Palatability status and animals preferences of forage plants in Koh Valley, Chitral, Hindu Kush Range Pakistan

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Abstract

Background: The different plants of the Koh area provide food and fodder to the cattle of the resident. The preferences of livestock and their nutritional requirements are quantified by the palatability of different plants. The current research work is the first attempt to document the palatability status of plant resources of Koh Valley.

Objectives: The objective of this investigation was to assess the palatability of the flora and the preferences of grazing and browsing animals in the Koh valley Chitral, Khyber Pakhtunkhwa, Pakistan.

Methods: Frequent field visits were carried out in order to gather information from local people and nomads of the research locality in different seasons. The palatability status of plant resources were also obtained through interviews, corner meeting, group discussion and visual observations about grazing animals.

Results: The flora of the research area is freely grazed by goats, sheep and cows. Some 482 species of plants were assessed for its palatability classes during the survey. Out of them 140 plants assessed as rarely palatable followed by 115 mostly palatable, 91 highly palatable, 89 species less palatable and 47 were identified as non-palatable. On the basis of plant parts used, leaves top the list with 232 plants followed by whole plant having 193 plant species. Among cattle goats mostly utilized plants for grazing and browsing having 390 species followed by cows with 229 and sheep with 220 plant species.

Conclusions: It was concluded that the research area had very rich palatable plants diversity. Different plant parts were consumed by livestock in Koh valley. Local inhabitants mostly depend on their cattle for survival. Several variables affect the palatability such as morphology, phenology and chemical nature of plants.

*Keywords***:** Palatability, grazing, browsing, Hindukush region, Koh valley.

Background

Chitral is situated to North West of Pakistan within 35^0 15/ to 36^0 55/ latitude and 71^0 11/ to 73^0 51/ longitude. It is surrounded from North by Wakhan corridor separating from Tajikistan, from North-East by Gilgit-Baltistan, from East by Swat, from west by Afghanistan and from South by Dir upper (Fazal *et al.* 2020). Agriculture, livestock rearing and farming are main occupations. Cultivable area only consists of 4% and terrain is mostly mountainous while forest and grazing land include 50% of the total land. Its geographical locality provides vast diversity of flora utilized by local communities for different purposes

such as food and fodder (Fazal *et al.* 2019). Palatability was measured for grazing animals such as sheep, cows and goats. Other related investigation about palatability of plant was also obtained from the local nomadic people. The ability of plant species to be tolerated by grazing animals' taste buds is known as palatability. The appropriateness of plant parts for grazing animals varies depending on a number of aspects, including developmental stages, morphological adaption such as spines and hairs, their chemical components, and the kind of plant species (Ekblom & Gillson 2010). Herbivore selection of a given plant species is determined by the physiological status of the plant, allied species, habitat, climate conditions and the palatability. These features can either trigger a certain reaction in grazing animals or prevent them from grazing altogether (Heady 1964). According to (Rahim *et al*. 2008) palatability is inversely connected with carbon levels and the ratio of Nitrogen to carbon in the aerial sections of the plant body and favorably correlated with the water and nitrogen contents of the leaves. Animals' preferences are also influenced by a variety of plant characteristics, including shape, phenology, mineral contents and secondary metabolite contents (Ibrar *et al*. 2015). One of the key elements influencing the distribution of flora in a given region and reducing the occurrence of species in rangeland vegetation is grazing (Hussain & Durrani 2009). As a result of occurrence of distinct nutritional contents and external appearance and adaptability, cattle choose to eat certain plants in fresh form while, consuming others in their dried out form (Peters 2007).

Material and Methods

Study area

Koh valley is present in 72° 07/ to 72° 46/ East and 35° 20/ to 35° 55/ North location. It is located in central portion of Chitral. Sloppy and uneven terrains characterized the study area. Temperature fluctuates from -8^{0}C in winter to 42^{0}C in summer season. Phytogeographically, the valley occurs in Turano-Iranian region and very rich in floristic composition due to land escape features and altitudinal variations. Geo-climatically and ecologically the area representing dry temperate, sub-alpine and alpine types of vegetation. In the valley, many peaks are present such as Phasti peak with (6498m) of the Hindukush range followed by Golain peak (6468m), Moroi peak (6240m), Koghuzi peak (6440m) and many other peaks with low altitudes (Figure 1).

Survey of the research area and monitor sites

A complete survey was carried out from April 2020 to September 2022 in the different site of the valley. The specific site position was determined with the help of GPS (Global Positioning System) and the geographic coordinates for latitude, longitude and altitude were taken from each site (Table 1).

Data collection

The study area was frequently surveyed to collect data on palatability through observing grazing and browsing animals and conducting interviews with sheepherders and villagers. For identification of palatable plant species, all the species of the area were collected, identified with the help of flora of Pakistan (Ali & Qaiser 1995-2018) and then verified with the plants of world online https://powo.science.kew.org/. The information from the local inhabitants and nomadic people was collected through questionnaires. The collected information was confirmed with available published literature (Hussain & Durrani 2009; Amjad *et al.* 2014; Abdullah *et al.* 2017; Geng *et al*. 2017; Haq & Badshah 2021; Hussain *et al.* 2023). The specimens were then submitted to the Herbarium of Botany, University of Peshawar (PUP).

Parts of plants consumed and their conditions

Based on animal preferences, the palatable plant species were then further classified into consumed parts (Whole plant, leaf and stem). For determination of seasonal availability and abundance of the plants were recorded in the field survey (Hussain & Durrani 2009; Badshah *et al.* 2016; Haq & Badshah 2021).

Data management and analysis

The collected data of the field survey were further analyzed using descriptive statistics, summarized and presented in tables and figures using Microsoft Excel 2016.

Plants were classified into different groups by following (Shaheen *et al*. 2005; Hussain & Durrani 2008; Amjad *et al*. 2014).

i). Highly Palatable (HP): Plant species, which were preferred the most by livestock.

ii). Mostly Palatable (MP): Plant species with an average preference by the livestock.

iii). Less Palatable (LP): Plant species with less preference by livestock.

iv). Rarely Palatable (RP): Plant species grazed under compulsions in the absence of forage species.

v). Non-Palatable (NP): Plant species, not grazed by animals at any stages.

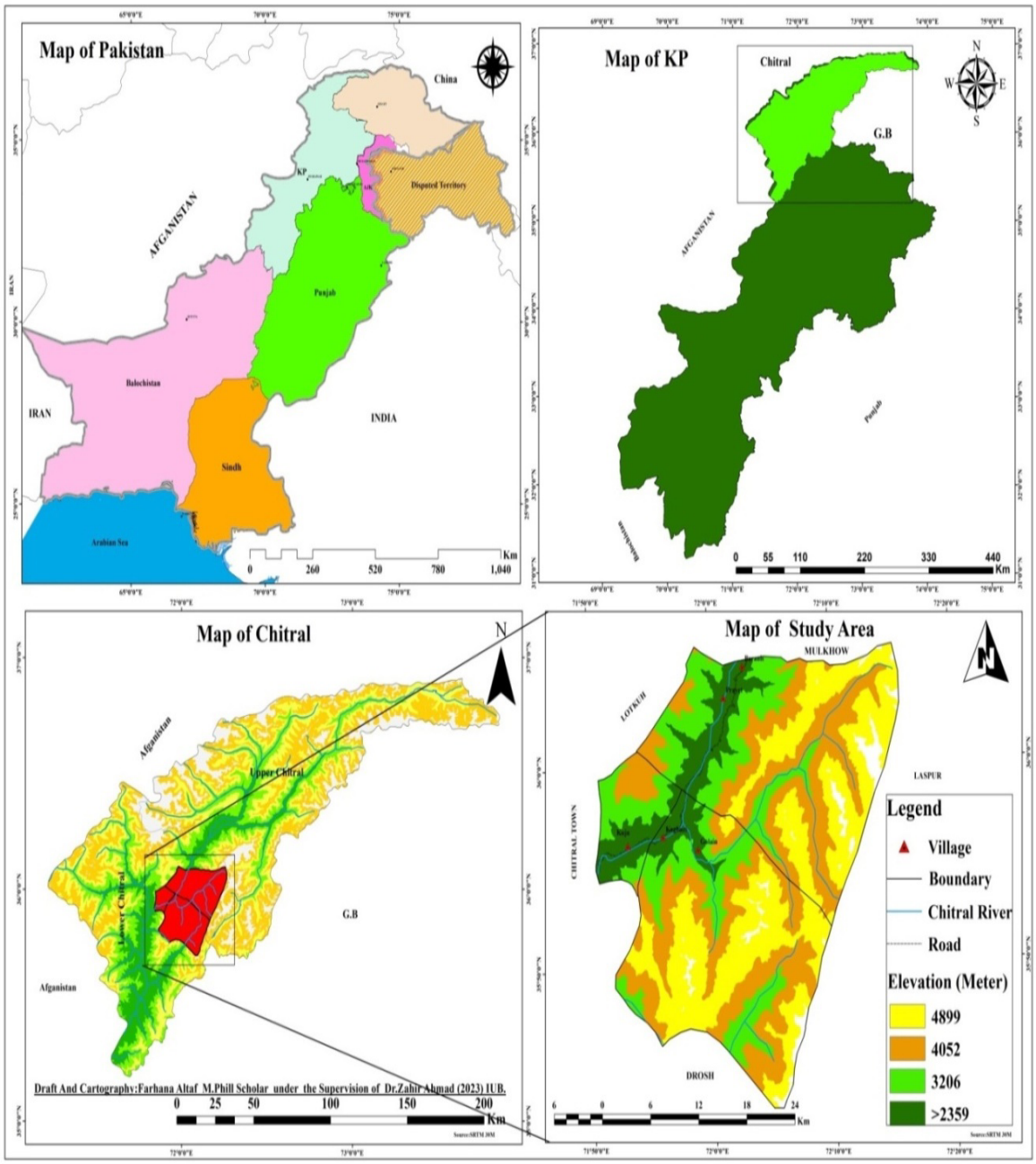

Figure 1. Research locality (Koh valley) Hindukush ranges Chitral.

Table 1. Location of survey sites Koh valley, Chitral

Mean rainfall **Annual rainfall = 580 mm** **Moonson rainfall = 450 mm**		**Mean temperature** **Winter= 3^0C to -12^0C** **Summer= 18^0C to 35^0C**	
Site name	**Altitude (m)**	**Latitude**	**Longitude**
Koghuzi	1680	35' 56' 35" N	71' 56' 27" E
Prayet	1825	36' 2' 32" N	72' 1' 0" E
Golain	1840	36' 5' 16" N	72' 6' 30" E
Kuju	1640	35' 54' 36" N	71' 50' 6" E
Barenis	1880	36' 0' 4" N	72 8 1" E
Moroi	1780	36' 0' 51" N	71' 59' 56" E

Results

The cattle of Koh valley mainly depend on different plants parts for their survival. Over the course of the investigation, the palatability status of 482 species was evaluated. Out of them, 140 species were reported to be rarely palatable. Similarly, some 115 species were observed as mostly palatable and 91 were highly palatable, 89 less palatable and 47 were non-palatable (Table 3). Less palatable species comprised of 89 (18.47 %) and Likewise, 140 (29.46 %) of the plants were reported as rarely palatable. Examples of less palatable species include *Saccharum spontaneum* L., *Artemisia maritima* L. and *Artemisia scoparia* Waldst & Kit., *Angelica glauca* Edgew. and *Carum capticum* L. Additionally some examples of rarely palatable plant species includes *Dicanthium annulatum* (Forssk.) Stapf., *Berberis lycium* Royle and *Nasturtium officinale* R. Br. Many types of Livestock depend on these very palatable plants for survival. Among the different types of Palatable plant species, 390 (%) were consumed by goats. Similarly, cows also utilized 229 (77.53%) of the palatable plants and last but not the least the sheep also preferred 220 (78.65%) of the palatable plant species for their daily usage. Majority of the palatable plants parts consumed by the cattle was the leaves with 232 (48.13%) followed by whole plants having 193 (40.04 %). According to life form classes therophytes were dominant group containing 190 species followed by hemicryptophytes with 127 species. Similarly, leaf size spectra depicted that nanophylls were prominent group containing 178 plant species followed by leptophylls having 106 plant species.

Table 2. Plant species with palatability classes, plant parts used and grazing animals.

Plant species	L.F	L.S	Palatability Classes					Plant parts			Grazing animals		
			NP	HP	MP	RP	LP	WP	L	S	C	G	S
1. *Adiantum capillus-veneris* L.	Geo	Nan	-	-	-	+	-	+	-	-	+	+	+
2. *Adiantum venustum* D. Don.	Geo	Nan	-	-	-	-	+	+	-	-	+	+	+
3. *Equisetum ramossimum* Desf.	Geo	Nan	+	-	-	-	-	-	-	-	-	-	-
4. *Pteris spps*	Geo	Nan	-	-	+	-	-	+	-	-	+	+	+
5. *Juniperus excelsa* M. Bieb.	Mp	Lep	+	-	-	-	-	-	-	-	-	-	-
6. *Juniperus communis* L.	Np	Lep	+	-	-	-	-	-	-	-	-	-	-
7. *Cupressus sempervirens* L.	Np	Lep	+	-	-	-	-	-	-	-	-	-	-
8. *Ephedra gerardiana* Wall. ex. Stapf.	Ch	Aph	-	-	-	+	-	-	-	+	-	+	-
9. *Ephedra intermedia* Scherink & Meyer.	Ch	Aph	-	-	-	-	+	-	+	-	-	+	-
10. *Pinus roxburghii* Sarg.	Mp	Nan	+	-	-	-	-	-	-	-	-	-	-
11. *Pinus wallichiana* A. B. Jackson.	Mp	Nan	+	-	-	-	-	-	-	-	-	-	-
12. *Picea smithiana* (Wall.) Boiss.	Mp	Nan	+	-	-	-	-	-	-	-	-	-	-
13. *Allium purum* L.	Geo	Mes	-	-	-	+	-	-	+	-	-	+	-
14. *Allium chitralicum* Wang and Tang	Geo	Mes	-	-	+	-	-	+	-	-	-	+	-
15. *Allium griffithianum* Boiss.	Geo	Mes	-	-	-	+	-	+	-	-	-	+	-
16. *Allium tuberosum* Rottl. Ex. Spreng.	Geo	Mes	-	-	-	-	-	-	+	-	-	+	-
17. *Amaryllis belladonna* L.	Geo	Mes	-	-	-	-	+	-	+	-	-	-	+
18. *Ixilirion montanum* (Labill.)	Geo	Mes	-	-	-	+	-	-	+	-	-	-	+
19. *Arisaema jacquemontii* Blume.	Geo	Mic	-	-	-	-	+	-	+	-	-	+	+
20. *Arum italicum* Mill.	Hem	Mes	+	-	-	-	-	-	-	-	-	-	-
21. *Colchicum luteum* Baker.	Geo	Mes	-	+	-	-	-	+	-	-	-	+	+
22. *Colchicum aitchisoni* (Hook. f.) E. Nasir	Geo	Nan	-	+	-	-	-	+	-	-	-	+	+
23. *Carex alpina* Swartz.	Geo	Lep	-	+	-	-	-	+	-	-	-	+	+
24. *Carex diluta* M. Bieb.	Hem	Lep	-	+	-	-	-	+	-	-	-	+	+

25. *Carex infuscata* Nees.	Hem	Lep	-	+	-	-	-	+	-	-	-	+	+
26. *Cyperus rotundus* L.	Hem	Lep	-	+	-	-	-	+	-	-	+	+	+
27. *Iris germiniaca* L.	Geo	Mes	+	-	-	-	-	-	-	-	-	-	-
28. *Iris hookeriana* Foster.	Geo	Mes	+	-	-	-	-	-	-	-	-	-	-
29. *Crocus sativus* L.	Geo	Mes	+	-	-	-	-	-	-	-	-	-	-
30. *Juncus regia* L.	Hem	Lep	-	-	+	-	-	+	-	-	-	+	+
31. *Juncus articulata* L.	Hem	Mic	-	-	-	+	-	+	-	-	-	+	+
32. *Juncus effuses* L.	Hem	Lep	-	+	-	-	-	+	-	-	+	+	+
33. *Juncus himalensis* Klotzsch.	Hem	Mic	-	+	-	-	-	+	-	-	-	+	+
34. *Juncus membranaceus* Royle ex. D. Don	Hem	Mic	-	-	+	-	-	+	-	-	-	+	+
35. *Triglochin palustris* L.	Geo	Nan	-	-	-	+	-	-	+	-	-	-	+
36. *Eremurus perisicus* (Jaub & Spach) Boiss.	Geo	Nan	-	-	-	+	-	-	+	-	-	+	+
37. *Eremurus stenophyllus* (Boiss & Buhse) Baker.	Geo	Nan	-	-	-	-	+	-	+	-	-	+	-
38. *Gagea chitralensis* S. Dasgupta & Deb.	Geo	Lep	-	-	-	+	-	-	+	-	+	+	-
39. *Gagea stefolia* Baker	Geo	Nan	-	-	-	+	-	-	-	+	-	+	-
40. *Tulipa gesneriana* L.	Geo	Mes	+	-	-	-	-	-	-	-	-	-	-
41. *Lilium auratum* Lindl.	Geo	Lep	-	-	-	-	+	-	+	-	-	-	+
42. *Cyperipedium cordigerum* D. Don	Geo	Nan	-	-	+	-	-	-	+	-	+	+	+
43. *Aristida cynantha* Nees & Steud.	Hem	Nan	-	+	-	-	-	+	-	-	+	+	+
44. *Avena sativa* L.	Th	Nan	-	+	-	-	-	+	-	-	+	+	+
45. *Avena barbata* Pott ex. Link	Th	Nan	-	+	-	-	-	+	-	-	+	+	+
46. *Bothriochloa barbinodis* (Lag.) Herter	Hem	Nan	-	+	-	-	-	+	-	-	-	+	+
47. *Bromus danthoniae* Trin	Hem	Lep	-	-	+	-	-	+	-	-	-	+	-
48. *Bromus pectinatus* Thunb	Hem	Mic	-	+	-	-	-	+	-	-	-	+	-
49. *Calamagrostris pseudophragmites* (Haller f.) Koeler	Hem	Nan	-	+	-	-	-	+	-	-	-	+	-
50. *Cynodon dactylon* (L.) Pers.	Hem	Nan	-	+	-	-	-	+	-	-	+	+	+
51. *Corynephorus canescens* (L.) P. Beauv.	Hem	Lep	-	-	+	-	-	-	+	-	-	+	-
52. *Dactylis glomerata* L.	Th	Nan	-	-	+	-	-	-	+	-	-	+	-
53. *Dichanthium annulatum* (Forssk.) Stapf.	Hem	Nan	-	-	-	+	-	-	+	-	+	-	-
54. *Digitaria sanguinalis* L.	Geo	Nan	-	+	-	-	-	+	-	-	+	+	+
55. *Echinochloa crus-galli* (L.) P. Beauv.	Th	Nan	-	-	+	-	-	+	-	-	+	+	+
56. *Elymus nutans* Griseb.	Hem	Nan	-	-	+	-	-	+	-	-	+	+	+
57. *Elymus repens* (L.) Gould	Hem	Nan	-	+	-	-	-	+	-	-	+	+	+
58. *Eragrostis minor* Host.	Th	Nan	-	+	-	-	-	+	-	-	-	+	-
59. *Eragrostis nigra* Nees ex Steud.	Th	Nan	-	+	-	-	-	+	-	-	-	+	+
60. *Festuca kashmirina* Stapf.	Hem	Lep	-	+	-	-	-	-	+	-	-	+	+
61. *Festuca valesiaca* Schleich ex Gaud	Hem	Lep	-	+	-	-	-	+	-	-	-	+	-
62. *Heteropogan contortus* (L.) P. Beauv. Ex Roem & Schult	Hem	Mic	-	-	+	-	-	-	+	-	-	+	-

63. *Hordium vulgare* L.	Th	Nan	-	+	-	-	-	+	-	-	+	+	+
64. *Hyparrhenia hirta* (L.) Stapf.	Hem	Nan	-	-	-	+	-	-	-	-	-	+	
65. *Koeleria cristata* Pers.	Hem	Nan	-	+	-	-	-	-	+	-	-	+	+
66. *Lolium rigidum* Guad.	Th	Nan	-	-	+	-	-	+	-	-	+	+	+
67. *Melia ciliata* L.	Ch	Nan	-	-	+	-	-	-	-	-	-	+	+
68. *Melica persica* Kunth.	Hem	Lep	-	-	+	-	-	-	-	-	+	+	+
69. *Oryza sativa* L.	Th	Mic	-	+	-	-	-	+	-	-	+	+	+
70. *Phragmites australis* (Cav.) Trin ex Steud.	Th	Mac	-	-	+	-	-	-	+	-	+	+	+
71. *Poa alpina* L.	Ch	Nan	-	+	-	-	-	+	-	-	+	+	+
72. *Poa annua* L.	Th	Lep	-	+	-	-	-	+	-	-	+	+	+
73. *Poa bulbosa* L.	Geo	Nan	-	+	-	-	-	+	-	-	+	+	+
74. *Poa pratensis* L.	Th	Nan	-	-	+	-	-	+	-	-	+	+	+
75. *Poa sterilis* M. Bieb.	Th	Lep	-	-	+	-	-	+	-	-	+	+	+
76. *Saccharum spontaneum* L.	Ch	Mac	-	-	-	-	+	-	+	-	+	+	+
77. *Secale cereal* L.	Th	Lep	-	+	-	-	-	+	-	-	+	+	+
78. *Setaria glauca* (L.) P. Beauv.	Hem	Nan	-	-	+	-	-	+	-	-	+	+	+
79. *Setaria intermedia* Roem & Schult.	Hem	Nan	-	-	+	-	-	+	-	-	+	+	+
80. *Setaria virides* (L.) P. Beauv.	Hem	Nan	-	+	-	-	-	+	-	--	+	-	-+
81. *Stipa himalacia* Rozhev.	Hem	Nan	-	-	+	-	-	-	+	-	-	+	-
82. *Stipa trichoides* P. Smirnn	Hem	Nan	-	+	-	-	-	+	-	-	-	+	-
83. *Tetrapogon villosus* Desf	Hem	Nan	-	-	+	-	-	-	+	-	-	+	-
84. *Triticum aestivum* L.	Th	Mic	-	+	-	-	-	+	-	-	+	+	+
85. *Triticum durum* Desf.	Th	Mic	-	+	-	-	-	+	-	-	+	+	+
86. Zea mays L.	Th	Mes	-	+	-	-	-	+	-	-	+	+	+
87. *Potamogeton alpinus* Balbis.	Geo	Lep	-	-	+	-	-	+	-	-	-	+	-
88. *Potamogeton nodosus* Poiret.	Geo	Lep	-	-	+	-	-	+	-	-	-	+	+
89. *Typha angustata* Borry & Chaub.	Geo	Mac	-	-	-	+	-	+	-	-	-	+	+
90. *Amaranthus cruentius* L.	Th	Mes	-	-	+	-	-	+	-	-	+	-	-
91. *Amaranthus hybridus* L.	Th	Nan	-	-	+	-	-	-	+	-	+	+	+
92. *Amaranthus retroflexus* L.	Th	Mes	-	-	-	+	-	-	+	-	-	+	+
93. *Amaranthus viridis* L.		Mes	-	+	-	-	-	+	-	-	+	-	-
94. *Dysphania pumilio* (R. Br) Mosyakin & Clemants	Th	Mes	-	-	+	-	-	-	+	-	-	+	+
95. *Pistacia integerrhima* J.L. Steward ex. Brandis.	Np	Mes	-	-	-	+	-	-	+	-	-	+	-
96. *Pistacia khinjuk* Stocks.	Np	Nan	-	-	+	-	-	-	+	-	-	+	-
97. *Ammi visnega* (L.) Lam.	Th	Nan	-	-	-	+	-	-	+	-	-	+	-
98. *Anethum graveolens* L.	Th	Nan	-	-	-	-	+	+	-	-	+	-	+
99. *Bunium persicum* (Boiss.) Fedstch.	Geo	Nan	-	-	-	+	-	+	-	-	+	-	+
100. *Carum capticum* L.	Geo	Mic	-	-	-	-	+	-	+	-	+	+	+
101. *Angelica glauca* Edgew.	Th	Nan	-	-	-	-	+	+	-	-	-	+	-
102. *Carum carvi* L.	Th	Nan	-	-	-	-	+	+	-	-	+	+	-
103. *Carum copticum* L.	Geo	Mic	-	-	-	-	+	-	+	-	+	+	-
104. *Coriandrum sativum* L.	Th	Nan	-	-	-	+	-	+	-	-	+	+	+
105. *Conium macullatum* L.	Th	Nan	-	-	-	-	+	-	+	-	-	+	-
106. *Eryngium maritimum* L.	Th	Nan	-	-	-	+	-	-	+	-	-	+	+
107. *Ferula assafoitida* L.	Geo	Mes	-	-	-	+	-	+	-	-	-	+	-

108. *Ferula northex* Boiss.	Geo	Mes	-	-	-	+	-	+	-	-	-	+	-
109. *Foeniculum vulgare* Miller.	Th	Nan	-	-	-	-	+	+	-	-	+	-	+
110. *Pimpinella stewartii* Dunn. Nasir	Th	Nan	-	-	-	-	+	-	+	-	+	+	-
111. *Prongus pabularia* Lindl.	Hem	Nan	-	+	-	-	-	-	-	-	+	+	+
112. *Seseli libanotis* (L.) Koch.	Th	Lep	-	-	-	+	-	+	-	-	-	+	-
113. *Trachydium roylei* Lindl.	He	Mic	-	-	-	-	+	-	+	-	-	+	-
114. *Trachyspermum ammi* (L.) Spargue.	Geo	Nan	-	-	-	-	+	-	+	-	+	+	-
115. *Nerium indicum* Mill.	Th	Mes	+	-	-	-	-	-	-	-	-	-	-
116. *Trachomitum venetum* (L.) Woodson	Hem	Mes	-	-	-	+	-	-	+	-	-	+	-
117. *Cynanchum acutum* L.	Ch	Mes	-	-	-	+	-	-	+	-	-	+	-
118. *Anthemus cotola* L.	Hem	Nan	-	-	-	+	-	-	+	-	-	+	-
119. *Artemisia brevifolia* Wall. ex. D.C	Hem	Lep	-	-	-	+	-	-	+	-	-	+	-
120. *Artemisia herba-alba* L.	Hem	Lep	-	-	-	-	+	-	+	-	-	+	+
121. *Artemisia indica* Willd.	Hem	Lep	-	-	-	-	+	-	+	-	+	+	+
122. *Artemisia japonica* Thunb.	Hem	Mic	-	-	-	-	+	+	-	-	-	+	-
123. *Artemisia maritima* L.	Hem	Nan	-	-	-	-	+	+	-	-	+	+	+
124. *Artemisia parviflora* Roxb. ex. D. Don.	Hem	Mic	-	-	-	+	-	+	-	-	-	+	+
125. *Artemisia persica* Boiss.	Ch	Lep	-	-	-	-	+	+	-	-	-	+	-
126. *Artemisia rutifolia* Spreng.	Hem	Lep	-	-	-	-	+	+	-	-	-	+	-
127. *Artemisia santolinifolia* Turcz ex Krasch.	Ch	Lep	-	-	-	-	+	+	-	-	-	+	+
128. *Artemisia scoparia* Waldst & Kit.	Hem	Nan	-	-	-	-	+	+	-	-	-	+	+
129. *Aster altaicus* Willdenow	Hem	Mes	-	-	-	+	-	-	+	-	-	+	-
130. *Aster flaccidus* Bunge.	Hem	Nan	-	-	-	-	+	-	+	-	-	-	-
131. *Bidens tripartite* L.	Hem	Nan	-	-	-	+	-	-	+	-	-	-	-
132. *Calendula officinalis* L.	Th	Mes	-	-	+	-	-	+	-	-	+	+	+
133. *Carthamus cotola* L.	Th	Mes	+	-	-	-	-	-	-	-	-	-	-
134. *Carthamus carduncellus* L.	Th	Mes	+	-	-	-	-	-	-	-	-	-	-
135. *Centaurea calcitrapa* L.	Th	Nan	+	-	-	-	-	-	-	-	-	-	-
136. *Centaurea corymbosa* Pourr.	Th	Nan	+	-	-	-	-	-	-	-	-	-	-
137. *Cichorium intybus* L.	Th	Mes	-	+	-	-	-	+	-	-	+	+	+
138. *Cirsium acaule* (L.) Scop.	Th	Mac	+	-	-	-	-	-	-	-	-	-	-
139. *Cirsium argyacanthum* D. C.	Th	Mac	+	-	-	-	-	-	-	-	-	-	-
140. *Cirsium vulgare* (Savi) Ten	Th	Mes	+	-	-	-	-	-	-	-	-	-	-
141. *Cnicus benedictus* L.	Th	Mes	-	-	-	-	+	-	+	-	-	+	-
142. *Conyza bonariensis* (L.) Cronquist.	Th	Nan	-	-	-	+	-	-	+	-	+	+	+
143. *Conyza Canadensis* (L.) Cronquist.	Th	Nan	-	-	-	+	-	-	-	-	-	+	+
144. *Conyza stricta* Willd.	Th	Nan	-	-	-	-	+	+	-	-	-	+	-
145. *Cosmos bipinnatus* Cav.	Th	Nan	-	+	-	-	-	+	-	-	-	+	-
146. *Cotulla coronopifolia* L.	Th	Nan	-	-	-	+	-	+	-	-	+	+	-
147. *Cousinia buphthalmoides* Regel	Th	Lep	-	-	-	+	-	-	+	-	+	+	-
148. *Cousinia multiloba* D.C.	Th	Lep	-	-	-	+	-	-	+	-	-	+	-

149. *Cousinia thomsonii* C. B. Clarke.	Th	Lep	-	-	-	+	-	-	+	-	-	+	-
150. *Crepis multicaulis* Ledeb.	Th	Lep	-	-	-	-	-	-	+	-	-	+	-
151. *Crepis thomsonii* Babc.	Th	Nan	-	-	-	-	-	-	+	-	-	+	-
152. *Cynara humilis* L.	Th	Lep	+	-	-	-	-	+	-	-	-	+	-
153. *Echinops echinatus* Roxb.	Th	Mac	-	-	-	-	+	-	+	-	-	+	+
154. *Echinops cornigerus* D.C	Th	Mes	-	-	-	-	+	-	+	-	-	-	-
155. *Erigeron alpinus* L.	Th	Mic	-	-	-	+	-	+	-	-	+	+	-
156. *Erigeron canadensis* L.	Th	Nan	-	-	-	-	+	-	+	-	+	+	-
157. *Erigeron uniflorus* L.	Th	Lep	-	-	-	-	+	-	+	-	-	+	+
158. *Gnaphalium thomsonii* Hook. f.	Hem	Nan	-	-	-	+	-	+	-	-	-	+	
159. *Inula obtusifolia* A. Kerner	Th	Mes	-	-	-	-	+	-	-	-	-	+	+
160. *Lactuca dissecta* D. Don	Hem	Nan	-	-	-	+	-	-	+	-	+	-	-
161. *Lactuca orientalis* Boiss.	Th	Nan	-	-	+	-	-	-	+	-	+	-	-
162. *Lactuca sativa* L.	Th	Mac	-	+	-	-	-	-	+	-	+	+	-
163. *Lactuca serriola* L.	Th	Mes	-	-	+	-	-	-	+	-	+	+	-
164. *Lactuca viminea* (L.) J. & C. Presl.	Hem	Nan	-	-	+	-	-	-	-	-	-	+	+
165. *Launaea procumbens* (Roxb.).	Th	Nan	-	-	-	+	-	-	-	-	-	+	+
166. *Matricaria chamomilla* L.	Th	Nan	-	+	-	-	-	-	-	-	-	+	+
167. *Matricaria disciformis* (C. A. Mey) DC.	Th	Nan	-	-	+	-	-	-	-	-	-	+	+
168. *Santolina chamaecyparissus* L.	Th	Lep	-	-	-	+	-	-	-	-	-	+	+
169. *Saussurea lappa* (Falc.) Lipsch.	Hem	Lep	-	-	-	-	+	-	+	-	-	+	-
170. *Saussurea bracteata* Decne	Hem	Lep	-	-	-	+	-	-	+	-	-	+	-
171. *Saussurea falconeri* Hook. f.	hem	Lep	-	-	-	-	+	-	+	-	-	+	-
172. *Saussurea gilesii* Hemsley	Hem	Lep	-	-	-	-	+	-	+	-	-	+	-
173. *Senecio* spps	Th	Nan	-	-	-	-	+	-	+	-	-	+	+
174. *Seripidium kurramense* (Qazilb.) Y. R. Ling	Hem	Lep	-	-	-	+	-	-	+	-	-	+	-
175. *Solidago virgaurea* L.	Hem	Nan	-	-	-	-	+	-	+	-	-	+	-
176. *Sonchus arvensis* (L.) Hill.	Th	Mes	-	-	-	-	+	-	+	-	-	+	-
177. *Sonchus asper* (L.) Hill.	Th	Mes	-	-	-	-	+	-	+	-	+	-	-
178. *Sonchus oleraceus* L.	Th	Nan	-	-	-	+	-	+	-	-	-	+	+
179. *Taraxacum officinale* Webber.	Geo	Mes	-	-	+	-	-	+	-	-	+	+	+
180. *Taraxacum stenolepium* Hand-Mazz	Geo	Nan	-	-	+	-	-	+	-	-	+	+	-
181. *Tragopogon gracilis* D. Don	Hem	Nan	-	-	-	+	-	-	+	-	-	+	-
182. *Tussilago farfara* L.	Geo	Mac	-	-	-	-	+	-	+	-	-	+	-
183. *Xanthium strumarium* L.	Th	Mes	+	-	-	-	-	-	-	-	-	-	-
184. *Berberis lycium* Royle.	Np	Nan	-	-	-	+	-	-	+	-	+	-	+
185. *Berberis orthobotrys* Bien. ex. Aitch.	Np	Nan	-	-	-	+	-	-	+	-	+	+	-
186. *Betula utilis* D. Don	Mp	Mes	-		+	-	-	-	+	-	+	+	+
187. *Betula chitralica* Browicz	Mp	Mes	-	+	-	-	-	-	+	-	+	+	+

188. *Arnebia hispidissima* (Lehm.) A. DC.	Hem	Mes	-	-	-	+	-	-	+	-	+	+	-
189. *Arnebia linearifolia* (Lehm.) A. DC	Hem	Nan	-	-	-	+	-	-	+	-	-	+	-
190. *Cynoglossum lanceolatum* Forssk.	Hem	Mic	-	-	-	+	+	-	+	-	-	+	-
191. *Heliotropium dasycarpum* Ledeb.	Hem	Lep	-	-	-	-	+	-	+	-	-	+	+
192. *Lappula barbata* (M. Bieb) Gurke.	Hem	Lep	-	-	-	-	+	-	+	-	+	+	+
193. *Lappula squarrosa* (Retz.) Dumort.	Th	Lep	-	-	-	+	-	-	+	-	+	+	-
194. *Lindelofia longiflora* (Benth) Baill.	Hem	Nan	-	-	-	+	-	-	+	-	-	+	-
195. *Mattiastrum* species	Ch	Lep	-	-	-	-	+	-	+	-	-	+	-
196. *Myosotis arvensis* (L.) Hill.	Hem	Nan	-	-	-	-	+	-	+	-	-	+	-
197. *Myosotis ramosissima*	Hem	Mic	-	-	+	-	-	+	-	-	-	+	-
198. *Nonea edgeworthii* A. DC.	Hem	Nan	-	-	+	+	-	-	+	-	-	+	-
199. *Onosma hispidium* Wall ex G. Don	Th	Nan	-	-	+	-	-	-	+	-	+	+	-
200. *Pentaglottis sempervirens* L.	Ch	Lep	-	-	-	+	-	-	+	-	+	+	-
201. *Rochelia stylaris* Boiss.	Th	Nan	-	-	-	+	-	-	+	-	-	+	-
202. *Arabis fruticulosa* C. A, Mey	Hem	Nan	-	-	+	-	-	+	-	-	+	+	-
203. *Brassica campestris* L.	Th	Mac	-	+	-	-	-	+	-	-	+	+	+
204. *Brassica napus* L.	Geo	Mes	-	+	-	-	-	+	-	-	+	-	+
205. *Capsella bursa-pastoris* (L.) Medic.	Th	Mes	-	+	-	-	-	+	-	-	+	+	+
206. *Chorispora macropoda* Trautv.	Th	Nan	-	-	-	+	-	-	+	-	-	+	-
207. *Coronopus didymus* (L.) Smith.	Th	Lep	-	-	+	-	-	-	+	-	+	+	-
208. *Draba lanceolata* Royle	Hem	Lep	-	-	+	-	-	+	+	-	+	+	-
209. *Draba memorosa* L.	Th	Lep	-	-	+	-	-	+	-	-	-	+	+
210. *Draba tibetica* Hook. f. & Thoms.	Hem	Lep	-	-	+	-	-	-	+	-	-	+	+
211. *Lepidium sativum* L.	Th	Nan	-	+	-	-	-	-	+	-	-	+	-
212. *Lepidium apetalum* Willdenow.	Th	Nan	-	+	-	-	-	+	-	-	+	+	-
213. *Malcomia* spps.	Ch	Mes	-	-	+	-	-	-	+	-	+	+	-
214. *Mathiola flavida* Boiss.	Th	Mes	-	-	+	-	-	+	-	-	+	+	-
215. *Nasturtium officinale* R. Br.	Th	Nan	-	-	-	+	-	+	-	-	+	+	-
216. *Raphanus raphanistrum* L.	Th	Nan	-	-	+	-	-	-	+	-	+	+	-
217. *Rapistrum rugosum* (L.) All.	Th	Lep	-	+	-	-	-	+	-	-	-	+	+
218. *Sisymbrium irio* L.	Th	Lep	-	+	-	-	-	+	-	-	+	+	+
219. *Callitriche palustris* L.	Geo	Lep	-	-	+	-	-	+	-	-	+	+	-
220. *Codonopis clematidea* (Schrenk) C. B. Clarke.	Th	Nan	-	-	-	+	-	-	+	-	-	+	-
221. *Codonopsis rotundifolia* Benth.	Hem	Mes	-	-	-	+	-	-	+	-	-	+	-
222. *Cannabis sativa* L.	Th	Nan	+	-	-	-	-	-	-	-	-	-	-

223. *Capparis spinosa* L.	Hem	Mes	-	-	-	+	-	-	+	-	-	+	+
224. *Capparis racemosa* Mill.	Hem	Mes	-	-	-	+	-	-	+	-	-	+	+
225. *Cleome ariana* Hedge & Lamond.	Th	Nan	-	-	+	-	-	-	+	-	-	+	-
226. *Lonicera asperifolia* (Decne.) Hook. f. Thoms	Ch	Nan	+	-	-	-	-	-	-	-	-	-	-
227. *Arenaria griffithi Boiss*.	Ch	Lep	-	-	+	-	-	-	+	-	+	+	-
228. *Arenaria serpyllifolia* L.	Th	Nan	-	-	-	+	-	-	+	-	+	+	+
229. *Cerastium cerastiodes* (L.) Britton.	Th	Mes	-	-	-	-	+	-	+	-	+	+	-
230. *Cerastium glomeratum* Thuill.	Th	Lep	-	-	-	-	+	-	+	-	-	+	-
231. *Dianthus species.*	Hem	Nan	-	-	-	+	-	-	+	-	+	+	-
232. *Dianthus anatolicus* Boiss.	Hem	Nan	-	-	-	+	-	-	+	-	+	+	-
233. *Minuartia kashmirica* (Edgew.) Mattf.	Hem	Lep	-	-	-	+	-	-	+	-	+	+	-
234. *Saponaria griffithiana* Boiss.	Hem	Lep	-	-	-	+	-	+	-	-	-	+	-
235. *Silene arenosa* C. Koch.	Th	Nan	-	-	-	-	+	-	+	-	+	-	-
236. *Silene conoidea* L.	Th	Nan	-	-	-	-	+	-	+	-	-	+	-
237. *Silene vulgaris* L.	Th	Lep	-	-	-	-	+	+	-	-	-	+	+
238. *Stellaria alsinoides* Boiss & Buhse.	Th	Lep	-	-	-	+	-	+	-	-	+	-	-
239. *Stellaria media* (L.) Vill.	Th	Nan	-	-	-	+	-	+	-	-	+	-	-
240. *Stellaria uliginosa* Murr.	Hem	Nan	-	-	-	+	-	+	-	-	+	-	-
241. *Atriplex tatarica* L.	Th	Nan	-	-	-	+	-	-	+	-	+	+	-
242. *Chenopodium album* L.	Th	Nan	-	+	-	-	-	+	-	-	+	+	+
243. *Chenopodium ambrosioides* L.	Th	Lep	-	-	+	-	-	+	-	-	+	+	+
244. *Chenopodium botrys* L.	Th	Lep	-	+	-	-	-	+	-	-	+	+	+
245. *Chenopodium morale* L.	Th	Nan	-	-	+	-	-	+	-	-	+	+	+
246. *Haloxylon griffithii* (Moq.) Boiss.	Ch	Lep	-	-	-	+	-	-	+	-	-	+	-
247. *Kochia stellaris* Mocq.	Th	Lep	-	-	+	-	-	-	+	-	-	+	-
248. *Salsola tragus* L.	Th	Lep	-	+	-	-	-	-	+	-	-	+	-
249. *Spinacia oleracia* L.	Th	Mes	-	+	-	-	-	-	+	-	+	+	-
250. *Convulvulous arvensis* L.	Th	Mes	-	+	-	-	-	+	-	-	+	+	-
251. *Rhodiola coccinea* (Royle) Boriss.	Ch	Mes	-	-	+	-	-	-	+	-	-	+	-
252. *Rosularia rosulata* (Edgew.) H. Ohba.	Ch	Mes	-	-	+	-	-	-	+	-	+	+	-
253. *Sedum ewersii* Ledeb.	Geo	Nan	-	-	-	-	+	-	+	-	-	+	-
254. *Cuscuta europaea* L.	Th	Aph	+	-	-	-	-	-	-	-	-	-	-
255. *Cuscuta reflexa* Roxb.	Th	Aph	+	-	-	-	-	-	-	-	-	-	-
256. *Diospyrus lotus* L.	Mp	Mes	-	-	+	-	-	-	+	-	+	-	+
257. *Diospyrus kaki* L.	Mp	Mes	-	-	+	-	-	-	+	-	+	-	+
258. *Elaeagnus angustifolia* L.	Mp	Mes	-	-	+	-	-	-	+	-	+	+	+
259. *Elaeagnus umbellata* Thunb.	Mp	Mes	-	-	-	+	-	-	+	-	+	+	+
260. *Hippophae rhamnoides* L.	Mp	Nan	-	-	-	+	-	-	+	-	-	+	-
261. *Euphorbia falcata* L.	Th	Nan	+	-	-	-	-	-	-	-	-	-	-
262. *Euphorbia heliscopia* L.	Ch	Nan	+	-	-	-	-	-	-	-	-	-	-
263. *Euphorbia pamirica* Prokh.	Hem	Lep	+	-	-	-	-	-	-	-	-	-	-

264. *Euphorbia prostrata* Ait.	Th	Nan	-	-	-	-	+	-	+	-	-	-	+
265. *Euphorbia wallichi* Hk.	Th	Nan	+	-	-	-	-	-	-	-	-	-	-
266. *Fumaria indica* (Haussk) Pugsly.	Th	Lep	-	+	-	-	-	+	-	-	+	+	+
267. *Gentiana kurrooa* Royle.	Th	Lep	-	-	-	+	-	-	+	-	-	+	+
268. *Swertia speciosa* D.Don.	Geo	Nan	-	-	-	+	-	-	+	-	-	+	+
269. *Ribes alpestre* Decne.	Ch	Nan	-	-	+	-	-	-	+	-	-	+	-
270. *Ribes orientala* Desf.	Ch	Mes	-	-	+	-	-	-	+	-	-	+	-
271. *Gunneria tinctoria* (Moilna) Mirb.	Th	Mes	+	-	-	-	-	-	-	-	-	-	-
272. *Hippuris vulgaris* L.	Th	Mic	-	-	-	-	+	-	+	-	-	+	-
273. *Hypericum perforatum* L.	Hem	Nan	-	-	-	+	-	-	+	-	+	+	-
274. *Hypericum scabrum* L.	Hem	Nan	-	-	-	+	-	-	+	-	+	+	-
275. *Juglans regia* L.	Mp	Mac	-	-	+	-	-	-	+	-	+	+	+
276. *Lamium amplexicaule* L.	Th	Nan	-	+	-	-	-	+	-	-	+	-	+
277. *Lamium purpurium* L.	Th	Nan	-	-	+	-	-	+	-	-	+	+	-
278. *Leonurus cardiaca* L.	Ch	Nan	-	-		+	-	+	-	-	-	+	-
279. *Marrubrium vulgare* L.	ch	Mes	-	-	+	-	-	-	+	-	-	+	+
280. *Mentha arvensis* L.	Hem	Nan	-	-	+	-	-	+	-	-	+	+	+
281. *Mentha longifolia* (L.) Huds.	Hem	Nan	-	-	-	+	-	+	-	-	+	+	+
282. *Mentha spicata* L.	Hem	Nan	-	-	-	+	-	+	-	-	+	+	+
283. *Mentha pulegium* L.	Hem	Nan	+-	-	-	-	-	-	-	-	-	-	-
284. *Mentha piperita* L.	Hem	Nan	-	-		+	-	+	-	-	+	+	+
285. *Mentha royeleana* Benth.	Hem	Nan	-	-	-	-	+	+	-	-	+	+	+
286. *Nepeta cataria* L.	Ch	Mes	-	+	-	-	-	+	-	-	+	+	-
287. *Nepeta discolor* Royle ex. Bth.	Hem	Nan	-	+	-	-	-	+	-	-	-	+	-
288. *Nepeta glutinosa* Benth.	Ch	Mes	-	-	+	-	-	+	-	-	+	+	-
289. *Nepeta lavaegata* (D. Don) Hand. Mazz.	Ch	Mes	-	-	+	-	-	+	-	-	-	+	-
290. *Nepeta longibractiata* Benth.	Hem	Mic	-	-	+	-	-	+	-	-	-	+	-
291. *Nepeta nepetella* L.	Ch	Mes	-	-	+	-	-	+	-	-	+	+	-
292. *Nepeta kokanica* Regel	Th	Nan	-	-	-	+	-	+	-	-	+	+	+
293. *Nepeta subincisa* Benth.	Hem	Nan	-	-	-	+	-	+	-	-	+	+	-
294. *Salvia aegyptiaca* L.	Ch	Nan	-	-	+	-	-	+	-	-	+	+	-
295. *Scutellaria multicaulis* Boiss.	Hem	Lep	-	-	-	+	-	-	+	-	+	+	-
296. *Thymus linearis* Benth.	Ch	nan	-	-	+	-	-	+	-	-	+	+	-
297. *Thymus serphylum* L.	Hem	Nan	-	-	+	-	-	+	-	-	+	+	-
298. *Thymus vulgaris* L.	Hem	Nan	-	-	+	-	-	+	-	-	+	+	+
299. *Utricularia australis* R. Br.	Geo	Lep	-	-	-	+	-	+	-	-	-	+	-
300. *Linum usitatisimum* L.	Th	Nan	-	-	+	-	-	+	-	-	+	+	-
301. *Magnolia grandiflora* L.	Mp	Mes	+	-	-	-	-	-	-	-	-	-	-
302. *Abutilon bidentatum* Hochst ex A. Rich.	Th	Mes	-	-	-	+	-	-	+	-	+	+	-
303. *Alcea nudiflora* (Lindl.) Boiss.	Th	Mac	+	-	-	-	-	-	-	-	-	-	-
304. *Althea rosea* L. Cav.	Np	Mes	+	-	-	-	-	-	-	-	-	-	-
305. *Althea officinalis* L.	Np	Mes	+	-	-	-	-	-	-	-	-	-	-
306. *Malva neglecta* Wall.	Th	Mes	-	-	-	+	-	-	+	-	-	+	+
307. *Malva parviflora* L.	Th	Nan	-	-	-	+	-	-	+	-	+	+	

308. *Ficus carica* Forsk.	Mp	Mac	-	-	-	-	+	-	+	-	+	+	+
309. *Ficus palmata* Forsk.	mp	Mac	-	-	-	-	+	-	+	-	+	+	+
310. *Morus alba* L.	Mp	Mac	-	+	-	-	-	-	+	-	+	+	+
311. *Morus nigra* L.	Mp	Mac	-	+	-	-	-	-	+	-	+	+	+
312. *Morus rubra* L.	Mp	Mac	-	+	-	-	-	-	+	-	+	+	+
313. *Fraxinus hookerrii* Wenzig.	Mp	Mic	-	+	-	-	-	-	+	-	+	+	+
314. *Fraxinus xanthoxyloides* Wall. ex. G. Don.	Mp	Mic	-	+	-	-	-	-	+	-	+	+	+
315. *Epilobium angustifolium* L.	Th	Mes	-	-	-	+	-	+	-	-	-	+	+
316. *Epilobium hirsutum* L.	Th	Mes	-	-	-	+	-	+	-	-	-	+	+
317. *Epilobium cylindricum* D. Don.	Th	Nan	-	-	+	-	-	+	-	-	-	+	+
318. *Oxalis carnicullata* L.	Th	Mic	-	+	-	-	-	+	-	-	+	+	+
319. *Paeonia emodi* Wall. ex. Royle.	Geo	Nan	-	-	-	-	+	-	+	-	-	+	-
320. *Papaver nudicauli* L.	Hem	Lep	-	-	-	+	-	+	-	-	+	+	+
321. *Papaver dubium* L.	Th	Lep	-	-	+	-	-	+	-	-	-	+	-
322. *Astragalus candolleanus* Royle ex. Bth.	Hem	Lep	-	-	-	-	+	-	+	-	+	+	-
323. *Astragalus chlorostachys* Lindl.	Th	Nan	-	-	-	+	-	-	+	-	-	+	-
324. *Astragalus chitralensis* Ali.	Hem	Lep	-	+	-	-	-	+	-	-	+	+	+
325. *Astragalus corrugates* Bertol.	Th	Nan	-	-	-	-	+	-	+	-	-	+	-
326. *Astragalus falconeri* Bunge.	Hem	Lep	-	-	-	-	+	-	+	-	-	+	+
327. *Astragalus falcatus* Lam.	Hem	Lep	-	-	-	+		-	+	-	-	+	+
328. *Astragalus laspurensis* Ali.	Hem	lep	-	-	-	-	+	-	+	-	-	+	-
329. *Astragalus psilocentros* Fistch.	Hem	Lep	-	-	-	-	+	-	+	-	-	+	-
330. *Astragalus nivalis* Kar and Kir.	Hem	Lep	-	-	-	+	-	-	+	-	-	+	+
331. *Astragalus sempervirens* Lam.	Hem	Lep	-	-	-	+	-	-	+	-	-	+	-
332. *Astragalus subumbellatus* Klotzsch.	Hem	Nan	-	-	-	-	+	-	+	-	-	+	-
333. *Astragalus tragacantha* L.	Hem	Nan	-	-	-	+	-	-	+	-	-	+	-
334. *Astragalus tibetanus* Benth ex. Bunge.	Hem	Lep	-	-	-	-	+	-	+	-	-	+	-
335. *Cicer arietinum* L.	Th	Nan	-	+	-	-	-	+	-	-	+	+	+
336. *Cicer macranthum* M. Popov.	Hem	Lep	-	+	-	-	-	+	-	-	+	+	+
337. *Cicer microphylum* Benth.	Hem	Lep	-	+	-	-	-	+	-	-	+	+	+
338. *Coronilla viminalis* Salisb.	Hem	Mes	-	-	+	-	-	-	+	-	+	+	-
339. *Glycyrrhiza glabra* L.	Geo	Mes	-	-	-	+	-	+	-	-	+	+	+
340. *Crotolaria prostrata* Roxb ex. D. Don.	Hem	Lep	-	-	-	+	-		+	-	-	+	-
341. *Lathyrus aphaca* L.	Th	Mic	-	+	-	-	-	+	-	-	+	+	+
342. *Lathyrus odoratus* L.	Th	Mic	-	+	-	-	-	+	-	-	+	+	+
343. *Lespedeza species*	Th	Nan	-	+	-	-	-	+	-	-	+	+	+
344. *Medicago lupulina* L.	Th	Nan	-	+	-	-	-	+	-	-	+	+	+
345. *Medicago denticulata* L.	Th	Nan	-	+	-	-	-	+	-	-	+	+	+
346. *Medicago sativa* L.	Hem	Nan	-	+	-	-	-	+	-	-	+	+	+

347. *Medicago polymorpha* L.	Th	Lep	-	+	-	-	-	+	-	-	+	+	+
348. *Melilotus albus* Medik.	Th	Nan	-	+	-	-	-	+	-	-	+	+	+
349. *Melilotus indica* (L.) All.	Th	Nan	-	+	-	-	-	+	-	-	+	+	+
350. *Melilotus officinale* (L.) Desr.	Th	Nan	-	+	-	-	-	+	-	-	+	+	+
351. *Oxytropis mollis* Royle ex. Bth.	Hem	Lep	-	+	-	-	-	-	+	-	-	+	+
352. *Oxytropis tatarica* Camb ex. Bunge.	Hem	Lep	-	-	+	-	-	-	+	-	-	+	+
353. *Pisum sativum* L.	Th	Mic	-	+	-	-	-	+	-	-	+	+	+
354. *Sophora mollis* (Royle.) Baker	Np	Nan	-	-	+	-	-	-	+	-	-	-	-
355. *Sophora alopecuroides* (L.) Boiss.	Ch	Nan	-	-	+	-	-	-	+	-	-	+	-
356. *Trifolium pretense* L.	Hem	Mic	-	+	-	-	-	+	-	-	+	+	+
357. *Trifolium repens* L.	Hem	Mic	-	+	-	-	-	+	-	-	+	+	+
358. *Trifolium resupinatum* L.	Th	Mic	-	+	-	--	-	+	--	-	+	+	+
359. *Trifolium alexandrum* L.	Th	Mic	-	+	-	-	-	+	-	-	+	+	+
360. *Vigna radiata* (L.) R. Wilczek.	Th	Mic	-	-	+	-	-	+	-	-	+	+	+
361. *Vicia faba* L.	Th	Nan	-	-	+	-	-	+	-	-	-	+	-
362. *Vicia monentha* Retz.	Th	Nan	-	+	-	-	-	+	-	-	-	+	-
363. *Vicia sativa* L.	Th	nan	-	-	+	-	-	+	-	-	+	+	+
364. *Wisteria sinensis* (Sims) DC.	Th	Lep	+	-	-	-	-	-	-	-	-	-	-
365. *Parnassia nubicola* Planch ex. Clarke.	Th	Mes	-	-	-	+	-	-	+	-	-	+	-
366. *Linaria repens* (L.) Mill.	Th	Nan	-	-	-	+	-	+	-	-	+	+	-
367. *Plantago lanceolata* L.	Th	Mic	-	-	+	-	-	+	-	-	+	+	-
368. *Plantago major* Aitch.	Th	Mes	-	-	+	-	-	+	-	-	+	+	-
369. *Plantago subulata* L.	Th	Mes	-	-	-	+	-	+	-	-	+	+	-
370. *Veronica beccagunga* L.	Th	Mes	-	-	-	+	-	+	-	-	+	+	-
371. *Platanus orientalis* L.	Mp	Mes	+	-	-	-	-	-	-	-	-	-	-
372. *Acantholimon longiscapum* Bokhari	Ch	Lep	+	-	-	-	-	-	-	-	-	-	-
373. *Acantholimon ulicinum* (Schult.) Boiss.	Hem	Lep	+	-	-	-	-	-	-	-	-	-	-
374. *Psylliotachys suworoii* (Regel.) Roshk.	Th	Mac	-	-	-	+	-	-	+	-	-	+	-
375. *Atraphaxis pyrifolia* Bunge	Np	Mes	-	-	-	-	+	-	+	-	-	+	-
376. *Atraphaxis spinosa* L.	Ch	Lep	-	-	-	-	+	-	+	-	-	+	-
377. *Bistorta affinis* (D. Don) Green	Ch	Nan	-	-	-	-	+	-	+	-	-	+	+
378. *Fallopia convulvulous* (L.) A. Love.	Th	Nan	-	-	-	-	+	-	+	-	-	+	+
379. *Fallopia dumetorum* (L.) Holub	Th	Mes	-	-	-	-	+	-	+	-	-	+	+
380. *Oxyria digyna* (L.) Hill.	Th	Nan	-	-	-	+	-	+	-	-	+	+	-
381. *Persicaria chinensis* (L.) H. Gross	Th	Nan	-	-	+	-	-	+	-	-	+	+	-
382. *Persicaria glabra* (Willd) M. Gomes.	Hem	Nan	-	-	+	-	-	+	-	-	+	+	-

383. *Persicaria nepalensis* (Meiss.) H. Gross	Th	Nan	-	-	+	-	-	+	-	-	+	+	-
384. *Persicaria orientalis* (L.) Spach.	Th	Nan	-	-	+	-	-	+	-	-	+	+	-
385. *Polygonum aviculare* L.	Th	Lep	-	-	+	-	-	+	-	-	+	+	-
386. *Polygonum afghanicum* Meiss.	Th	Lep	-	-	-	+	-	+	-	-	+	+	-
387. *Rheum emodi* Wall. ex. Meissn.	Geo	Mac	-	-	-	+	-	+	-	-	-	+	-
388. *Rheum webbianum* Royle.	Th	Mac	-	-	-	+	-	+	-	-	-	+	-
389. *Rumex crispus* L.	Ch	Mes	-	-	+	-	-	+	-	-	-	+	+
390. *Rumex hastatus* D. Don.	Ch	Mes	-	+		-	-	+	-	-	-	+	+
391. *Rumex dentatus* L.	Hem	mes	-	-	+	-	-	+	-	-	-	+	+
392. *Rumex nepalensis* Spreng.	Hem	Mes	-	-	+	-	-	+	-	-	+	-	+
393. *Rumex pulcher* L.	Ch	Mic	-	-	+	-	-	+	-	-	+	-	-
394. *Podophyllum emodi* Wall. ex. Royle	Th	Lep	-	-		+	-	-	+	-	-	+	-
395. *Portulaca oleraceae* L.	Th	Nan	-	-	+	-	-	+	-	-	+	+	-
396. *Primulla officinalis* (L.) Hill	Th	Mes	-	-	-	+	-	-	+	-	-	+	-
397. *Primula macrophylla* D.Don.	Hem	Mes	-	-	+	-	-	-	+	-	-	+	-
398. *Punica granatum* L.	Np	Mes	-	-	-	+	-	-	+	-	+	+	+
399. *Aquilegia vulgaris* L.	Hem	Mic	-	-	-	+	-	-	+	-	-	+	+
400. *Anemone polyanthes* D. Don.	Hem	Mic	-	-	-	-	+	-	+	-	-	+	+
401. *Aconitum heterophyllum* Wall ex. Royle	Hem	Mes	-	-	-	+	-	+	-	-	-	+	-
402. *Aconitum napellus* L.	Hem	Mes	-	-	-	+	-	+	-	-	-	+	+
403. *Aconitum rotundifolium* Kar & Kar.	Hem	Mes	-	-	-	+	-	+	-	-	-	+	+
404. *Clematis graveolens* Lindl.	Ch	Nan	-	-	-	+	-	+	-	-	+	-	+
405. *Clematis grata* Wall.	Ch	Nan	-	-	-	+	-	+	-	-	+	-	+
406. *Clematis orientalis* L.	Ch	Nan	-	-	-	-	+	+	-	-	+	-	+
407. *Delphenium nordhagenii* Wendelbo.	Ch	Mes	-	-	-	+	-	+	-	-	+	+	-
408. *Ranunculus arvensis* L.	Th	Nan	-	-	+	-	-	+	-	-	+		+
409. *Ranunculus muricatus* L.	Th	Nan	-	-	+	-	-	+	-	-	+	+	+
410. *Ranunculus natans* C.A. Mey.	Th	Nan	-	-	+	-	-	+	-	-	+		+
411. *Thalictrum alpinum* L.	Th	Nan	-	-	-	+	-	-	+	-	+	+	-
412. *Reseda odorata* L.	Th	Lep	-	-	-	-	+	-	+	-	-	+	-
413. *Cotoneaster microphylla* Wall. ex. Lind.	Np	Lep	-	-	-	+	-	-	+	-	-	+	+
414. *Cotoneaster nummularia* Fish. & Mey.	Np	Nan	-	-	-	-	+	-	+	-	-	+	-
415. *Cotoneaster affinis* var. *bacillaris* (Lindl.) Schneider	Np	Lep	-	-	-	+	-	-	+	-	-	+	+
416. *Crataegus songarica* C. Koch.	Mp	Mes	-	-	+	-	-	-	+	-	+	+	+
417. *Crataegus oxicantha* L.	Mp	Mes	-	-	-	+	-	-	+	-	+	-	+
418. *Crataegus wattiana* Hemsl. & Lace, J. L.	Mp	Mic	-	-	-	+	-	-	+	-	+	-	+

419. *Eriobotriya japonica* Lindle.	Mp	Mes	+	-	-	-	-	-	-	-	-	-	-
420. *Fragaria vesica* L.	Np	Mes	-	-	+	-	-	+	-	-	+	+	+
421. *Malus domestica* L.	Mp	Mac	-	+	-	-	-	-	+	-	+	+	+
422. *Potentilla bifurca* L.	Ch	Mes	-	-	-	+	-	-	+	-	+	+	
423. *Potentilla gelida* C. A. Mey.	Ch	Mes	-	-	-	+	-	-	+	-	-	+	+
424. *Potentilla multifida* L.	Hem	Mes	-	-	+	-	-	-	+	-	-	+	+
425. *Potentilla pamirica* Th. Wolf.	Th	nan	-	-	+	-	-	-	+	-	-	+	+
426. *Prunus amygdalus* Batsch.	Mp	Mes	-	-	-	-	+	-	+	-	+	+	-
427. *Prunus armeniaca* Marsh.	Mp	Mes	-	+	-	-	-	-	+	-	+	-	+
428. *Prunus avium* L.	Mp	Mes	-	-	+	-	-	-	+	-	+	+	-
429. *Prunus domestica* L.	Mp	Mes	-	-	-	-	+	-	+	-	+	+	+
430. *Prunus dulcis* (Mill.) D.A. Webb.	Mp	Mes	-	+	-	-	-	-	+	-	+	+	+
431. *Prunus griffithii* (Boiss.) C. K. Schneid.	Mp	Mes	-	-	+	-	-	-	+	-	+	-	-
432. *Prunus jacquemontii* Hook. f.	Mp	Mes	-	-	-	+	-	-	+	-	+	-	-
433. *Prunus persica* L.	Mp	Mes	+	-	-	-	-	-	-	-	-	-	-
434. *Pyrus communis* L.	Mp	Mes	-	+	-	-	-	-	+	-	+	+	+
435. *Rosa webbiana* Wall. ex. Royle.	Np	Nan	-	-	-	-	+	-	+	-	+	-	+
436. *Rubus fruticousus* L.	Np	Mes	-	-	-	+	-	-	+	-	+	+	+
437. *Rubus anatolicus* Fodce.	Np	Mes	-	-	-	+	-	-	+	-	+	+	+
438. *Sorbaria sorbifolia* (L.) A. Braun.	Np	Mes	-	+	-		-	+	-	-	+	+	+
439. *Galium aparine* L.	Hem	Mic	-	-	-	+	-	+	-	-	+	+	+
440. *Galium boreale* L.	Hem	Mic	-	-	-	+	-	+	-	-	+	+	-
441. *Galium tricornutum* Dandy.	Hem	Lep	-	-	-	+	-	-	+	-	+	+	-
442. *Poplus alba* L.	Mp	Mes	-	-	+	-	-	-	+	-	+	+	+
443. *Poplus nigra* L.	Mp	Mes	-	-	+	-	-	-	+	-	+	+	+
444. *Salix acmophylla* Boiss.	Mp	Mic	-	-	+	-	-	-	+	-	+	+	+
445. *Salix babylonica* L.	Mp	Mic	-	-	+	-	-	-	+	-	+	+	+
446. *Salix discolor* Muhl.	Mp	Mic	-	-	+	-	-	-	+	-	+	+	+
447. *Salix iliensis* Regel.	Np	Mic	-	-	+	-	-	-	+	-	+	+	+
448. *Salix tetrasperma* Roxb.	Mp	Mes	-	-	+	-	-	-	+	-	+	+	+
449. *Salix viminalis* L.	Mp	Mes	-	-	+	-	-	-	+	-	+	+	+
450. *Saxifraga* spps	Geo	Mic	-	-	-	+	-	-	+	-	+	+	+
451. *Saxifraga flagellaris* Willd. ex. Sternb	Geo	Mic	-	-	-	-	+	-	+	-	-	+	-
452. *Bergenia stracheyi* L.	Geo	Mic	-	-	-	+	-	-	+	-	-	+	+
453. *Bergenia himalacia* Boriss.	Geo	Mic	-	-	-	+	-	-	+	-	-	+	-
454. *Leptorhabdos parviflora* (Bth.) Bth.	Th	Lep	-	-	-	-	+	-	+	-	-	+	-
455. *Linaria vulgaris* Miller.	Th	Lep	-	-	-	-	+	-	+	-	-	+	+
456. *Pedicularis albida* Penn.	Hem	Mes	-	-	-	-	+	-	+	-	-	+	+
457. *Pedicularis brevifolia* D. Don	Hem	Mes	-	-	-	+	-	-	+	-	-	+	-
458. *Verbascum erianthum* Benth.	Th	Mic	-	-	-	-	+	-	+	-	-	+	-
459. *Verbascum Thapsus* L.	Geo	Mac	-	-	-	-	+	-	+	-	-	+	-

460. *Veronica serpyllifolia* L.	Th	Mic	-	-	-	+	-	-	+	-	+	-	-
461. *Ailanthus altissima* (P. Mill.) Swingle.	Np	Mic	-	-	-	+	-	-	+	-	+	-	-
462. *Datura Innoxia* Mill.	Th	Mac	+	-	-	-	-	-	-	-	-	-	-
463. *Datura stramonium* L.	Th	Mac	+	-	-	-	-	-	-	-	-	-	-
464. *Hyoscymus niger* L.	Th	Lep	-	-	-	-	+	-	+	-	-	+	-
465. *Hyoscymus pusillus* L.	Th	Nan	-	-	-	-	+	-	+	-	-	+	+
466. *Lycopersicum esculentum* L.	Th	Mic	-	-	+	-	-	+	-	-	+	-	+
467. *Solanum melongena* L.	Th	Mac	-	-	-	+	-	-	+	-	+	-	+
468. *Solanum nigrum* L.	Th	Mes	-	-	-	-	+	+	-	-	+	+	
469. *Solanum tuburosum* L.	Geo	Mes	-	-	-	+	-	+	-	-	+	+	+
470. *Myricaria germanica* (L.) Desv.	Mp	Mic	-	-	-	+	-	-	+	-	+	+	-
471. *Tamaricaria elegans* (Royle) Qaiser & Ali	Np	Lep	-	-	-	+	-	-	+	-	-	+	-
472. *Tamarix dioica* Rox. ex. Roth.	Np	Lep	-	-	-	-	+	-	+	-	-	+	-
473. *Daphne oleoides* Schrend.	Np	Lep	+	-	-	-	-	-	-	-	-	-	-
474. *Daphne alpina* L.	Np	Lep	+	-	-	-	-	-	-	-	-	-	-
475. *Thymelaea passerina* (L.) Cosson & Germain.	Th	Nan	-	-	-	-	+	-	+	-	-	+	-
476. *Celtis australis*	Mp	Lep	-	-	+	-	-	-	+	-	+	+	+
477. *Urtica diocia* L.	Th	Lep	+	-	-	-	-	-	-	-	-	-	-
478. *Parietaria jadaica* L.	Th	Mic	-	-	-	+	-	-	+	-	+	+	-
479. *Pilea umbrosa* Blume.	Th	Nan	-	-	-	+	-	-	+	-	-	+	-
480. *Viola odorata* L.	Hem	Mic	-	+	-	-	-	+	-	-	+	+	+
481. *Vitis venifera* L.	Np	Mac	-	+	-	-	-	-	+	-	+	+	+
482. *Tribulus terristris* L.	Th	Lep	+	-	-	-	-	-	-	-	-	-	-

Key to Abbreviations:

Palatability classes: NP- Non-palatable, RP- Rarely palatable, LP- Less palatable, MP- Mostly palatable, HP- Highly palatable.

Parts used: WP- Whole plant, L- Leaves, ST- Stem

Livestock: C-Cow, G-Goat, S-Sheep

Life form classes: G-Geo,Th-Therophytes, Mp-Megaphenerophytes, Np-Nanophanerophytes, Ch-Chemophytes, Hm-Hemicryptophytes.

Leaf size classes: Nan-Nanophylls, Lep-Leptophylls, Aph-Aphyllous, Mes- Mesophylls, Mic-Microphylls, Mac-Macrophylls.

Table 3. Palatability status of plants

Palatability of plants	**Total plants**	**Plants parts used**	**Total plants**	**Cattle**	**Total plants consumed**	**Life form classes**	**Total**	**Leaf size classes**	**Total**
Non-palatable	47	Whole plants	193	Cows	229	Geo	53	Nan	178
						Th	190	Lep	106
Highly palatable	91	Leaves	232	Goats	390	Mp	45	Aph	04
Mostly palatable	115	Stem	02	Sheep	220	Np	27	Mes	117
Rarely palatable	140					Ch	40	Mic	52
Less palatable	89					Hem	127	Mac	25

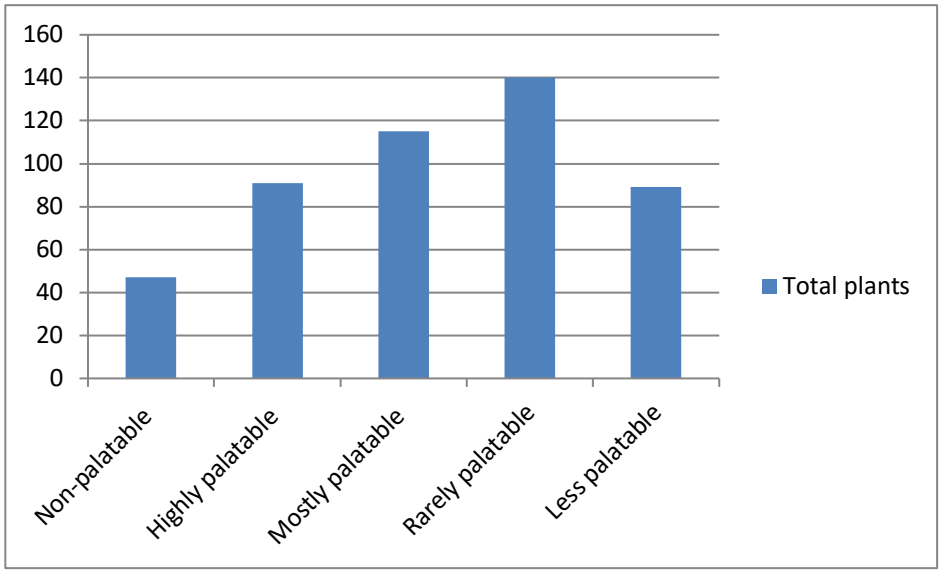

Figure 2. Total number of plants with palatability status

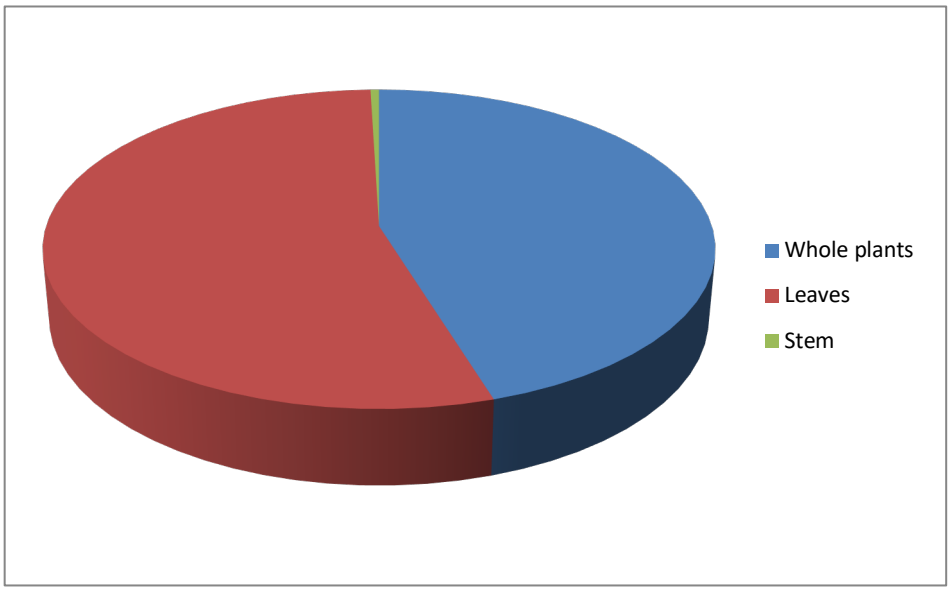

Figure 3. Plants parts used by Livestock

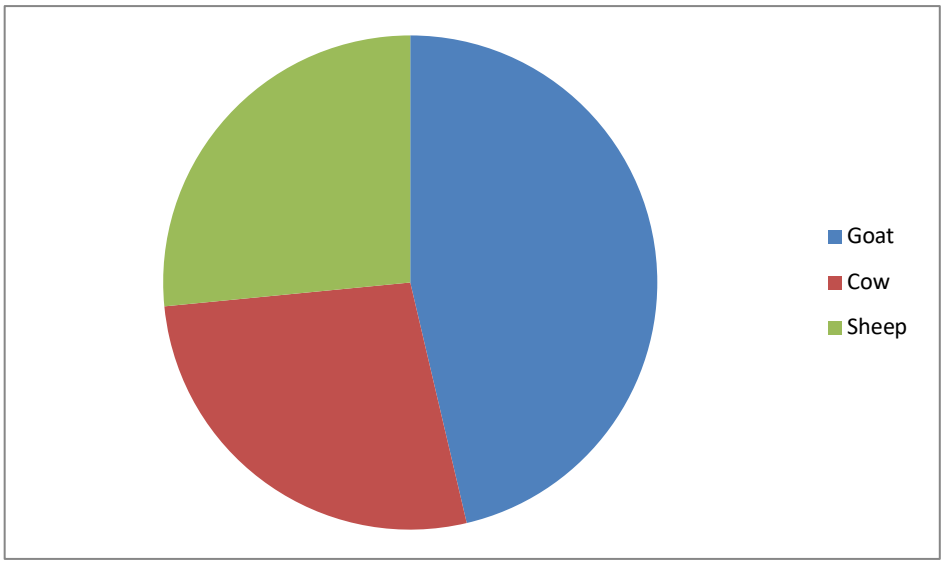

Figure 4. Total number of plants used by Livestock

Discussion

Palatability status of plants showed that out of 482 plants 47 plants were non-palatable and remaining 435 plants were palatable. Rarely palatable topped the list with 140 plant species followed by mostly palatable with 115, highly palatable with 91 species and less palatable having 89 plants. Among plant parts used leaves showed dominancy with 232 plants followed by whole plants with 193 plants and stems with only two plant species. Among livestock goats consumed 390 plants followed by cows having 229 plants and sheep having 220 plants species. Life form classes depicted the dominancy of Therophytes having 190 species followed by Hemicryptophytes with 127 species. Leaf size classes showed that Nanophylls topped the list with 178 species followed by Mesophylls with 117 species. In grazing lands, animal first choice may be documented by direct observation of what is being eaten or by a calculation of the progressive consumption of plants themselves (Palkova & Leps 2008). Different factors influenced the palatability of plants in different localities of the world. These factors include morphology, phenology, minerals and secondary metabolites in plants (Ibrar 2003; Hussain & Durrani 2009). Palatability is also influenced by phase of pregnancy, period, general health and preference for forage species and appetites of animals (Khan *et al.* 2012). Cattle of Koh area mostly prefer plants during flowering stage and the nomadic people revealed that the milk production and health of their livestock greatly enhanced during spring and summer seasons. Phenological aspects of the plants may affect the palatability of plants by animals due to accumulation and concentration of certain minerals elements (Miller &Thompson 2005: Gunasekran *et al.* 2014). Our results are matching with the work (Hussain *et al.* 2023) as herbivores preferred smaller leaves with a smaller specific leaf area and a higher dry matter content in the leaf. Phenological changes associated with climate change are related to the seasonal availability and palatability of food plants. The presence of minerals like Ca, Mg, K, Fe, Mn, Mg and Ca in different palatable plants in Koh valley contributed the reason for their being palatable. Secondary metabolites like alkaloids, glycosides, nitrates and others such as lectins, tannins and oxalate have harmful effects on the taste of plants. The non-palatable plants contain chemical compounds such as alkaloids, phenolics and tannins that are toxic, bitter in taste or simply unpleasant to herbivores (Molyneux & Ralphs 1992: Divekar *et al.* 2022). Plants harboring these secondary compounds can lower animal preferences for palatability resulting in poor performance, significant morbidity and mortality (Tadele 2015). Literature review showed that the elemental concentration increases or decreases in different phenological stages of plant species (Milewski &Madden 2006). Some livestock prefer to eat a plant in its fresh form while others in dry form due to presence of different natural products and certain morphological adaptation (Ibrahim *et al.* 2015: Hussain *et al.* 2016). The presence of bioactive compounds in the plants is also associated with their therapeutic significance which is used for the treatment of human and livestock ailments (Haq *et al.* 2022; Hussain *et al.* 2023; Singh *et al.* 2023). Geographical distribution, climatic conditions and local geography have a key role on the availability of palatable plant species (Godde *et al.* 2021). The dominance of palatable plant species was herbaceous, and the animals preferred them for their different degree of palatability while the non-palatable plants had unpleasant taste and odor due to the presence of poisonous chemicals (Khan & Hussain 2012). During the grazing seasons, the goats, sheep and cows freely grazed and browsed the valley and usually reject the less palatable plants but prefer them under specific circumstances. When the palatable species were overgrazed and become scarce the cattle consumes some of the non-palatable species too (Gorade & Datar 2014). The non-palatable nature of plant species is due to their textural morphology, chemical composition and unpleasant aroma (Badshah & Hussain 2011; Abdullah *et al.* 2017). Some of the non-palatable species are collected, stored and after drying the aroma and chemical compositions changed and utilized by livestock in winter season.

Previous works of other researchers such as (Angasa & Baars 2001; Hussain & Durrani 2009; Badshah 2011) were in line with our findings and listed that goat and sheep favored small size plants. According to (Pfister & Malaecheck 1986; Hussain & Mustafa 2007) most livestock favors flowers and fruits during grazing. The nutritional value of the plant fragments ingested is typically correlated with their nature. The current investigation supports Heady's (1964) findings that young leaves and stems are preferred by animals over fruits. The morpho-anatomical aspects of plants influenced grazing and browsing (Hardison *et al*. 1954) and mostly stoloniferous are grazed by animals that creep above soil surface (Diaz *et al*. 2006). Grazing pressures on palatable species in a given locality results to the abundance of non-palatable species (Gorade & Datar 2014). According to studies by (Amjad *et al*. 2014; Abdullah *et al*. 2017) non-palatability of any plant species' can also be attributed to its physical appearance, chemical composition and offensive odor. Our findings supported their hypothesis that the chemical composition and morphological characteristics of plants influence their palatability. The nutritional value of feed for cattle is ultimately influenced by agronomic methods, genetic differences, feed processing technologies and climate variables. The most efficient method of utilizing rangeland and pastureland grasses is grazing. Overgrazing results in decline of the vegetation cover of herbaceous plants. According to Karki *et al*. (2000) heavy grazing limits the ability of ecosystem efficiency and structure. Our results were in the line with the research of Malik (2005), who examined how heavy browsing and grazing cause non-palatable species to be substituted by palatable ones. Proximate and elemental analyses have very vital role in assessing nutritional importance to livestock (Hussain *et al.* 2011). The availability of crude protein in plants

shows significance in plant selection for nutritive values, systematic nomenclature and plant enhancement programs (Nisar *et al.* 2009). Occurrence of many diseases and reduction of milk production are directly linked to micro and macro-elemental deficiency (Khan *et al.* 2013). Over-grazing in rangelands clearly explains the nutritional importance and pressure on forage plants (Hussain & Durrani 2008). The remote areas of Khyber Pakhtunkhwa have reported badly overgrazed and mostly palatable species of grass and forbs have disappeared and replaced by low quality plant species with rare preferences (Aberoumand 2009). Similarly medicinal plants of different localities were influenced by human and their cattle (Jan *et al.* 2021; Jan *et al.* 2023; Mir *et al*. 2018; Jan *et al.* 2020). The local communities of the research area were mainly utilizing various plant materials for their livestock. Therefore, it is need of the hour to focus and documents the palatability and elemental status of plants resources of the Koh valley in order to determine the extent of overgrazing before it is too dawn. Understanding the nutritional value and palatability status of plants is aided by their approximate compositions and elemental contents (Akinleye *et al*. 1996). According to Gafar *et al*. (2011) plants are rich in vitamins, nutrients, fatty acids, minerals and fiber. The quantity and nutritional content of fodder plants are decreased by grazing pressure in any locality. Mineral components affect the species' palatability and reduce the productivity, growth and regeneration capacity of grazing and browsing animals. According to (Hussain & Durrani 2008), the mineral contents of fodder plants often increased or decreased in opposition to the many stages of phenological development that many plants were going through. Usually, less of the minerals are needed for the plant body's development. Animals' and plants' metabolic processes are impacted by excessive trace element intake (Sharma *et al*. 2011). It is likely that insufficient mineral content in some fodder plants contributes to low output of domesticated animals in some areas of Koh valley.

Conclusion

The current research work showed 140 rarely palatable, 115 mostly palatable, 91 highly palatable, 89 less palatable and 47 non-palatable species from Koh valley, district Chitral, Pakistan. Of the 482 plants, the cattle preferred 233 plants leaves and goats utilized 390 plants during grazing. Livestock were the integral source of income for the local community and the feed of their cattle directly associated with plants resources of the locality. The local people mostly harvest and store in dry form of the herbaceous plants for harsh winter season. Many factors such as animal types, seasonal activities, morphology, phenology, habitat, climatic conditions and chemical nature of the plants affect the palatability status of the plants. The occurrence of secondary metabolites and specific minerals concentration protected the plants from the biotic pressure of overgrazing and browsing. It is suggested that the plants should be confirmed based on nutritional and elemental values to improve the food requirements of domestic animals in the area.

Pictorial view of the research area and data collection

Declarations

Ethics approval and consent to participate: All participants provided oral informed consent.

Consent for publication: All participants shown in images provided oral prior informed consent.

Availability of data and materials: The first author can be consulted for any data.

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