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FLAVONOIDS IN PLANTS OF PAKISTAN: A REVIEW

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ABSTRACT

Flavonoids are phytochemicals derived from plants. They are naturally occurring plants secondary metabolites. They have been divided in several sub classes. They have many biological effects like anti-inflammation, antioxidation, antimicrobial activity, antiallergic, protection against hydrogen peroxide, antibacterial, antimalarial, anti tumor, anti cancer and immunomodulation . The total flavonoid contents varied significantly among medicinal plant, fruits and vegetables. They are involved in plants pigmentation.

Keywords: Medicinal plants , Flavonoids, Distribution of Flavonoids , Antioxident properties, phytochemicals constituents

INTRODUCTION

Plants have the ability to produce a large variety of secondary metabolites, such as terpenoids, phenylpropanoids, flavonoids and alkaloids, which together account for over 200,000 compounds. Flavonoids are a diverse group of natural products found in all plants **(Naeem *et al*., 2010).** There are more than 8000 number of phenols both flavonoids and nonflavonoids (**Sultana *et al*., 2007 ; Munir *et al*., 2014**). One of the important properties of phenols is their ability to ionize in the presence of base (**Thomson, 1986; Ameer *et al*., 2012**).
Flavonoids are a class of phenolic compounds ubiquitously found in plant parts like leaves, seeds, fruits, bark and flowers. They are plant pigments that generally display marvelous colors in the flowering parts of plants (**Clifford et al., 2000; Yao *et al*., 2004**). Flavonoids are called plant secondary metabolites **(Ameer *et al*., 2012**) having several pharmacological effects and other health benefits in humans due to their different properties like antioxidant, anti-inflammatory, antiallergic, antimutagenic, antiviral, antineoplastic and antithrombolic **(Middleton *et al*., 2000; Ameer *et al*., 2012**).

Currently, the use of antioxidative phytochemicals such as plant polyphenols, vitamin C, phenolic acids and flavonoids in foods is gaining popularity due to their anticarcinogenic activity, potential health benefits including the prevention and lowering risk of development of cancer, heart and neurodegenerative disorders (**Choi et al., 2007; Liu and Yao 2007, Anwar *et al*., 2012**). Plants are valued as the best source of natural antioxidants (**Wang *et al*., 2003, Rababah *et al*., 2004**). Phenolic compounds are very important plant constituents exhibiting antioxiodant activity by inactivating lipid free radicals, or by preventing the decomposition of hydroperoxides into free radicals **(Nasapon *et al*., 2010; Samatha *et al*., 2012)**. Phytochemicals include primary and secondary compounds. Chlorophyll, proteins and common sugars are primary compounds while secondary compounds are terpenoid, alkaloids and phenolic compounds **(Krishnaiah *et al*., 2007; wadood *et al*., 2013**).

OCCURRENCE OF FLAVONOIDS

Flavonoids are one of the largest groups of known natural products, having widespread occurrence in plant kingdom (**Havseen, 1983; Siddique *et al*., 2011; Rehan *et al*., 2014;)** These are generally located in plant leaves as water soluble glycosides in the vacuoles of epidermal cells **(Harborne & Williams, 2000; Galeotti *et al*., 2008; kanwal *et al*., 2010**).Flavonoids occur as aglycons. glycosides and methylated derivatives (**Markhan 1982; Havseen, 1983**).

STRUCTURE OF FLAVONOIDS

Flavonoid is the general name of the compounds based upon a fifteen-carbon skeleton. At the simplest level, the skeleton consists of two phenyl rings (A- and B-rings) connected by a three-carbon bridge (C-ring) (Figure 1). In most cases, the flavonoids are present as glycosides in vacuoles of flowers, leaves, stems or roots (Iwashina, 2000).Classification of flavonoids is given in table (1) showing their classes, sub classes and structures.

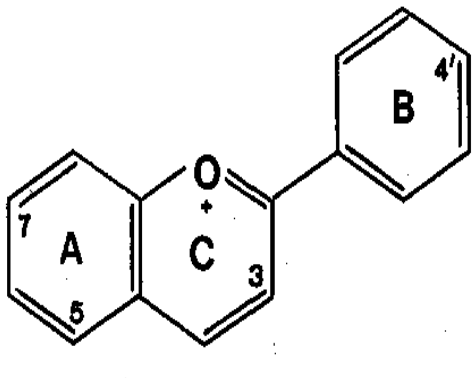
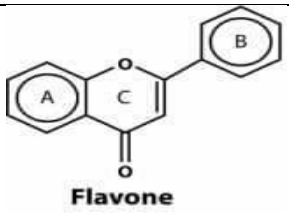
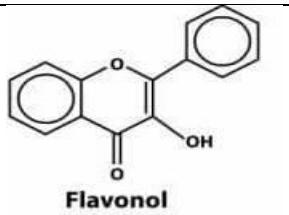
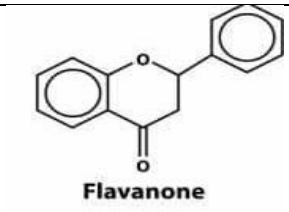
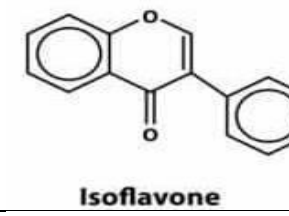
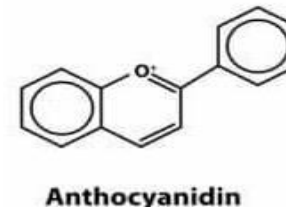


Figure 1 Structure of flavonoids

Table 1 CLASSIFICATION OF FLAVONOIDS

Sr. no	classes	subclasses	structure	Reference
1	Flavones	luteonin, apigenin, tangeritin	 Flavone	
2	Flavonols	quercetin, kaemferol, myricetin, isorhamnetin, pachypodol, rhamnazin	 Flavonol	
3	Flavanones	hesteretin, naringenin, eriodictyol	 Flavanone	
4	Flavan-3-ols	catechins catechin, gallocatechin, catechin 3-gallate, gallocatechin 3-gallate and epicatechins epicatechin, epigallocatechin, epicatechin 3-gallate, epigallocatechin 3-gallate	 Flavan-3-ol	**Wiseman,1996; Janicijevic,*et al*.,2006; qurashi *et al*., 2014**
5	Isoflavones	genistein, daidzein, glycitein	 Isoflavone	
6	Anthocyanidins	cyanidin, delphinidin, malvidin, pelargonidin,peonidin,petunidin	 Anthocyanidin	

PHARMACOLOGICAL EFFECTS OF FLAVONOIDS

It is estimated that about 35,000 to 70,000 plants species are used as medicinal plants out of 422127 reported worldwide plant species **(Bibi *et al*., 2011; Javid *et al*., 2015**).Flavonoids bioavailable to cells and tissues is advantageous and more relevant for the physiological situation (**Yang et al., 2008; Habauzit *et al*., 2009; Palvica *et al*., 2010**)

Flavonoids are widely occurring extremely important polyphenolic compounds **(Bernerdi et al., 2007; Mohy-ud-Din, *et al., 2009*)**.They have enormous biological and pharmacological activities conferring many health benefits to the humans (**qureshi *et al*., 2014; sultana *et al*., 2008; Numonov *et al*., 2015).**phenolic compounds give protection against coronary heart diseases and carcinogenesis **(Robert *et al*., 2001; Uddin *et al*., 2011; Rauf *et al*., 2013**).Phenolic compounds reduce risk of cardiovascular diseases and cancers (**Agbo *et al*., 2015**). Being plant phytochemicals, flavonoids cannot be synthesized by humans and animals. Flavonoids are absorbed by the gastrointestinal tracts of humans and animals, and are excreted either unchanged or as their metabolites in the urine and feces (**Cook *et al*., 1996; Yao *et al*., 2004**).Dietary antioxidants, especially flavonoids, are being considered as a promising approach to prevent or slow down neurological illness and aging (**Vauzour *et al*., 2008; Bournival *et al*., 2009; Pavlica *et al*., 2010**).

BIOLOGICAL EFFECT OF FLAVONOIDS

Flavonoids are found in fruits, vegetables, and certain beverages that have diverse beneficial biochemical and antioxidant effects (**taskeen *et al*., 2010).**

Flavonoids first appeared in green algae 500 million years ago, resulting from the fusion of two biogenetic pathways, namely the cinnamate and the ancient polyketide route and they have then become more and more complex with plant evolution (**Swain et al.1975; yaseen *et al*., 2014**).Flavonoid contents in some common fruits of Pakistan, estimated in different studies have been given in Table (2).This table depicts presence of different types of flavonoids in common fruits of Pakistan in significant amount.Table (3) and Table (4) shows flavonoid contents in different parts of vegetables and medicinal plants respectively along with their beneficial effects.

Flavonoids exhibit anti-bacterial effects (**Alarcon *et al*., 2008**). Plant phenolics have been reported to have a lot of biological activities including anti-carcinogenic **(Stalikas, 2007; Ramos, 2007,Janićijević, *et al*., 2006**), antioxidant and anti-mutagenic **(Stalikas, 2007; Biju et al., 2014; Agbo *et al*., 2015**). The flavonoids possess a remarkable spectrum of biochemical and pharmacological activities suggesting that they significantly affect basic cell functions such as growth, differentiation and/or programmed cell death (apoptosis). Although some epidemiological studies provided evidence that a high dietary intake of flavonoids could be associated with low cancer prevalence in humans **(Messina et al., 1992; Knekt et al., 1997; Kuntz *et al*., 1999**).

Polyphenols (cinnamic acid derivatives, flavonols, anthocyanins) and vitamins are present in vegetables, fruits, berries, and herbs, which are the main source of natural antioxidants in our daily diet**.(taskeen *et al*., 2010 ; jae et al., 2006; cieslik et al., 2006**).Phenolic compounds possess antimicrobial (**Huma et al.,2014; Majhenic et al., 2007**), antiulcerative, antiviral **(wang et al., 1998; Umamaheswari and Chatterjee, 2008**) antioxidant, anti-coagulative, antihistaminic and anti-allergic (**Hossain et al., 2013; ameer et al., 2012**) activities (**munir *et al*., 2014**). Phenolic compounds contribute to quality and nutritional value in terms of modifying colour, taste, aroma and flavor besides providing health beneficial effects **(Memnune sengul et al, 2009; samatha *et al*., 2012**).

Flavonoids, with various biological activities, are considered as key compounds in plants. Their natural colour is yellow (**yaseen *et al*., 2014**). Flavonoids are involved in production of pigmentation in flowers. For example, blue colour results from presence of anthocyanin (delphinidinbased) in petals (**Janićijević, *et al*., 2006).** Plants have been proven to be the reservoir for various chemical compounds of biological and pharmacological importance **(Qureshi *et al*., 2013; Qureshi *et al*., 2012; ;qurashi *et al*., 2014; Sultana *et al*., 2008)**.Flavonoids and phenolic acids have many functions in plants. They are very important for growth development and play key role in defense against microbial activities and infections. They provide oxidative stabilities to the plants in case of injuries **(Cetkovic *et al*., 2007; jahan *et al*., 2013**).Antioxidant activity of flavonoids is largely depend on the molecular structure (availability of phenolic hydrogen atom) and substitution pattern of hydroxyl groups, which effects on the stability of resulting phenoxyl radical by hydrogen bond or delocalization of free electron **(Amic *et al*., 2003; jahan *et al*., 2013**). Extensive epidemiological studies have indicated an inverse relationship between dietary flavonoids intake and the risk of coronary heart diseases, and certain cancers (**Hung et al., 2004; Puupponen-Pimia et al., 2001; sultana *et al*., 2008**). Phenolic and flavonoid contents are source of natural antioxidants (**Saeed *et al*., 2012**). phenolic acids and flavonols are regarded as major functional food components and are thought to contribute to the health effects of fruit-derived products due to the prevention of various diseases associated with oxidative stress, such as cancers, cardiovascular diseases and inflammation (**Lodovici et al., 2001; Mahmood *et al*., 2012**).

FLAVONOIDS CONTENT IN DIFFERENT PLANTS OF PAKISTAN

Table 2 Distribution of Flavonoids in Fruits

Scientific Name	Common Name	Part of plant	Flavonoids	Quantity or Percentage	Reference	Effects
Malus pumila	Apple	Fruit	Myricetin	308.9 ± 12.4 mg/kg	**Sultana *et al*., 2008**	N.D
Prunus salicin	Plum	fruit	Myricetin	564.1 ± 11.3 mg/kg	**Sultana *et al*., 2008**	
Prunus armeniaca	Apricot	Fruit	Myricetin Quercetin Kaempferol	406.9 ± 16.3 mg/kg B119.5e ± 4.8 31.4f ± 1.3mg/kg	**Sultana *et al*., 2008**	
Fragaria ananassa	Strawberry	Fruits	Myricetin	3382.9 ± 101.5 mg/kg	**Sultana *et al*., 2008**	
Morus alba	Mulberry	Fruit	Quercetin Kaempferol	359.4 ± 7.2 mg/kg 284.3 ± 5.7 mg/kg	**Sultana *et al*., 2008** **Sultana *et al*., 2008**	
Eugenia jambolana Lam	Jaman		Quercetin Kaempferol	1.2i ± 0.3 mg/kg 1.3 ± 0.2 mg/kg	**Sultana *et al*., 2008**	
Mangifera indica	Mango	Leaves	Myricetin	5.0 mg/kg	**Sultana *et al*., 2008**	Antifungal **(Sultana *et al*., 2008)**
Sitrus sinensis	Orange	Fruit	Quercetin Rhamnetin	2.5 mg/kg 0.5 mg/kg	**Taskee*n et al*., 2010**	Antioxidant **(Taskee*n et al*., 2010)**
Ananas comosus	Pineapple	Fruit	Kaempferol	2.5 mg/kg	**Taskeen *et al*., 2010**	
			Rhamnetin Quercetin Lueteolin	7.0 mg/kg 2.5 mg/kg 3.5 mg/kg	**Taskeen *et al*., 2010**	
Grewia asiatica	Falsa	Fruit	Rhamnetin Lueteolin	32 mg/kg 1.0 mg/kg		

N.D means not determined

Table 3 Distribution of Flavonoids in vegetables

Scientific Name	Common Name	Part of plant	Flavonoids	Quantity or Percentage	Reference	Effects
Pisum sativum	Peas	Seed	Myricetin Quercetin Kaempferol	146.2 ±2.2 mg/kg 36.4 ± 1.1 mg/kg 15.5 ± 0.6 mg/kg	**Sultana *et al*., 2008**	N.D
Daucus carota *Brassica oleracea*	Carrot Cabbage	Root Bud	Myricetin Kaempferol	525.3 ± 10.5 mg/kg 23.9 ± 0.7 mg/kg	**Sultana *et al*., 2008**	N.D
Brassica oleracea	Cauliflowers	Flowers	Myricetin Kaempferol	1586.9 ± 33.7 mg/kg 17.9 ± 0.4 mg/kg		
Spinacia oleracea	Spinach	Leaves	Myricetin Kaempferol	1660.9 ± 30.2 mg/kg 59.6e ± 1.8		
Brassica rapa	Turnip	Roots	Myricetin Kaempferol	457.0h ± 18.3 mg/kg 0.3j ± 0.1	**Sultana *et al*., 2008**	N.D

Allium cepa	Onion	Bulb	Quercetin Kaempferol	104.5e ± 4.2 0.3j ± 0.1	**Sultana *et al*., 2008**	N.D
Zingiber cassumunar	Ginger	Rhizome	Kaempferol	14.9h ± 0.4		
SOLANUM LCOPERSICUM	Tomato	Fruit	Myricetin Rhamnetin Luteolin	13.0 mg/kg 167 mg/kg 3.0 mg/kg	**Taskeen *et al*., 2010**	N.D
Capsicum annuum	Green chili	Fruit	Myricetin Quercetin	1.0 mg/kg 3.6 mg/kg	**Taskeen *et al*., 2010**	N.D
leptophyllaTorilis		plantWhole	flavonoid phenolic	60.9 ±2.2 mg/g 121.9±3.1 mg/g	**Saeed *et al*., 2012**	Antioxidant **(Saeed *et al*., 2012)**
Cicer arietinum	Channa	young shootsLeaves	Phenolic content	189.3 mg/g,	**Khanzaadi, 2011**	antioxidants are effective in preventing the oxidative damage that may be the cause of arteriosclerosis, brain disorders, cancers and immune system deterioration (**Ames, 1983; Steinberg, 1991**)
Caralluma tuberculata	Chunga	Shoots		69.0 mg/g,		

N.D means not determined

Table 4 Distributon of flavonoids in medicinal plants

Scientific Name	Common Name	Part of plant	Flavonoids	Quantity or Percentage	Reference	Effects
Rumex hastatus	Khatimal	leaves	Luteolin	24.67±2.90 mg/g	**Sumaira *et al*., 2011**	Antioxidant **(Sumaira *et al*., 2011)**
			Kaempherol	17.03±1.67 mg/g		
			Luteolin-7-O-glucoside	14.73±2.17 mg/g		
			Rutin	8.24±1.43 mg/g		
			unknown	15.93±2.10 mg/g		
Azadirachta indica	Neem	leaves	Flavonoids	2.5%	**Aslam *et al*.,2009**	Antibacterial **(Aslam *et al*.,2009)**
Woodfordia fruticosa	Dhawi	Leaves	Myricetin	9.18%	**Ameer et al., 2012**	Antioxidative, peroxidative, antimutagenic andanticarcinogn **(Ameer *et al*., 2012)**
			Catechin	1.6%		Antioxidant **(Ameer *et al*., 2012)**
			Orientin	2.20%		
			Isoquercitin	3.07%		
			Luteolin	20.00%		
Adhatoda vasica	Bhekkar	Leaves twings	Vitexin	6.66%	**Ameer *et al*., 2012**	Decrease aortic pressure, pulmonary capillary pressure and heart rate **(Ameer *et al*., 2012)**
			Orientin	5.38%	**Ameer *et al*., 2012**	Antioxidant **(Ameer *et al*., 2012)**
			Isoquercitin	7.69%		
			Luteolin	3.38%		
Chenopodium ambrosoides	Chondan bathwa	Arial parts	Catechin	0.87%		
			Vitexin	2.4%		Decrease aortic pressure, pulmonary capillary pressure and heart rate
Viburnum cotinifolium	Taliana	Leaves	Isovitexin	2.57%	**Ameer *et al*., 2012**	Anti-inflammatory **(Ameer *et al*., 2012)**
			Luteolin	2.85%		
			Apigenin	2.11%		
			Myricetin	1.87%	**Ameer *et al*., 2012**	protection against hydrogen peroxide **(Ameer *et al*., 2012)**
			Orientin	3.84%		
			Luteolin	1.71%		
			Hyperside	6.15%		
Euphorbia hirta	Dudhi	Arial parts	Myricetin	6.4%	**Ameer *et al*., 2012**	protection against hydrogen peroxide **(Ameer *et al*., 2012)**
			Orientin	6.61%		

			Luteolin	1.47%		
			Quercetin	3.83%		Anti-inflammatory, Antifungal **(Ameer *et al*., 2012)**
Vitex negundo,	Banna	Leaves twings	Orientin	3.07%		
			Myricetin	15.75%	**Ameer *et al*., 2012**	protection against hydrogen peroxide **(Ameer *et al*., 2012)**
			Isovitexin	3.51%		
			Luteolin	3.14%		
			Apigenin	3.68	**Ameer *et al*., 2012**	Anti-inflammatory **(Ameer *et al*., 2012)**
Peganum harmala	Harmal	Arial parts	Orientin	4.86%	**Ameer *et al*., 2012**	Decrease aortic pressure, pulmonary capillary pressure and heart rate **(Ameer *et al*., 2012)**
			Vitexin	6.15%		
			Hyperside	4.62%		
			Luteolin	1.00%		
Broussonetia papyrifera,	Jangli toot	Leaves	Myricetin	2.66%	**Ameer *et al*., 2012**	protection against hydrogen peroxide **(Ameer *et al*., 2012)**
			Rutin	6.2%	**Ameer *et al*., 2012**	Analgesic and antioxidant **(Ameer *et al*., 2012)**
			Kaempfrol-7-Neohesperidoside	5.6%		
			Luteolin	0.81%		
Taraxacum officinale,	Dudal	Flowers	Luteolin	2.5%		
Urtica dioica	Bichu booti	Arial parts	Quercetin	3.83%	**Ameer *et al*., 2012**	Anti-inflammatory, Anti-fungal, protection against hydrogen peroxide, Antimalarial **(Ameer *et al*., 2012)**
			Luteolin	3.6%		
Verbascum thapsus	Gigdar tambaku	Arial parts	Kaempferol	70.83%	**Ameer et al., 2012**	Anti-inflammatory, Anti-fungal, protection against hydrogen peroxide, Antimalarial **(Ameer *et al*., 2012)**
			Quercetin	16.69%		
			Luteolin	17.00%		
Caryopteris grata	-	Leaves	Catechin	19.2%	**Ameer *et al*., 2012**	Anti-inflammatory, Anti-fungal, protection against hydrogen peroxide, Antimalarial **(Ameer *et al*., 2012)**
			Orientin	3.84%		
			Isoquertin	4.00%		
			Quercetin	6.13%		
			Luteolin	3.5%		
Mimosa rubicaulis	Ral	Stem	Quercetin	65.38%	**Ameer *et al*., 2012**	Anti-inflammatory, Anti-fungal, protection against hydrogen peroxide, Antimalarial **(Ameer *et al*., 2012)**
Acacia nilotica	Desi kikar	Bark	Myricetin	188.9 ± 3.8 mg/kg	**Sultana *et al*., 2007**	ND
			Quercetin	63.4 ± 1.9 mg/kg		
			Kaempferol	21.7 ± 0.6 mg/kg		
Azadirachta indica	Neem	Bark	Quercetin	31.9 ± 1.3 mg/kg		
			Kaempferol	0.5 ± 0.1 mg/kg		
Terminalia arjuna	Arjan	Bark	Quercetin	7.7 ± 0.3 mg/kg		
			Kaempferol	8.9 ± 0.3 mg/kg		
Moringa oleifera	Sohanjana	Leaves	Myricetin	5804.4 ± 116.1 mg/kg		
			Quercetin	281.0 ± 5.6 mg/kg		
			Kaempferol	40.2 ± 0.8 mg/kg		
		Root	Myricetin	170.2 ± 6.8 mg/kg		
			Kaempferol	13.9 ± 0.4 mg/kg		
Ficus religiosa	Peepal	Fruit	Myricetin	694.0 ± 13.9 mg/kg		
			Quercetin	256.3 ± 2.6 mg/kg		
			Kaempferol	160.8 ± 4.8 mg/kg		
Aloe barbadensis	Aloevera	Leaves	Myricetin	1283.5 ± 38.5 mg/kg		
			Quercetin	94.8 ± 2.8 mg/kg		
			Kaempferol	257.7 ± 5.2 mg/kg		
Impatiens bicolor	Amphara balsam	Leaves	Kaempferol	N.D	**Hassan et al., 2005**	
			Naringennin			
			Quercetin			
Aerva javanica	Desert cotton	Whole plant	Kaempferol	N.D	**Munir *et al*., 2014**	Antimicrobila, antioxidant **Munir *et al*., 2014**
Carissa opaca	Wild karanda	Roots	Gallic acid	211.95 ± 0.78 µg/mL	**Ahmed *et al*., 2014**	Antioxidant, free radical scavenging, and lipid peroxidation inhibitory

						potential **Ahmed *et al.*, 2014**
			Rutin	8.35 ± 0.21 µg/Ml	**Ahmed *et al.*, 2014**	
Parthenium hysterophorus	Congress weed, carrot weed, star weed, feverfew		Flavonoid	2.8±0.3 %	**M.yasin et al., 2014**	It is applied externally on skin disorders and decoction of the plant is often taken internally as a remedy for a wide variety of ailments (**Dominguez and Sierra, 1970; Morton, 1981**), promising remedy against hepatic amoebiasis (**Sharma and Bhutani, 198**8)
Salvia plebeia	Mizo-kouiju	seeds	flavonoid	3.5±0.1 %	**M.yasin *et al*., 2014**	promote sexual power and cure seminal weakness; as diuretic, vermifuge and astringent; for toothache(**Sales *et al*., 2010**)
Saussurea heteromalla	Batula, Murang, Kaliziri	leaves	flavonoid	3.9±1.0 %	**M.yasin *et al*., 2014**	Leaf paste with mustard oil massaged on leucoderma and wounds. Root extract taken for fever and colic (**Butola and Samant, 2010**)
Nerium oleander	Kaner	Whole plant	Flavonoids	3.8±2.2 %	**M.yasin *et al*., 2014**	Anti bacterial activity (**Sawhney *et al*., 1978**), abortifacient (**Zargari, 1995**), cardiotonic and diuretic in edema (**Srinivasan *et al*., 2001**).
Justicia adhatoda	Bahker	Whole plant	flavonoid	4.4±2.11 %	**M.yasin *et al*., 2014**	Used in Cough, tuberculosis, asthma and indigestion (**Abbasi *et al*., 2010)**
Segeretia brandrethiana	Gunger	Whole plant	flavonoid	3.0±2.11 %	**M.yasin *et al*., 2014**	Used inAsthma, jaundice and scanty urination (**Abbasi *et al*., 2010**)
Conyza bonariensis	Bakkar booti	Whole plant	flavonoid	2.0±3.2 %	**M.yasin *et al*., 2014**	Use as Laxative, diarrhea (**Baquar , 1989; Kasture *et al*., 2000**), cough, aphrodisiac, emollient (**Pullaiah, 2002)**
Solanum nigrum L.	Nightshade	Whole plant	flavonoid	128 ± 2.34 mg	**Siddique *et al*., 2013**	Anthelmintic activity against sheep intestinal worms Haemonchus contortus **(Siddique *et al*., 2013)**
Brassica campestris	Sarson		Leaves	221.0 mg /g,	**Khanzaadi, 2011**	
Portulaca oleracea	Kulfa		Leaves	111.7 mg/g,		
Chenopodium album	Bathu	Leaves and young shoots		91.0 mg/g,		
Rheum emodi	Himalayan rhubarb	Whole plant	Quercetin	67.5 ± 1.5 µg/g	**Jahan *et al*., 2013**	Antioxidant **(Jahan *et al*., 2013)**
			Myricetin	708.7 ± 1.2 µg/g		
			Kaempferol	106 ± 1.3 µg/g		
Euphorbia tirucalli	Pencil tree	Whole plant	Quercetin	1.31 ± 0.2 µg/g		
			Myricetin	821 ± 0.45 µg/g		
Cyperus rotundus	nutgrass		Myricetin	104 ± 0.5 µg/g		
Cyperus rotundus	nutgrass	Rhizome	Quercetin	110.6 ± 0.56 µg/g		
			Myricetin	702 ± 0.23 µg/g		
			Kaempferol	32 ± 0.5 µg/g		
Trigonella foenum-graecum	fenugreek	Whole plant	Myricetin	830 ± 0.9 µg/g		
			Kaempferol	1.13 ± 0.8 µg/g		
Trigonella foenum-graecum	fenugreek	seed	Myricetin	547 ± 1.5 µg/g		
Millettia ovalifolia	Moulmein rosewood	bark	7-(4-methoxyphenyl)-9H-furo[2,3-f]chromen-9-one	N.D	**Rehman *et al*., 2015.**	Antimalarial **(Rehman *et al*., 2015)**
Launaea procumbens	Creeping launaea	Whole plant	Kaempferol	0.607 ± 0.03 µg/mg	**Rehmat *et al*., 2012.**	Antioxidant Scavenging activity

			Orientin	0.725 ± 0.02 µg/mg		**(Rehmat *et al*., 2012).**
			Rutin	0.608 ± 0.07 µg/mg		
			Hyperuside	0.335 ± 0.06 µg/mg		
			Myricetin	0.897 ± 0.05 µg/mg		
Capparis decidua	Khair	Stem Fruit Seeds	Rutin	N.D	**Amna *et al*., 2014.**	Antifungal Antibacterial Anti-inflammatory **Amna *et al*., (2014).**
Pistacia integerrima	Crab's claw	Whole plant	Catechins and flavonoids	N.D	**Bibi *et al*., 2015.**	Antioxidant Anti-inflammatory Antifungal activities **Bibi *et al*., (2015).**
Descurainia sophia	Flixweed	Seeds	Kaempferol Quercetin Isorhamnetine and derivatives	N.D	**Khan and Wang 2012.**	Antioxidant Antitumor and Anticancer activities Anti fungal activity **Khan and Wang (2012).**
Juglans regia		Leaves and outer parts	Myricetin	0.023 mg/ml	**Qureshi et al., 2014.**	antimicrobial, antihelmintic, astringent, keratolytic, antidiarrhoeal, hypoglycaemic, depurative, tonic, carminative activity **Qureshi et al., (2014)**
			Quercetin,	0.247 mg/ml		
			Apigenin	0.003 mg/ml		
			kaempferol	0.029 mg/ml		

N.D means not determine.

CONCLUSION

Present review concluded that flavonoids are present in all types of plants eg fruits, vegetable and medicinal plants. In plants they are involve in pigmentation of fruits and flower while in animals they have many biological and pharmacological effects. They act as anti inflammatory, anticarcinogen, antioxidant, antibacterial, antimicrobial, antidiarrhoel, antihelmintic, antimutagenic, protective against hydrogen peroxide, antimalarial, antifungal, anticancer and anti tumor. They also decrease aortic pressure, pulmonary capillary pressure and heart rate.

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