

THE GENUS *RANUNCULUS*: A PHYTOCHEMICAL AND ETHNOPHARMACOLOGICAL REVIEW

M SHAHZAD ASLAM\*, BASHIR A. CHOUDHARY, M UZAIR, A SUBHAN IJAZ

Department of pharmacy, Bahauddin Zakariya University, Multan, Pakistan. Email: Muhammad.shahzad.aslam@hotmail.com

Received: 12 July 2012, Revised and Accepted 17 August 2012

## ABSTRACT

The genus *Ranunculus* has been reviewed for distribution in the world, traditional uses, isolated chemical constituents and their pharmacological activities of some common species. Almost 600 species belong to the genus *Ranunculus*. It is distributed throughout the northern hemisphere and southern temperate regions in the tropic where they usually limited to higher altitude. The most common use of *Ranunculus* species in traditional medicines are anti-rheumatism, intermittent fever and rubefacient. The findings in some *Ranunculus* species of, for example, Protoanemonin (**21**), anemonin (**3**), may justify the uses of these species against fever, rheumatism and rubefacient in Asian traditional medicines. The aim of the present paper is to review the comprehensive knowledge of the plants of this genus including the traditional uses, chemical constituents and pharmacology.

**Keywords:** *Ranunculus*; Anti-rheumatism; Anemonin; Intermittent fevers; Protoanemonin.

## INTRODUCTION

Throughout our research on medicinal plants present in Pakistani vegetative fields we concentrated our attention in the genus *Ranunculus*. During our study on *Ranunculus muricatus*, which is traditionally used against plague, abscess and tumors of plague<sup>1</sup>, we observed that several *Ranunculus* species are traditionally used, throughout Asia, to reduce fever and rheumatism. Several ethno-pharmacological literatures are available for the genus which is still not documented in single article that is beneficial for the future researchers. These reviews will cover almost all literature data on the ethno-botanical, phytochemical and pharmacological activities. Scopus, Science direct, Google scholar, Tropicos (for plant taxonomy)

are used for the compilation of all data. All the data are reported in alphabetical order.

## Botany

*Ranunculus* is a huge genus containing almost 600 species<sup>2</sup>. There are about 122 species exist in China<sup>3 4 5 6</sup>. It is distributed throughout the northern hemisphere and southern temperate regions in the tropic where they usually limited to higher altitude.

In Pakistan, the family Ranunculaceae is represented by 22 genera and about 114 species of which several genera are of ornamental value while other are toxic and used for medicinal purposes<sup>7</sup>. About 23-25 species occur in Pakistan.

Ranunculus Species, synonyms, distribution and their flowering period<sup>30</sup>

Species	Synonyms	Distribution	Flowering period
<i>Ranunculus arvensis</i>	<i>Ranunculus arvensis</i> var. <i>echinatissimus</i> (Blatter); <i>Ranunculus echinatissimus</i> Blatter; <i>Ranunculus fernandezii</i> Blatter	C. & S. Europe through S. Siberia, Western and S. W. Asia to India and the Himalaya.	March-April.
<i>Ranunculus bulbosus</i> L.	<i>Ranunculus bulbosus</i> L. var. <i>dissectus</i> Barbey; <i>Ranunculus bulbosus</i> L. var. <i>valdepubens</i> (Jord.) Briq.	U.S.A	March-April.
<i>Ranunculus brotherusii</i>	<i>Ranunculus affinis</i> ; <i>Ranunculus pedatifidus</i> ; <i>Ranunculus caespitosus</i> Wall <i>Ranunculus chinensis</i> Bunge;	Kashmir, Tien Shan	-
<i>Ranunculus cantoniensis</i>	<i>Ranunculus linearifolius</i> ; <i>Ranunculus pennsylvanicus</i> subsp. <i>riparius</i> (Edgew.) H. Riedl; <i>Ranunculus riparius</i> Edgew.	Pakistan, Kashmir, India. S.F. China.	March-April.
<i>Ranunculus chaerophyllos</i>	-	In the Mediterranean region of Europe, Asia and N. Africa	April-May.
<i>Ranunculus diffusus</i>	<i>Ranunculus vitifolius</i> Royle	Afghanistan, Pakistan, Himalaya, India, China	July-August
<i>Ranunculus hirtellus</i>	<i>Ranunculus attenuatus</i> Royle	Afghanistan, Pakistan, Kashmir, Himalaya in N. India.	June-July.
<i>Ranunculus jacquemontii</i>	<i>Ranunculus tenellus</i> Jacquem. Ined. Stewart	N. W. & W. Himalaya	June-July
<i>Ranunculus karakoramicola</i>	-	Karakorums, N. W. Himalaya	June-July.
<i>Ranunculus laetus</i>	<i>Ranunculus laetus</i> subsp. <i>chitralicus</i> Qureshi & Chaudhri; <i>Ranunculus laetus</i> var. <i>kashmiricus</i> Qureshi & Chaudhri; <i>Ranunculus pathanorum</i> Rech. f; <i>Ranunculus pseudo-laetus</i> Tamura; <i>Ranunculus distans</i> (flower of india)	Pamir, Western Tien-Shan, Afghanistan, Pakistan, India, Himalaya.	June-July.
<i>Ranunculus lobatus</i>	-	Endemic in the Western Himalaya.	May-June
<i>Ranunculus muricatus</i>	<i>Ranunculus pseudo-muricatus</i> Balter & Hallb	Atlantic and S. Europe, W. & S. W. Asia, Crimea, Caucasus, S. Siberia, Pakistan, India	March-April.
<i>Ranunculus membranaceus</i>	<i>Ranunculus pulchettus</i> var. <i>sericeus</i> Hook. f. & Thoms.	Endemic in the Western Himalaya including Kashmir.	June-July.

<i>Ranunculus munroanus</i>	<i>Ranunculus munroanus</i> var. <i>minor</i> Tamura	Kashmir, Paksitan.	April-June
<i>Ranunculus natans</i>	<i>Ranunculus hyperboreus</i> var. <i>natans</i> (C.A. Mey.) Regel	Siberia, Mongolia, Kashmir.	July-August
<i>Ranunculus palmatifidus</i>	-	Kashimir and Gilgat	June-July
<i>Ranunculus pangiensis</i>	-	Endemic in the W. Himalaya	July-August
<i>Ranunculus pulchellus</i>	<i>Ranunculus flammula</i> D. Don	From Altai mountains and a few locations in eastern Siberia, Tien-Shan, Mongolia & China, to Afghanistan and Pakistan.	June-July
<i>Ranunculus repens</i>	-	Widely distributed as a weed in most parts of Europe and the USSR, W. & S.W. Asia	-
<i>Ranunculus rubrocalyx</i>	-	Pamir-Alai, Tien Shan, Kashmir, Pakistan, Afghanistan.	June-July
<i>Ranunculus rufosepalus</i>	-	Pamir-Alai, Tien-Shan, Kashmir, Pakistan and Afghanistan.	June-July
<i>Ranunculus sceleratus</i>	-	Found nearly in all parts of Europe, Asia and N. Africa	March-April
<i>Ranunculus stewartii</i>	<i>Ranunculus rubrocalyx</i> subsp. <i>stewartii</i> (H. Riedl) Qureshi&Chaudhri	Baltistan	May-June
<i>Ranunculus glacialiformis</i>	-	Himalaya, Kashmir.	July
<i>Ranunculus aquatilis</i>	<i>Batrachium paucistamineum</i> (Tausch.) F. Schultz; <i>Ranunculus aquatilis</i> subsp. <i>trichophyllum</i> (Chaix) Moore & Moore; <i>Ranunculus flaccidus</i> Perz; <i>Ranunculus paucistamineus</i> Tausch; <i>Ranunculus trichophyllum</i> Chaix; <i>Batrachium trichophyllum</i>	Kashmir to Sikhm	March -May

#### Traditional Uses of Ranunculus

The most common use of *Ranunculus* species is for the treatment of anti-rheumatism, rubifacient and intermittent fever. For this use the plant is commonly prepared as decoction. It is also indicated as a remedy for anti-

hemorrhagic (*Ranunculus repens*)<sup>8</sup>, neuralgia pains, anti-spasmodic, diaphoretic (*Ranunculus bulbosus*)<sup>9</sup>, vermifacient, anthelmintic (*Ranunculus hirtellus*)<sup>10</sup>, tympany, conjunctivitis of an eye (*Ranunculus laetus*)<sup>11,12</sup>, cure internal abscess, malaria, scrofula, snake or scorpion venom, and acute icteric hepatitis (*Ranunculus sceleratus*)<sup>13</sup>.

#### Ranunculus species with their common names, part use and their traditional uses

Species	Common names	Part use	Traditional uses	Reference
<i>Ranunculus arvensis</i>	Corn Buttercup (English); Chambul; Gagerkanda (Folk)	Leaves	Used in intermittent fevers, asthma and gout.	31
<i>Ranunculus bulbosus</i> L.	Bulbous Buttercup (English)	Whole plant	It is indicated for gout, arthritic and neuralgia pains. The whole plant, and especially the sap, is acrid, anodyne, antispasmodic, diaphoretic, rubefacient	9
<i>Ranunculus Chinensis</i> Bunge	Jeotgaraknamul (Korean); HuiHuiSuan (Chinese)	Whole Plant	It is used against Diarrhea, parasites	32
<i>Ranunculus diffusus</i>	Spreading Buttercup (English); Nakkorejhar (Nepali)	Leave and stem	Rheumatism	33
<i>Ranunculus hirtellus</i>	Softly Hairy Buttercup (English); Goodi (Hindi)(sanjay)	Roots	Used as vermifacient, cooling agent and anthelmintic	10
<i>Ranunculus laetus</i>	Cheerful Buttercup (English)	Leaves and flower	Tympany Conjunctivitis and diseases of eye	11,12
<i>Ranunculus muricatus</i>	Spiny buttercup (English); Chambul, jaghagha, Latokari, Korgandal(Folk)	Whole plant	Slightly poisonous; A decoction of plant is used for periodic fever and asthma	34
<i>Ranunculus repens</i>	Creeping butter cup	Whole Plant	Antihaemorrhagic	8
<i>Ranunculus sceleratus</i>	Blister Buttercup, Celeryleaved Crowfoot (English); Jal-dhaniyaa (folk)	Whole Plant	It is capable of promoting blood circulation by removing blood stasis, expelling cold, relieving swelling, and removing excessive heat from the liver and the gall bladder. It can also cure internal abscess, malaria, scrofula, snake or scorpion venom, and acute icteric hepatitis.	13
<i>Ranunculus aquatilis</i>	Water Crowfoot (English); Tohlab (Folk)	Whole plant	Use in intermittent fever, asthma and rheumatism	31

### Chemical compounds isolated from genus *Ranunculus*

*Ranunculus arvensis* are rich source of Alkaloid, Phenol, Flavonoid and Saponin<sup>14</sup> but their isolation is undetermined. Hexadecanoic acid (**1**),  $\beta$ -sitosterol (**2**), anemonin (**3**) are the compounds isolated from *Ranunculus bulbosus* L.<sup>15</sup>. A huge bunch of Flavonoid glycoside isolated from *Ranunculus chinensis* that are 3-O- $\alpha$ -L-arabinopyranosyl-(1 $\rightarrow$ 2)- $\beta$ -D-galactopyranosyl-7-O- $\beta$ -D-glucopyranosylkaempferol(**4**),3-O- $\alpha$ -L-arabinopyranosyl-(1 $\rightarrow$ 2)-{4-O-[(E)-caffeoyl] $\beta$ -D-galactopyranosyl}-7-O- $\beta$ -D-glucopyranosylquercetin(**4a**),3-O-{2-O-[(E)-caffeoyl]- $\alpha$ -L-arabinopyranosyl(1 $\rightarrow$ 2)- $\beta$ -D-galactopyranosyl}-7-O- $\beta$ -D-glucopyranosylkaempferol (**4b**),3-O-{2-O-[(E)-caffeoyl]- $\alpha$ -L-arabinopyranosyl-(1-2)- $\beta$ -D-galactopyranosyl}kaempferol (**4c**)<sup>16</sup>. It is interesting to note that *Ranunculus laetus* consist of Jacein (**5**), jacedin-5-O- $\beta$ -D-glucoside (**5a**), centaurein (**5b**), 6, 7-dimethoxycoumarin (**6**),  $\beta$ -amyryn (**7**), and  $\beta$ -sitosterol-3-O- $\beta$ -D-

glucoside<sup>17</sup>. *Ranunculus muricatus* contains phenolic class of compounds such as stigmaterol -4 - ene-3 ,6 - dione, stigmaterol, Anemonin, Aescin lactone dimethyl ether (**8**), beta-Valley sterol, protocatchuic aldehyde (**9**), protocatchuic acid (**10**), and luteolin factors (**11**)<sup>18</sup>. R (+)-Dalbergi phenol (**12**), R (+)-4methoxydalbergione (**13**), methyl 3, 4, 5,-trihydrobenzoate(**14**),4-hydroxy-2-methoxybenzoic acid (**15**), p-hydroxycinnamic acid (**16**),  $\beta$ -sitosterol and Ranupenin are chemical constituents isolated from *Ranunculus repens*<sup>19 20</sup>. The most interesting species among all genus is *Ranunculus sceleratus* containing 5-hydroxy tryptamine (**17**)<sup>21</sup>, apigenin (**18**), apigenin 4'-O- $\alpha$ -rhamnopyranoside, apigenin 7-O- $\beta$ -glucopyranosyl-4'-O- $\alpha$ -rhamnopyranoside, tricrin 7-O- $\beta$ -glucopyranoside, isoscopoletin (**19**), tricrin (**20**), Protocatechuy aldehyde<sup>22</sup>, Protoanemonin<sup>23</sup>. It is interesting to note that  $\beta$ -sitosterol is isolated from three of the species of *Ranunculus* such as *Ranunculus bulbosus*, *Ranunculus laetus* and *Ranunculus repens*.

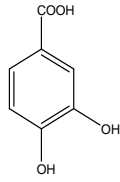
### List of Chemical constituents in genus *Ranunculus*

Species	Chemical constituents
<i>Ranunculus arvensis</i>	Alkaloid,Phenol,Flavonoid,Saponin are present but their isolation is not determined <sup>14</sup> .
<i>Ranunculus bulbosus</i> L.	Hexadecanoic acid ( <b>1</b> ), $\beta$ -sitosterol( <b>2</b> ), anemonin( <b>3</b> ) <sup>10</sup> , Protoanemonin( <b>21</b> ) <sup>28</sup>
<i>Ranunculus chinensis</i>	3-O- $\alpha$ -L-arabinopyranosyl-(1 $\rightarrow$ 2)- $\beta$ -D-galactopyranosyl-7-O- $\beta$ -D-glucopyranosylkaempferol ( <b>4</b> ); 3-O- $\alpha$ -L-arabinopyranosyl-(1 $\rightarrow$ 2)-{4-O-[(E)-caffeoyl] $\beta$ -D-galactopyranosyl}-7-O- $\beta$ -D- glucopyranosylquercetin ( <b>4a</b> ); 3-O-{2-O-[(E)-caffeoyl]- $\alpha$ -L-arabinopyranosyl(1 $\rightarrow$ 2)- $\beta$ -D-galactopyranosyl}-7-O- $\beta$ -D- glucopyranosylkaempferol ( <b>4b</b> ); 3-O-{2-O-[(E)-caffeoyl]- $\alpha$ -L-arabinopyranosyl-(1-2)- $\beta$ -D-galactopyranosyl}kaempferol ( <b>4c</b> ) <sup>16</sup>
<i>Ranunculus laetus</i>	Jacein( <b>5</b> ), jacedin-5-O- $\beta$ -D-glucoside( <b>5a</b> ), centaurein( <b>5b</b> ), 6,7-dimethoxycoumarin ( <b>6</b> ), $\beta$ -amyryn( <b>7</b> ), and $\beta$ -sitosterol-3-O- $\beta$ -D-glucoside <sup>17</sup>
<i>Ranunculus muricatus</i>	stigmaterol -4 - ene-3 ,6 - dione, stigmaterol, Anemonin, Aescin lactone dimethyl ether ( <b>8</b> ), beta-Valley sterol, protocatchuic aldehyde ( <b>9</b> ), protocatchuic acid ( <b>10</b> ), and luteolin factors ( <b>11</b> ) <sup>18</sup> .
<i>Ranunculus repens</i>	R(+)-Dalbergi phenol ( <b>12</b> ), R(+)-4methoxydalbergione ( <b>13</b> ), methyl 3,4,5,-trihydrobenzoate( <b>14</b> ),4-hydroxy-2-methoxybenzoic acid( <b>15</b> ), p-hydroxycinnamic acid( <b>16</b> ), $\beta$ -sitosterol <sup>19</sup> , Ranupenin <sup>20</sup> .
<i>Ranunculus sceleratus</i>	5-hydroxy tryptamine( <b>17</b> ) <sup>21</sup> ,apigenin( <b>18</b> ),apigenin 4'-O- $\alpha$ -rhamnopyranoside, apigenin 7-O- $\beta$ -glucopyranosyl-4'-O- $\alpha$ -rhamnopyranoside, tricrin 7-O- $\beta$ -glucopyranoside, isoscopoletin( <b>19</b> ),tricrin( <b>20</b> ),Protocatechuy aldehyde <sup>17</sup> , Protoanemonin( <b>21</b> ) <sup>23</sup> .
<i>Ranunculus sieboldii</i>	apigenin-4'-O- $\alpha$ -L-arabinopyranoside, apigenin-7-O- $\beta$ -D-glucopyranosyl-4'-O- $\alpha$ -L-rhamnopyranoside, apigenin-8-C- $\alpha$ -L-arabinopyranoside, apigenin-8-C- $\beta$ -D-galactopyranoside, tricrin-7-O- $\beta$ -D-glucopyranoside, tricrin, luteolin, scopoletin, esculetin, scoparone, ferulic acid, protocatchuic acid, and ternatolide <sup>43</sup>
<i>Ranunculus sardous</i>	7-O-methylherbacetin 3-O-[2-O-E-feruloyl-fl-D-glucoside <sup>44</sup>
<i>Ranunculus ternatus</i>	Ternatoside, ternatoside B, sternbin, methylparaben, 4-O-D-glucopyranosyl-p-coumaric acid, linocaffein, Robustaflavone-4'-methyl ether, Kayaflavone, Podocarpusflavone A, Bilobeti, Isoginkgetin, Amentoflavone, 4-oxo-5-(O- $\beta$ -D-glucopyranosyl)-pentanoic acid-10-butyl ester, 4-oxo-5-(O- $\beta$ -D-glucopyranosyl)-pentansaeure-methyl ester, benzyl alcohol O- $\beta$ -D-glucopyranoside <sup>45 46</sup>

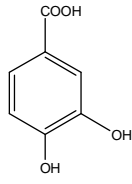
### List of Chemical nature of Compounds isolated in genus *Ranunculus*

Chemical Nature	Compounds present	Reference
Flavonoid	3-O- $\alpha$ -L-arabinopyranosyl-(1 $\rightarrow$ 2)- $\beta$ -D-galactopyranosyl-7-O- $\beta$ -D-glucopyranosylkaempferol ( <b>4a</b> ); 3-O- $\alpha$ -L-arabinopyranosyl-(1 $\rightarrow$ 2)-{4-O-[(E)-caffeoyl] $\beta$ -D-galactopyranosyl}-7-O- $\beta$ -D- glucopyranosylquercetin ( <b>4b</b> ); 3-O-{2-O-[(E)-caffeoyl]- $\alpha$ -L-arabinopyranosyl(1 $\rightarrow$ 2)- $\beta$ -D-galactopyranosyl}-7-O- $\beta$ -D- glucopyranosylkaempferol ( <b>4c</b> ); 3-O-{2-O-[(E)-caffeoyl]- $\alpha$ -L-arabinopyranosyl-(1-2)- $\beta$ -D-galactopyranosyl}kaempferol	16,17,35, 43,44
Phytosterol	Apigenin, Jacein( <b>5</b> ), jacedin-5-O- $\beta$ -D-glucoside( <b>5a</b> ), centaurein( <b>5b</b> ), R(+)-Dalbergi phenol ( <b>12</b> ), R(+)-4methoxydalbergione ( <b>13</b> ), apigenin-4'-O- $\alpha$ -L-arabinopyranoside, apigenin-7-O- $\beta$ -D-glucopyranosyl-4'-O- $\alpha$ -L-rhamnopyranoside, apigenin-8-C- $\alpha$ -L-arabinopyranoside, apigenin-8-C- $\beta$ -D-galactopyranoside, tricrin-7-O- $\beta$ -D-glucopyranoside, 7-O-methylherbacetin 3-O-[2-O-E-feruloyl-fl-D-glucoside	36,37
Coumarin	$\beta$ -sitosterol( <b>2</b> ), stigmaterol -4 - ene-3 ,6 - dione, stigmaterol	17,38
Derivative	6,7-dimethoxycoumarin ( <b>6</b> ), isoscopoletin	
Triterpene	$\beta$ -amyryn( <b>7</b> )	39
Fatty acid	Hexadecanoic acid ( <b>1</b> )	40
Saponin	Aescin( <b>8</b> )	41
Lactone	Anemonin( <b>3</b> ), Protoanemonin( <b>21</b> )	42
Derivative		

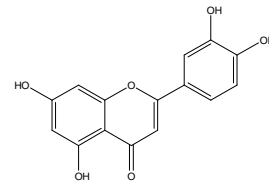




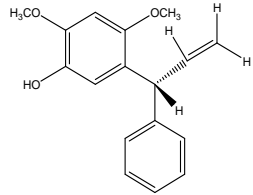
(9)



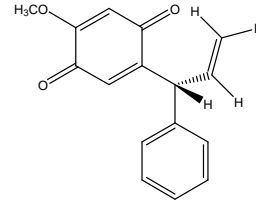
(10)



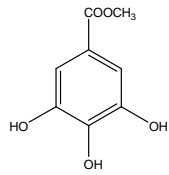
(11)



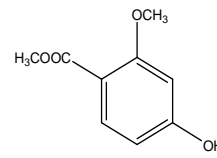
(12)



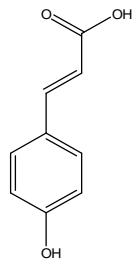
(13)



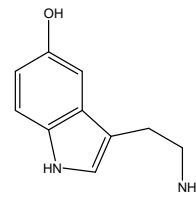
(14)



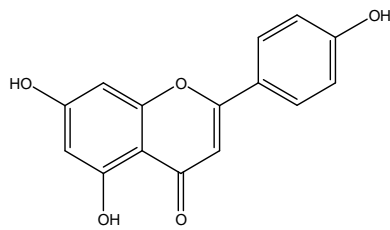
(15)



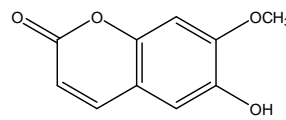
(16)



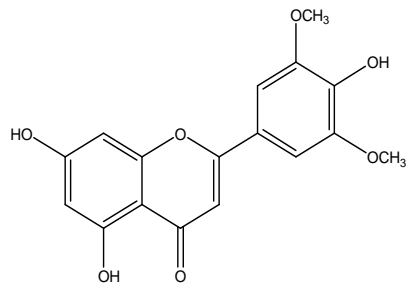
(17)



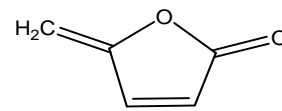
(18)



(19)



(20)



(21)

### Pharmacological activities

Although there are number of species that have been traditionally useful yet there are no pharmacological prove yet present. The aerial part of *Ranunculus sceleratus* possesses anti-inflammatory properties. It is examined in rat's in-vivo and in-vitro. Later it is found that non-polar extract were able to inhibit eicosanoid production whereas polar extract enhance the synthesis of 5(S)-HETE, LTB4 AND 12(s)-HHTrE<sup>24</sup> It also possesses anti-bacterial activity. The roots and leaves are used and is found that it is active against Salmonella typhi and Agrobacterium tumefaciens<sup>25</sup>.

*Ranunculus aestivalis*, *Ranunculus marginatus* and *Ranunculus laetus* also possess anti-bacterial activity against different bacterial strains. *Ranunculus aestivalis* is active against Klebsiella pneumonia and Staphylococcus aureus<sup>26</sup>. *Ranunculus marginatus* showed activity against Streptococcus faecalis, Staaphylococcus aureus, Staphylococcus epidermidis, Bacillus subtilis, Pseudomonas aeruginosa, Enterobacter aerogenes, and Echerichia coli<sup>27</sup>. All the isolated compounds of *Ranunculus laetus* showed the activity against Staaphylococcus aureus, Bacillus subtilis, Pseudomonas aeruginosa, Echerichia coli, and Bacillus subtilis<sup>17</sup>. Whole plant of *Ranunculus bulbosus* showed activity against selected strain of yeast and dermatophytes<sup>28</sup>. Analgesic and anti-inflammatory activity is present in *Ranunculus japonicum*. It is observed in mice in-vivo<sup>29</sup>.

### DISCUSSION AND CONCLUSION

Generally natural product has been useful tool for discovery of new drugs<sup>49</sup>. The species of the genus *Ranunculus* has showed number of components isolated. The class of compounds present in the highest frequency were the Flavonoids: Apigenin, Jacein (**5**), jacedin-5-O-β-D-glucoside (**5a**), centaurein (**5b**), R(+)-Dalbergi phenol (**12**), R(+)-4-methoxydalbergione(**13**), 3-O-α-L-arabinopyranosyl-(1→2)-β-D-galactopyranosyl-7-O-β-D-glucopyranosylkaempferol(**4**); 3-O-α-L-arabinopyranosyl-(1→2)-{4-O-[(E)-caffeoyl]β-D-galactopyranosyl}-7-O-β-D-glucopyranosylquercetin(**4a**); 3-O-{2-O-[(E)-caffeoyl]-α-L-arabinopyranosyl(1→2)-β-D-galactopyranosyl}-7-O-β-D-glucopyranosylkaempferol(**4b**); 3-O-{2-O-[(E)-caffeoyl]-α-L-arabinopyranosyl-(1-2)-β-D-galactopyranosyl}kaempferol (**4c**). Saponin and Phytosterol compounds have been less studied. The Phytosterol found in these species are β-sitosterol (**2**), stigmasterol - 4 - ene-3,6 - dione. The residual chemical composition of these species has been less investigated. In conclusion, only few pharmacological activities have been studied of these species. Most of studies up till now have concentrated their attention on the antibacterial, antifungal, Anti-inflammatory and analgesic of different extracts. There is a lack of comprehensive isolation studies issued or comprehensive investigation of their pharmacological actions. Thus, we believe that the isolation of new active component from these species would be of huge scientific value.

### List of Pharmacological activities reported

Species	Pharmacological properties	Application	Activity	Part used	Reference
<i>Ranunculus sceleratus</i>	Anti-inflammatory	Rats In-vivo and In-vitro	In vitro, non-polar extract were able to inhibit eicosanoid production whereas polar extract enhanced the synthesis of 5(S)-HETE ,LTB4 and 12(S)-HHTrE	Arial part	24
	Anti-bacterial	In-vitro	Active against Salmonella typhi and Agrobacterium tumefaciens	Root and Leaves	25
<i>Ranunculus aestivalis</i>	Antibacterial	In-vitro	Active against Klebsiella pneumonia and Staphylococcus aureus	Whole Plant	26
<i>Ranunculus japonicum</i>	Analgesic and Anti-inflammatory	In-vivo(mice)	Inhibit the paw edema induced by carrageenin, ear swelling of mice caused by acetic acid and granuloma formation in rats	-	29
<i>Ranunculus bulbosus</i>	antifungal activity	In-vitro	Active against selected strain of dermatophytes and yeasts.	Whole plant	28
<i>Ranunculus marginatus</i>	Anti-oxidant Anti-bacterial	In-vitro	It showed activity against Streptococcus faecalis, Staaphylococcus aureus, Staphylococcus epidermidis, Bacillus subtilis, Pseudomonas aeruginosa, Enterobacter aerogenes, Echerichia coli	Whole Plant	27
<i>Ranunculus laetus</i>	Anti-bacterial	In-vitro	All the isolated compounds showed the activity against Staaphylococcus aureus, Bacillus subtilis, Pseudomonas aeruginosa, Echerichia coli, Bacillus subtilis	-	17
<i>Ranunculus constantinopolitanus</i>	Wound healing and anti-inflammatory properties	linear incision and circular excision wound models(In-vivo)	Methanolic extract of <i>Ranunculus constantinopolitanus</i> demonstrated anti-inflammatory activity with the inhibition value of 23.3% at the dose of 100 mg/kg	Whole plant	47
<i>Ranunculus pedatus</i>	Wound healing and anti-inflammatory properties	linear incision and circular excision wound models (In-vivo)	Methanolic extract of <i>Ranunculus pedatus</i> showed significant wound healing effect both in incision (31.4% and excision 55.74% wound models).	-	47
<i>Ranunculus sieboldii</i>	Cytotoxicity	In vitro MTT assay on four different human tumor cell line (KB, BEL-7407, A549, HL-60)	Apigenin-4'-O-α-L-arabinopyranoside was active against BEL-7407 and A549 cell lines, scopoletin, scoparone showed inhibitory activities on KB cell lines and HL-60 cell lines while luteolin exerted moderate cytotoxic activities on KB, BEL-7407, A549 and HL-60 cell lines	Whole plant	43
<i>Ranunculi Ternati</i>	Human breast cancer cell	In-vitro	The Radix <i>Ranunculi Ternati</i> withdraws inhibits MCF-7 cells growth via apoptosis reduction	-	48

## REFERENCE

- H Iqbal, Z Sher, Z U Khan. Medicinal plants from salt range Pind Dadan Khan district Jhelum Punjab Pakistan. Journal of Medicinal Plants. 2011; 5(11): 2157-2168.
- Tamura M. Ranunculaceae. In: Hiepko P ed. Die Natulichen Pflanzenfamilien. Zwei Aufl.1995; 17a (4). Berlin: Duncker and Humblot.
- Yang Q E. *Ranunculus wangianus* Q. E. Yang, a new species from NW Yunnan, China and its karyotype. Acta Pytotax Sin.2000; 38: 551-556
- Liao L, Xu L. New taxa of the genus *Ranunculus* from China and teir karyotypes. Acta Pytotax Sin.1997; 35: 57-62
- Wang W T. A revision of the genus *Ranunculus* in China (1). Bull Bot Res.1995; 15: 137-180
- Wang W T. A revision of the genus *Ranunculus* in China (2). Bull Bot Res.1995; 15: 275-529
- Riedl, H, Nasir. Y. Flora of Pakistan"National Herbarium, PARC, Islamabad.
- David Mantle, FadelEddeb, Anne T. Pickering. Comparison of relative antioxidant activities of British medicinal plant species in vitro, Journal of Ethno-pharmacology. 2000; 72(1-2): 47-51.
- Maria Lucia Leporatti and Kamel Ghedira. Comparative analysis of medicinal plants used in traditional medicine in Italy and Tunisia. Journal of Ethnobiology and Ethnomedicine. 2009; 5: 31.
- Sanjay Kr Uniyal\*, KN Singh, Pankaj Jamwal and BrijLal. Traditional use of medicinal plants among the tribal communities of ChhotaBhngal, Western Himalaya. 2006; 2: 14.
- PC Pande, LalitTiwari, HC Pande. Ethnoveterinary plants of Uttaranchal- A review. Indian journal of traditional Knowledge. 2007; 6(3): 444-458.
- R.M. Dobriyal, G.S. Singh, K.S. Rao and K.G. Saxena. Medicinal Plant Resources in Chhakinal Watershed in the Northwestern Himalaya. Journal of herb, species and Medicinal Plants.1997;5(1):15-27.
- H. Mei, S. Zuo, L. Ye, J. Wang and S.Ma. Review of the application of the traditional Chinese medicinal herb. *Ranunculus sceleratus* Linn. Journal of Medicinal Plants Research. 2012; 6(10): 1821-1826.
- IqbalHussain, RiazUllah,RoohUllah, Muhammad Khurram, NaseemUllah, Abdul Baseer, Farhat Ali Khan, MuneeburRehmanKhattak, Mohammad Zahoor, Jehangir Khan and Naeem khan. Phytochemical analysis of selected medicinal plants. African Journal of Biotechnology. 2011; 10(38): 7487-7492.
- S. Louaer, S. Akkal, H. Duddeck, E. Makhloufi, A. Achouri and K. Medjroubi. Secondary Metabolites of *Ranunculus bulbosus*. Chemistry of natural Compounds. 2012; 48(1).
- Yan-Ping Zou, Chang-Heng Tan, Bao-De Wang, Shan-Hao Jiang and Da-Yuan Zhu. Flavonoid Glycosides from *Ranunculus chinensis*Bge, *Helvetica Chimica Acta*. 2007; 90.
- Javid Hussain, HidayatHussain, Zabta Khan Shinwari, Ijaz AHMAD, s. TasleemHussain and ViqarUddin Ahmad. Antibacterial activity of the Chemical constituents from *Ranunculus laetus*. Chemistry of Natural compounds. 2009; 45(5).
- Wang Lingjie, GAO Xiao-Zhong. Shengzhou stab the chemical composition of the fruit buttercup. China Modern Applied Pharmacy. 2009; 6:460-462.
- W. Noor, R.Gul, I. Ali and M.I. Choudhary. Isolation and Antibacterial activity of the Compounds from *Ranunculus repens*. Journal of Chemical society of Pakistan. 2006; 28(3).
- Wagner, H., Rüger, R., Maurer, G. and Farkas, L. Synthese der 8-, 4'- und 7-Monomethylether von Gossypetin (3,3',4',5,7,8-Hexahydroxyflavon) und KonstitutionsbeweissfürRanupeninaus *Ranunculus repens*L. Chem. Ber. 1977; 110: 737-743. doi: 10.1002/cber.19771100237.
- K.P. Bhargava, K. Kishor, M.C. Pant and P. R. Saxena. Identification of tryptamine derivatives in *Ranunculus sceleratus*. British journal of Pharmacology. 1965; 25: 743-750.
- Haibo Li, ChangXin Zhou, Yunxue Pan, XiaozhongGao, Xiumei Wu, HuaBai, Linfu Zhou, Zhi Chen, Shuili Zhang, Shuyun Shi, JialiLuo, JuanhuaXu, Liurong Chen, XiaoxiangZheng, Yu Zhao. Evaluation of Antiviral Activity of Compounds Isolated from *Ranunculus sieboldii* and *Ranunculus sceleratus*. *Planta Med*. 2005; 71(12): 1128-1133.
- Vergleichende, B. Schweiz. Bot. Ges. 1944;54: 399.
- Prieto, Recio, Giner, Manez, Rio. Journal of Ethnopharmacology. 2003; 89(1): 131.
- SharadBissa and A. Bohra. Evaluation of Anti-bacterial Potential of *Ranunculus sceleratus*. Botany Research International. 2012; 5(1): 10-13.
- Shahidi Bonjar. Evaluation of antibacterial properties of some medicinal plants used in Iran. Journal of ethnopharmacology. 2004; 94: 301-305.
- Gülenİrem, Nehir, Sibel, H. Tansel,N. Ülkü, Buket, Mustafa Ali. Turk J Biol. 2010; 34: 139-146.
- Mares. Mycopathologia.98(3) :133.
- Cao, Meng, Ji. Natural Planta Med. 1992; 58(6): 496.
- Ali, S. I. The Flora of Pakistan: some general and analytical remarks. Notes Roy. Bot. Gard. Edinburgh.1978; 36: 427-439.
- C.P. Khare. Indian Medicinal Plants. Springer-Verlag Berlin; 2007.
- ShicaiShen, JieQian, JianRen. Ethnoveterinary plant remedies used by Nu people in NW Yunnan of China. Journal of Ethnobiology and Ethnomedicine. 2010; 6:24.
- S Paulsamy,K K Vijayakumar, M Murugesan, S Padmavathy and P Senthilkumar. Ecological status of medicinal and other economically important plants in the Shola understories of Nilgiris the Western Ghats. Natural product radiance. 2007; 6(1): 55-61.
- Hinalqbal, ZamanSher, ZaheerUddin Khan, Medicinal plants from Salt range Pind Dadan Khan, district Jhelum, Punjab, Pakistan. Journal of Medicinal Plants Research. 5(11):2157-2168.
- W.B. Eyton, W.D. Ollis, I.O. Sutherland, O.R. Gottlieb, M. TaveiraMagalhães, L.M. Jackman. The neoflavonoid group of natural product-1 : Dalbegiones-A new class of quinones. *Tetrahedron*. 1965; 21(9): 2683-2696.
- Laura Soupas, Laura Juntunen, Anna-MaijaLampi, and VienoPiironen. Effects of Sterol Structure, Temperature, and Lipid Medium on Phytosterol Oxidation, *J. Agric. Food Chem*. 2004; 52 (21): 6485-649.
- C. Bernsdorff and R. Winter. Differential Properties of the Sterols Cholesterol, Ergosterol, $\beta$ -Sitosterol,trans-7-Dehydrocholesterol, Stigmasterol and Lanosterol on DPPC Bilayer Order, *J. Phys. Chem. B*. 2003; 107 (38): 10658-10664.
- Analysis of polyphenolic compounds of different vinegar samples. Miguel CarreroGálvez, Carmelo GarcíaBarroso and Juan Antonio Pérez-Bustamante, *ZeitschriftfürLebensmitteluntersuhung und -Forschung A*. 199(1):29-31, doi:10.1007/BF01192948.
- Ahmed G. H.; Faten K. (2001). Egyptian Propolis: Antioxidant, Antimicrobial Activities and Chemical Composition of Propolis from Reclaimed Lands, *Z. Naturforsch*. 2001; 57c: 395-402.
- Gutiérrez, J.C. del Río, F.J. González-Vila and F. Martín. *Holzforchung*. 1999; 53: 481-486.
- Kingsley Urum,TurgayPekdemir .Evaluation of biosurfactants for crude oil contaminated soil washing. *Chemosphere*. 2004. 57(9): 1139-1150
- N P Shusherina, N D Dmitrieva, Evgenii A Luk'yanets and R YaLevina (1967), *Progress in the Chemistry Of 2-Pyrone*, Russian Chemical Reviews. 1967; 36(3): 175-183.
- PAN Yun xue, ZHOU Chang xin, ZHANG Shui li, ZHENG Xiao xiang, and ZHAO Yu. Constituents from *Ranunculus sieboldii*. *Journal of Chinese Pharmaceutical Science* 2004; 13(2): 92-97.
- Kenneth R. Markham, Kevin A. Mitchell and Maria Campos. An unusual Lipophilic Flavonol glycoside from *Ranunculus Sardous* Pollen. *Phytochemistry* 1997, 45(1): 203-204.
- Jing Kui TIAN, Feng SUN, Yi Yu CHENG. Two New Glycosides from the Roots of *Ranunculus ternatus*. *Chinese chemical letters* 2005, 16(7): 928-930.
- Jing Kui TIAN, Feng SUN, Yi Yu CHENG. Chemical Constituents from the roots of *Ranunculus ternatus*. *Journal of Asian Natural Product* 2006, 8(1-2): 35-39.

47. Esra Küpeli Akkol, Ipek Sıntar, Tuğçafal Erdoğın, Hikmet Keles, Tuba Mert Gonen, Bijen Kıvcak. Wound healing and anti-inflammatory properties of *Ranunculus pedatus* and *Ranunculus constantinopolitanus*: comparative study. *Journal of Ethnopharmacology* 2012, 139: 478-484.
48. YIN Chun-ping, FAN Long-chang, ZHANG Li-dong, LIN Zhi-cheng, HE Jun-wen, LIU Miao-na, WANG Yue-qin. The inhibiting effect of extracts in *Radix Ranunculi Ternati* on the growth of human breast cancer cells in vitro. *Chinese journal of hospital pharmacy* 2008, DOI:CNKI:SUN:ZGYZ.0.2008-02-002.
49. Soumya Prakash Rout, K. A. Choudary, D. M. Kar, Lopamudra Das, Avijeet Jain. Plants in traditional medicinal system-future source of new drugs. *international journal of pharmacy and pharmaceutical science* 2009: 1(1):1-23.