39.
47. Dhar, D. N., Tewari, R., Tripathi, R., & Ahuja, A. (1972). Chemical examination of Capparis decidua. *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES INDIA SECTION A-PHYSICAL SCIENCES, 42*, 24-27.
48. Duhan, A., Chauhan, B., & Punia, D. (1992). Nutritional value of some non-conventional plant foods of India. *Plant Foods for Human Nutrition, 42*(3), 193-200.
49. El-Husseiny, O., Abd-Elsamee, M., Omara, I., & Fouad, A. (2008). Effect of dietary zinc and niacin on laying hens performance and egg quality. *International Journal of Poultry Science, 7*(8), 757-764.
50. Eldeen, I., & Van Staden, J. (2008). Cyclooxygenase inhibition and antimycobacterial effects of extracts from Sudanese medicinal plants. *South African Journal of Botany, 74*(2), 225-229.
51. Elhadi, I. M., Koko, W. S., Dahab, M. M., El Imam, Y. M., & El Mageed, M. A. E. A. (2013). Antigiardial activity of some Cucurbita species and Lagenaria siceraria. *laboratory animals, 3*, 8.
52. Fabricant, D. S., & Farnsworth, N. R. (2001). The value of plants used in traditional medicine for drug discovery. *Environmental health perspectives, 109*(suppl 1), 69-75.
53. Forster, Y., Ghaffar, A., & Bienz, S. (2016). A new view on the codonocarpine type alkaloids of Capparis decidua. *Phytochemistry, 128*, 50-59.
54. Forster, Y., Ghaffar, A., & Bienz, S. (2017). Chromatographic separation of the codonocarpine type alkaloids from the root bark of Capparis decidua. *Bio-protocol, 7*(4), 1-16.
55. Franco, O. L., Murad, A. M., Leite, J. R., Mendes, P. A., Prates, M. V., & Bloch Jr, C. (2006). Identification of a cowpea γ-thionin with bactericidal activity. *The FEBS journal, 273*(15), 3489-3497.

56. Friday, E. T., James, O., Olusegun, O., & Gabriel, A. (2011). Investigations on the nutritional and medicinal potentials of Ceiba pentandra leaf: A common vegetable in Nigeria. *International Journal of Plant Physiology, 3*(6), 95-101.
57. FUJISAWA, S., & KADOMA, Y. (2005). Kinetic evaluation of polyamines as radical scavengers. *Anticancer research, 25*(2A), 965-969.
58. Gailer, J., George, G. N., Pickering, I. J., Madden, S., Prince, R. C., Yu, E. Y., . . . Aposhian, H. V. (2000). Structural basis of the antagonism between inorganic mercury and selenium in mammals. *Chemical Research in Toxicology, 13*(11), 1135-1142.
59. Gaind, K., & Juneja, T. (1970). Capparis decidua-Phytochemical study of flowers and fruits. *Res Bull Punjab Univ Sc, 21*, 67-71.
60. Gaind, K., Juneja, T., & Jain, P. (1969). Anthelmintic and purgative activity of *Capparis decidua* Edgew. *Indian J. Hosp. Pharm, 2*, 153-155.
61. Gaind, K., & TR, J. (1972). VOLATILE PRINCIPLE FROM SEEDS OF CAPPARIS DECIDUA.(KINETICS OF IN VITRO ANTIBACTERIAL ACTIVITY AGAINST VIBRIO CHOLERAE OGAVA, INABA AND ELTOR.
62. Garedaghi, Y., AP, R. S., Naghizadeh, A., & Nazeri, M. (2011). Survey on prevalence of sheep and goats lungworms in Tabriz abattoir, Iran. *Advances in Environmental Biology*, 773-776.
63. Ghotge, N., Ramdas, S., Ashalata, S., Mathur, N., Broome, V., & Rao, M. S. (2002). A social approach to the validation of traditional veterinary remedies–the ANTHRA Project. *Tropical animal health production, 34*(2), 121-143.
64. Gilchrest, B. A. (1989). Skin aging and photoaging: an overview. *Journal of the American Academy of Dermatology, 21*(3), 610-613.
65. Goodman, S. M., & Ghafoor, A. (1992). The Ethnobotany of southern Balochistan, Pakistan, with particular reference to medicinal plants. *Publication/field museum of natural history*.
66. Goyal, M., & Sharma, S. (2009). Traditional wisdom and value addition prospects of arid foods of desert region of North West India.
67. Goyal, R., & Grewal, R. (2003). The influence of teent (Capparis decidua) on human plasma triglycerides, total lipids and phospholipids. *Nutrition health, 17*(1), 71-76.
68. Gugliucci, A., & Menini, T. (2003). The polyamines spermine and spermidine protect proteins from structural and functional damage by AGE precursors: a new role for old molecules? *Life sciences, 72*(23), 2603-2616.
69. Gull, T., Mahmood, Z., Anwar, F., Sultana, B., Nouman, W., Shahid, S. A., & Iqbal, M. Z. (2015). Variation of proximate composition and minerals within different parts of *Capparis decidua* (Forssk.) Edgew. as a function of harvesting seasons. *Pak. J. Bot, 47*(5), 1743-1748.
70. Gull, T., Sultana, B., Bhatti, I. A., & Jamil, A. (2015). Antibacterial potential of Capparis spinosa and *Capparis decidua* extracts. *International Journal of Agriculture Biology, 17*(4).
71. Gupta, A., & Tandon, N. (2004). Reviews on Indian medicinal plants.
72. Gupta, J., & Ali, M. (1997). Oxygenated heterocyclic constituents from *Capparis decidua* root-barks. *Indian Journal of Heterocyclic Chemistry, 6*(4), 295-302.
73. Gupta, R. (2010). Medicinal and Aromatic plants. *CBS publishers distributors, 234*, 499.
74. Hamburger, M., & Hostettmann, K. (1991). 7. Bioactivity in plants: the link between phytochemistry and medicine. *Phytochemistry, 30*(12), 3864-3874.
75. Harnack, L. J., Rydell, S. A., & Stang, J. (2001). *Prevalence of use of herbal products by adults in the Minneapolis/St Paul, Minn, metropolitan area.* Paper presented at the Mayo Clinic Proceedings.
76. Hassan, L. E. A., Koko, W. S., Osman, E., Dahab, M. M., & Sirat, H. M. (2011). In vitro antigiardial activity of Citrullus lanatus var. citroides extracts and cucurbitacins isolated compounds. *Journal of Medicinal Plants Research, 5*(15), 3338-3346.
77. Helrich, K. (1990). Official Methods of analysis of the Association of Official Analytical Chemisty.
78. Helvich, K. (1990). *Official methods of analysis*. Retrieved from

79. Hennekens, C. H. (1998). Increasing burden of cardiovascular disease: current knowledge and future directions for research on risk factors. *Circulation, 97*(11), 1095-1102.
80. Holechek, J. L., Pieper, R. D., & Herbel, C. H. (1995). *Range management: principles and practices*: Prentice-Hall.
81. Hossen, M. J., Kim, S. C., Son, Y.-J., Baek, K.-S., Kim, E., Yang, W. S., . . . Chung, W.-J. (2015). AP-1-targeting anti-inflammatory activity of the methanolic extract of Persicaria chinensis. *Evidence-Based Complementary Alternative Medicine, 2015*.
82. Hunskaar, S., & Hole, K. (1987). The formalin test in mice: dissociation between inflammatory and non-inflammatory pain. *Pain, 30*(1), 103-114.
83. Ilahi, I. (2008). Ethnobotanical studies and problems associated with regeneration of herbals in Kohat region. *Pakistan Journal of Botany, 40*(4), 1743-1753.
84. Imram, I., Zia-Ul-Haq, M., Calani, L., Mazzeo, T., & Pellegrini, N. (2014). Phenolic profile and antioxidant potential of selected plants of Pakistan. *Journal of Applied Botany Food Quality, 87*.
85. Iqbal, A., Anwar, F., Nadeem, R., Sultana, B., & Mushtaq, M. (2014). Proximate composition and minerals profile of fruit and flower of Karir (Capparis decidua) from Different regions of Punjab (Pakistan). *Asian Journal of Chemistry, 26*(2), 360.
86. İşcan, G., Kirimer, N., Kürkcüoğlu, M. n., Başer, H. C., & DEMIrci, F. (2002). Antimicrobial screening of Mentha piperita essential oils. *Journal of Agricultural Food Chemistry, 50*(14), 3943-3946.
87. Jabbar, A., Iqbal, Z., Kerboeuf, D., Muhammad, G., Khan, M. N., & Afaq, M. (2006). Anthelmintic resistance: the state of play revisited. *Life sciences, 79*(26), 2413-2431.
88. Jadoon, S., Karim, S., Asad, M. H. H. B., Akram, M. R., Kalsoom Khan, A., Malik, A., . . . Murtaza, G. (2015). Anti-aging potential of phytoextract loaded-pharmaceutical creams for human skin cell longetivity. *Oxidative medicine cellular longevity, 2015*.
89. Jayasri, M., Radha, A., & Mathew, T. (2009). α-amylase and α-glucosidase inhibitory activity of Costus pictus D. Don in the management of diabetes. *J Herb Med Toxicol, 3*(1), 91-94.
90. Ji, J., Lu, C., Kang, Y., Wang, G.-X., & Chen, P. (2012). Screening of 42 medicinal plants for in vivo anthelmintic activity against Dactylogyrus intermedius (Monogenea) in goldfish (Carassius auratus). *Parasitology research, 111*(1), 97-104.
91. Johnson, R. K., Wiederholm, T., & Rosenberg, D. M. (1993). Freshwater biomonitoring using individual organisms, populations, and species assemblages of benthic macroinvertebrates. *Freshwater biomonitoring benthic macroinvertebrates*, 40-158.
92. Joseph, B., & Jini, D. (2011). A medicinal potency of Capparis decidua-A harsh terrain plant. *Res. J. Phytochem, 5*(1), 1-13.
93. Joseph, B., & Raj, S. J. (2010). Phytopharmacological properties of Ficus racemosa Linn-An overview. *Int J Pharm Sci Rev Res, 3*(2), 134-138.
94. Juneja, T., Gaind, K., & Panesar, A. (1971). Investigations on *Capparis decidua* Edgew; study of isothiocyanate glucoside. *Panjab Univ Res Bull*.
95. Juul-Moller, S., Edvardsson, N., Sorensen, S., Jahnmatz, B., Rosén, A., & Omblus, R. (1992). Double-blind trial of aspirin in primary prevention of myocardial infarction in patients with stable chronic angina pectoris. *The Lancet, 340*(8833), 1421-1425.
96. K Vyas, G., Kumar, V., Sharma, R., Sharma, R., Sharma, S., Singh, J., & Kumar, S. (2012). Chemical and genetic diversity among some wild stands of Calligonum polygonoides (Polygonaceae) from the Thar Desert of Rajasthan. *Revista de biologia tropical, 60*(3), 1097-1108.
97. Kalemba, D., & Kunicka, A. (2003). Antibacterial and antifungal properties of essential oils. *Current medicinal chemistry, 10*(10), 813-829.
98. Kamal, M., Adnan, M., Murad, W., Bibi, H., Tariq, A., Rahman, H., & Shinwari, Z. K. (2016). Anti-rheumatic potential of Pakistani medicinal plants: a review. *Pak. J. Bot, 48*(1), 399-413.

99. Kapoor, B., & Mishra, R. (2013). Flavonoid contents from some Capparidaceous medicinal plants of North-West Rajasthan. *Indian Journal of Pharmaceutical Biological Research, 1*(02), 09-11.
100. Keymanesh, K., Hamedi, J., Moradi, S., Mohammadipanah, F., & Sardari, S. (2009). Antibacterial, antifungal and toxicity of rare Iranian plants. *Int J Pharmacol, 5*(1), 81-85.
101. Khan, A., Mehmood, S., Khan, R., & Khan, S. (2013). Ecological, Taxonomical an d Ethenobotanical Study of Wild Fruit Producing Xerophytes of District Bannu, Kpk. *J. Med. Plants Stud., 1*(4), 112-120.
102. Kinghorn, A. D., & Balandrin, M. F. (1993). *Human medicinal agents from plants*: ACS Publications.
103. Kirtikar, K., & Basu, B. (1935). Indian medicinal plants. *Indian Medicinal Plants*.
104. Kirtikar, K., & Basu, B. (1993). Indian Medicinal Plants. Vol. 2. Dehradun. *Indian Medicinal Plants.*
105. Kumar, A., & Azmi, W. (2014). Phytomedicine: a novel alternative for treatment of gout. *Ann. Phys. Med, 3*, 80-88.
106. Kumar, D. S., Shukla, A., Choudhury, P., & Singh, G. (2015). Analgesic and anti-nociceptive activity of hydroethanolic extract of *Capparis decidua* Linn. *Asian Journal of Pharmacy Pharmacology, 1*(1), 40-44.
107. Kumar, S., Sharma, R., Kumar, V., Vyas, G. K., & Rathore, A. (2013). Combining molecular-marker and chemical analysis of Capparis deciduas (Capparaceae) in the Thar Desert of Western Rajasthan (India). *Revista de biologia tropical, 61*(1), 311-320.
108. Lawrence, R. C., Helmick, C. G., Arnett, F. C., Deyo, R. A., Felson, D. T., Giannini, E. H., . . . Hunder, G. G. (1998). Estimates of the prevalence of arthritis and selected musculoskeletal disorders in the United States. *Arthritis Rheumatism: Official Journal of the American College of Rheumatology, 41*(5), 778-799.
109. Luecha, P., Umehara, K., Miyase, T., & Noguchi, H. (2009). Antiestrogenic constituents of the Thai medicinal plants Capparis flavicans and Vitex glabrata. *Journal of Natural Products, 72*(11), 1954-1959.
110. Mabberley, D. J. (1997). *The plant-book: a portable dictionary of the vascular plants*: Cambridge university press.
111. MacDonald, T., Spencer, J., Murch, S., Choy, M., Venugopal, S., Bundy, D., & Cooper, E. (1994). Immunoepidemiology of intestinal helminthic infections. 3. Mucosal macrophages and cytokine production in the colon of children with Trichuris trichiura dysentery. *Transactions of the Royal Society of Tropical Medicine Hygiene, 88*(3), 265-268.
112. Maheswara, M., Siddaiah, V., & Rao, C. V. (2006). Two new homoisoflavonoids from Caesalpinia pulcherrima. *Chemical pharmaceutical bulletin, 54*(8), 1193-1195.
113. Mali, R., Hundiwale, J., Sonawane, R., Patil, R., & Hatapakki, B. (2004). Evaluation of *Capparis decidua* for anthelmintic and antimicrobial activities. *Indian J Nat Prod, 20*(4), 10-13.
114. Mali, R. G., & Mehta, A. A. (2008). A review on anthelmintic plants.
115. Mann, S., Chaudhary, I., & Gupta, R. K. (2013). Value addition scenario of arid foods of desert area and evaluation of their nutritional and phytochemical potential. *Int. J. Pharm. Life Sci., 4*(1), 2335-2339.
116. Markham, K. R. (1982). *Techniques of flavonoid identification* (Vol. 36): Academic press London.
117. Masaki, H. (2010). Role of antioxidants in the skin: anti-aging effects. *Journal of dermatological science, 58*(2), 85-90.
118. McArdle, F., Rhodes, L., Parslew, R., Jack, C., Friedmann, P., & Jackson, M. (2002). UVR-induced oxidative stress in human skin in vivo: effects of oral vitamin C supplementation. *Free Radical Biology Medicine, 33*(10), 1355-1362.

119. McDonald, S., Prenzler, P. D., Antolovich, M., & Robards, K. (2001). Phenolic content and antioxidant activity of olive extracts. *Food chemistry, 73*(1), 73-84.
120. Meena, K., & Yadav, B. (2010). Some traditional ethnomedicinal plants of southern Rajasthan.
121. Mehta, K., Balaraman, R., Amin, A., Bafna, P., & Gulati, O. (2003). Effect of fruits of Moringa oleifera on the lipid profile of normal and hypercholesterolaemic rabbits. *Journal of ethnopharmacology, 86*(2-3), 191-195.
122. Miliauskas, G., Venskutonis, P., & Van Beek, T. (2004). Screening of radical scavenging activity of some medicinal and aromatic plant extracts. *Food chemistry, 85*(2), 231-237.
123. Mishra, S., Tomar, P., & Lakra, N. (2007). Medicinal and food value of Capparis—a harsh terrain plant.
124. Mohammed, M., Khalid, H. S., Muddathir, A., Siddiqui, N. A., & Ali, M. (2012). A novel germacranolide sesquiterpene lactone with antiinflammmatory effect from *Capparis decidua* (Forsk.). *IJRPC, 2*, 1073-1077.
125. Mohammed, M. S., Khalid, H. S., Muddathir, A., El Tahir, K. E., Osman, B., Osman, W. J., & Basudan, O. (2014). Effect of two sesquiterpene lactones from *Capparis decidua* (Forsk.) on arachidonic acid and adenosine diphosphate-induced platelets aggregation. *The Journal of Phytopharmacology, 3*, 1-4.
126. Moscow, S., & Jothivenkatachalam, K. (2012). Study on mineral content of some Ayurvedic Indian medicinal plants. *Int J Pharm Sci Res, 3*, 294.
127. Muhammad, G., Hussain, M. A., Jantan, I., & Bukhari, S. N. A. (2016). Mimosa pudica L., a high-value medicinal plant as a source of bioactives for pharmaceuticals. *Comprehensive Reviews in Food Science Food Safety, 15*(2), 303-315.
128. Mukhamedova, K. S., Akramov, S., & Yunusov, S. Y. (1969). Stachydrine fromCapparis spinosa. *Chemistry of Natural Compounds, 5*(1), 60-60.
129. Mutalik, S., Chetana, M., Sulochana, B., Devi, P. U., & Udupa, N. (2005). Effect of Dianex, a herbal formulation on experimentally induced diabetes mellitus. *Phytotherapy Research: An International Journal Devoted to Pharmacological Toxicological Evaluation of Natural Product Derivatives, 19*(5), 409-415.
130. Nadkarni, K. (2009). Indian Materia Medica, reprinted. *Bombay Popular Prakashan, 1*, 21.
131. Nancy, P., Manasi, M., & Varghese, A. (2011). Antiplaque activity of Juglans regia L. and characterization of Juglone from Juglans regia L. *The American Journal of Biochemistry Biotechnology, 7*(1), 29-31.
132. Nasir, S., Batool, M., Hussain, S. M., Nasir, I., Hafeez, F., & Debboun, M. (2015). Bioactivity of oils from medicinal plants against immature stages of dengue mosquito Aedes aegypti (Diptera: Culicidae). *Int. J. Agric. Biol, 17*, 843-847.
133. Nazar, S., Hussain, M. A., Khan, A., Muhammad, G., & Tahir, M. N. (2020). *Capparis decidua* Edgew (Forssk.): A comprehensive review of its traditional uses, phytochemistry, pharmacology and nutrapharmaceutical potential. *Arabian Journal of Chemistry, 13*(1), 1901-1916.
134. Nouman, W., Siddiqui, M. T., Basra, S. M. A., Farooq, H., Zubair, M., & Gull, T. (2013). Biomass production and nutritional quality of Moringa oleifera as a field crop. *Turkish Journal of Agriculture Forestry, 37*(4), 410-419.
135. Obadoni, B., & Ochuko, P. (2002). Phytochemical studies and comparative efficacy of the crude extracts of some haemostatic plants in Edo and Delta States of Nigeria. *Global Journal of pure applied sciences, 8*(2), 203-208.
136. Ogbonnia, S. O., Odimegwu, J. I., & Enwuru, V. N. (2008). Evaluation of hypoglycaemic and hypolipidaemic effects of aqueous ethanolic extracts of Treculia africana Decne and Bryophyllum pinnatum,/i> Lam. and their mixture on streptozotocin (STZ)-induced diabetic rats. *African Journal of Biotechnology, 7*(15).

137. Olas, B., Wachowicz, B., Stochmal, A., & Oleszek, W. (2005). Inhibition of blood platelet adhesion and secretion by different phenolics from Yucca schidigera Roezl. bark. *Nutrition, 21*(2), 199-206.
138. Özcan, M. (2005). Mineral composition of different parts of Capparis ovata Desf. var. canescens (Coss.) Heywood growing wild in Turkey. *Journal of Medicinal Food, 8*(3), 405-407.
139. Özcan, M. M., Ünver, A., Uçar, T., & Arslan, D. (2008). Mineral content of some herbs and herbal teas by infusion and decoction. *Food chemistry, 106*(3), 1120-1127.
140. Pai, M. R., Acharya, L. D., & Udupa, N. (2004). Evaluation of antiplaque activity of Azadirachta indica leaf extract gel—a 6-week clinical study. *Journal of ethnopharmacology, 90*(1), 99-103.
141. Pedersen, T. R. (2001). Pro and con: low-density lipoprotein cholesterol lowering is and will be the key to the future of lipid management. *The American journal of cardiology, 87*(5), 8-12.
142. Purohit, A., & Vyas, K. (2006). Antiatherosclerotic effect of Caparis decidua. Fruit extract in cholesterol-fed rabbits. *Pharmaceutical biology*, *44*(3), 172-177.
143. Rai, S. (1987). Chemical examination of edible plants of Rajasthan desert with special ref. to Capparadaceae. *Curr Agric*, *11*, 15-23.
144. Ram, A., Lauria, P., Gupta, R., Kumar, P., & Sharma, V. (1997). Hypocholesterolaemic effects of Terminalia arjuna tree bark. *Journal of ethnopharmacology, 55*(3), 165-169.
145. Ramot, Y., Pietilä, M., Giuliani, G., Rinaldi, F., Alhonen, L., & Paus, R. (2010). Polyamines and hair: a couple in search of perfection. *Experimental dermatology, 19*(9), 784-790.
146. Ramot, Y., Tiede, S., Bíró, T., Bakar, M. H. A., Sugawara, K., Philpott, M. P., . . . Paus, R. (2011). Spermidine promotes human hair growth and is a novel modulator of human epithelial stem cell functions. *PLoS One, 6*(7).
147. Rathee, P., Rathee, D., Rathee, D., & Rathee, S. (2012). In vitro anticancer activity of stachydrine isolated from *Capparis decidua* on prostate cancer cell lines. *Natural product research, 26*(18), 1737-1740.
148. Rathee, S., Mogla, O., Sardana, S., Vats, M., & Rathee, P. (2010). Antidiabetic activity of *Capparis decidua* Forsk Edgew. *J Pharm Res*, *3*, 231-234.
149. Rathee, S., Rathee, P., Rathee, D., Rathee, D., & Kumar, V. (2010). Phytochemical and pharmacological potential of kair (Capparis decidua). *Int J Phytomed, 2*(10), 10-17.
150. Ratheesh, M., & Helen, A. (2007). Anti-inflammatory activity of Ruta graveolens Linn on carrageenan induced paw edema in wistar male rats. *African Journal of Biotechnology, 6*(10).
151. Raza, M. A., Younas, M., & Schlecht, E. (2016). In vitro efficacy of selected medicinal plants from Cholistan desert, Pakistan, against gastrointestinal helminths of sheep and goats.
152. Revathi, P., Vani, B., Sarathchandiran, I., Kadalmani, B., Shyam, K. P., & Palnivel, K. (2010). Reproductive toxicity of Capparis aphylla (Roth.) in male albino rats. *Int J Pharm Biomed Res, 1*(3), 102-112.
153. RI, B., Magbagbeola, O., Akinwande, A., & Okunowo, O. (2010). Nutritional and chemical evaluation of Momordica charantia. *Journal of Medicinal Plants Research, 4*(21), 2189-2193.
154. Romeo, V., Ziino, M., Giuffrida, D., Condurso, C., & Verzera, A. (2007). Flavour profile of capers (Capparis spinosa L.) from the Eolian Archipelago by HS-SPME/GC–MS. *Food chemistry, 101*(3), 1272-1278.
155. Ruan, Z., Zhang, Y.-G., Yin, Y.-L., Li, T.-J., Huang, R.-L., Kim, S., . . . Deng, Z. (2007). Dietary requirement of true digestible phosphorus and total calcium for growing pigs. *Asian-australasian journal of animal sciences, 20*(8), 1236-1242.
156. Russell, W., & Duthie, G. (2011). Plant secondary metabolites and gut health: the case for phenolic acids. *Proceedings of the Nutrition Society, 70*(3), 389-396.
157. Saeed, M., Iqbal, Z., & Jabbar, A. (2007). Oxfendazole resistance in gastrointestinal nematodes of beetal goats at livestock farms of Punjab (Pakistan). *Acta Veterinaria Brno, 76*(1), 79-85.

158. Saengkhae, C. (2008). Arunnopparat and Sungkhajorn P. Antioxidant activity of Nelumbo nucifera Gaertn on oxidative stressinduced erythrocyte haemolysis in hypertensive and normotensive rats. *J. Physiol*, *20*, 70-78.
159. Sander, C. S., Chang, H., Salzmann, S., Müller, C. S., Ekanayake-Mudiyanselage, S., Elsner, P., & Thiele, J. J. (2002). Photoaging is associated with protein oxidation in human skin in vivo. *Journal of Investigative Dermatology*, *118*(4), 618-625.
160. Sarker, B. C., & Karmoker, J. (2011). Effect of phosphorus deficiency on growth and trasport of k+, na+, cl-, no 3-in lentil seedling (lens culinaris medik. Var. Barimasur-4). *Dhaka University Journal of Biological Sciences*, *20*(2), 103-108.
161. Shad, A. A., Ahmad, S., Ullah, R., AbdEl-Salam, N. M., Fouad, H., Rehman, N. U., . . . Saeed, W. (2014). Phytochemical and biological activities of four wild medicinal plants. *The Scientific World Journal*, *2014*.
162. Shah, A., Marwat, S. K., Gohar, F., Khan, A., Bhatti, K. H., Amin, M., . . . Zafar, M. (2013). Ethnobotanical study of medicinal plants of semi-tribal area of Makerwal & Gulla Khel (lying between Khyber Pakhtunkhwa and Punjab Provinces), Pakistan.
163. Shah, A. J., & Gilani, A. H. (2011). Blood pressure lowering effect of the extract of aerial parts of Capparis aphylla is mediated through endothelium-dependent and independent mechanisms. *Clinical Experimental Hypertension*, *33*(7), 470-477.
164. Sharma, B., & Kumar, P. (2009). Extraction and pharmacological evaluation of some extracts of Tridax procumbens and Capparis deciduas. *Int J Appl Res Nat Prod*, *1*(4), 5-12.
165. Sharma, B., Salunke, R., Balomajumder, C., Daniel, S., & Roy, P. (2010). Anti-diabetic potential of alkaloid rich fraction from *Capparis decidua* on diabetic mice. *Journal of ethnopharmacology*, *127*(2), 457-462.
166. Sharma, R. (2003). *Medicinal plants of India: an encyclopaedia*: Daya Books.
167. Sharma, S., Dwivedi, S., & Swarup, D. (1997). Hypoglycaemic, antihyperglycaemic and hypolipidemic activities of Caesalpinia bonducella seeds in rats. *Journal of ethnopharmacology*, *58*(1), 39-44.
168. Shekhawat, D., & Batra, A. (2006). Household remedies of Keshavraipatan tehsil in Bundi district, Rajasthan.
169. Shinwari, Z., Gilani, S., Kohjoma, M., & Nakaike, T. (2000). *Status of medicinal plants in Pakistani Hindukush Himalayas.* Paper presented at the Proceedings of Nepal–Japan Joint Symposium on Conservation and utilization of Himalayan Med. Resour.
170. Singh, D., & Singh, R. K. (2011). Kair (Capparis decidua): A potential ethnobotanical weather predictor and livelihood security shrub of the arid zone of Rajasthan and Gujarat.
171. Singh, P., Mishra, G., Srivastava, S., Jha, K., & Khosa, R. (2011). Traditional uses, phytochemistry and pharmacological properties of Capparis decidua: An overview. *Der Pharmacia Lettre*, *3*(2), 71-82.
172. Soda, K. (2010). Polyamine intake, dietary pattern, and cardiovascular disease. *Medical hypotheses*, *75*(3), 299-301.
173. Soetan, K., Olaiya, C., & Oyewole, O. (2010). The importance of mineral elements for humans, domestic animals and plants-A review. *African journal of food science*, *4*(5), 200-222.
174. Soetan, K., Olaiya, C., & Oyewole, O. (2010). The importance of mineral elements for humans, domestic animals and plants: A review. *African journal of food science*, *4*(5), 200-222.
175. Subramanian, S. S., & Nagarajan, S. (1969). Flavonoids of the seeds of Crotalaria retusa and Crotalaria striata. *Cur Sci*.
176. Tesoriere, L., Butera, D., Gentile, C., & Livrea, M. A. (2007). Bioactive components of caper (Capparis spinosa L.) from Sicily and antioxidant effects in a red meat simulated gastric digestion. *Journal of Agricultural Food Chemistry*, *55*(21), 8465-8471.
177. Tetik, F., Civelek, S., & Cakilcioglu, U. (2013). Traditional uses of some medicinal plants in Malatya (Turkey). *Journal of ethnopharmacology*, *146*(1), 331-346.

178. Tlili, N., Elfalleh, W., Saadaoui, E., Khaldi, A., Triki, S., & Nasri, N. (2011). The caper (Capparis L.): Ethnopharmacology, phytochemical and pharmacological properties. *Fitoterapia, 82*(2), 93-101.
179. Tripathi, Y., Singh, S., Anjum, N., & Srivastava, K. (2015). Antifungal activity of *Capparis decidua* extracts against seed-borne pathogenic fungi. *World J. Pharma. Pharma. Sci., 4*(10), 1500-1512.
180. Umar Dahot, M. (1993). Chemical evaluation of the nutritive value of flowers and fruits of Capparis decidua. *JOURNAL-CHEMICAL SOCIETY OF PAKISTAN, 15*, 78-78.
181. Upadhyay, R. (2012a). Insecticidal and oviposition inhibition efficacy of *Capparis decidua* to Sitophilus oryzae Linn.(Coleoptera: Curculionidae). *International Journal of Chemical Biochemical Sciences, 2*, 14-23.
182. Upadhyay, R. (2012b). Insecticidal Potential of *Capparis decidua* to Rhizopertha dominica (Fabr.)(Coleoptera: Bostrichidae). *World Journal of Agricultural Sciences, 8*(3), 269-279.
183. Upadhyay, R. K., Jaiswal, G., & Ahmad, S. (2010). Termiticidal effects of *Capparis decidua* on biochemical and enzymatic parameters of Odontotermes obesus (Isoptera: Termitidae). *Acta Universitatis Sapientiae Agriculture Environment, 2*, 80-110.
184. Upadhyay, R. K., Jaiswal, G., Ahmad, S., Khanna, L., & Jain, S. C. (2012). Antitermite activities of C. decidua extracts and pure compounds against Indian white termite Odontotermes obesus (Isoptera: odontotermitidae). *Psyche: A Journal of Entomology, 2012*.
185. uz Zaman, S., Akhtar, N., Khan, B. A., Mahmood, T., Rasul, A., Mahmood, A., . . . Ali, A. (2012). Development of a sebum control cream from a local desert plant Capparis decidua. *Journal of Medicinal Plants Research, 6*(5), 744-748.
186. Vaishnav, R., Agrawal, R., & Sandeep, S. (2015). Medicinal value and future perspective of some therapeutically important plants from Indian western region. *Int. J. Pharm. Sci. Rev. Res, 34*, 88-93.
187. Van Buren, J. P., & Robinson, W. B. (1969). Formation of complexes between protein and tannic acid. *Journal of Agricultural Food Chemistry, 17*(4), 772-777.
188. Verheugt, F. W., & Smith, S. C. (2005). The lady aspirin for cardiovascular disease. *The Lancet, 366*(9492), 1148-1150.
189. Wang, S. Y., & Zheng, W. (2001). Effect of plant growth temperature on antioxidant capacity in strawberry. *Journal of Agricultural Food Chemistry, 49*(10), 4977-4982.
190. Warrier, P. K. (1993). *Indian medicinal plants: a compendium of 500 species* (Vol. 5): Orient Blackswan.
191. WHO, U. (2009). Diarrhoea: why children are still dying and what can be done. *Geneva: UNICEF/WHO*.
192. Yadav, P., Sarkar, S., & Bhatnagar, D. (1997). ACTION OFCAPPARIS DECIDUAAGAINST ALLOXAN-INDUCED OXIDATIVE STRESS AND DIABETES IN RAT TISSUES. *Pharmacological Research, 36*(3), 221-228.
193. Yadav, P., Sarkar, S., & Bhatnagar, D. (1997). Lipid peroxidation and antioxidant enzymes in erythrocytes and tissues in aged diabetic rats. *Indian journal of experimental biology, 35*(4), 389-392.
194. Yadav, R., & Agarwala, M. (2011). Phytochemical analysis of some medicinal plants. *Journal of phytology*.
195. Yankauer, A. (1997). The recurring popularity of alternative medicine. *Perspectives in biology medicine, 41*(1), 132-137.
196. Younus, M., Nouman, W., Zubair, M., Manzoor, S. A., & Ashraf, I. (2016). Seed Priming Improves Emergence Potential, Growth Behaviour and Nutritional Quality of *Capparis decidua* (Forssk.) Edgew. under Drought Stress. *Pakistan Journal of Life Social Sciences, 14*(3).
197. Yu, P., Christensen, D., & McKinnon, J. (2004). In situ rumen degradation kinetics of timothy and alfalfa as affected by cultivar and stage of maturity. *Canadian Journal of Animal Science, 84*(2), 255-263.

198. Zhang, Y. (2004). Cancer-preventive isothiocyanates: measurement of human exposure and mechanism of action. *Mutation Research/Fundamental Molecular Mechanisms of Mutagenesis, 555*(1-2), 173-190.
199. Zia-Ul-Haq, M., Ćavar, S., Qayum, M., Imran, I., & Feo, V. d. (2011). Compositional studies: antioxidant and antidiabetic activities of *Capparis decidua* (Forsk.) Edgew. *International journal of molecular sciences, 12*(12), 8846-8861.
200. Zima, T., Fialová, L., Mestek, O., Janebová, M., Crkovská, J., Malbohan, I., . . . Popov, P. (2001). Oxidative stress, metabolism of ethanol and alcohol-related diseases. *Journal of biomedical science, 8*(1), 59-70.