DETERMINING THE FOOD HABITS OF INDIAN CRESTED PORCUPINE (*HYSTRIX INDICA)* IN THAL DESERT LANDS OF PUNJAB, PAKISTAN

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Abstract

Porcupine is an important vertebrate pest in majority of agro-ecosystems of Pakistan but little knowledge is available on the food habits of this pest in arid lands. To examine the food habits of the Indian crested porcupine (*Hystrix indica*), this study was conducted in Qaidabad Thal, Punjab, Pakistan. Analysis of the stomach contents of twenty animals and fecal pellets of sixty animals were carried out. Results revealed that the porcupine depended on plant material from both cultivated and non-cultivated lands. The porcupine diet varied seasonally and comprised of vegetative matter such as tubers, roots, leaves, stems and spikes of *Triticum aestivum, Hordeum vulgare, Sorghum vulgare* and *Zea mays and racemes of Arachis hypogea and, Vigna mungo,*. The pods of *Prosopis juliflora* also formed a significant part of their food. Relative frequency of occurrence of food items in the stomach and fecal pellet varied seasonally. The results exhibited that porcupine damaged the field crops as well as agroforestry trees.

Introduction

The Indian crested porcupine (*H. indica)* is a serious pest of crops and forest plantations (Taber *et al*, 1967; Ahmad and Chaudhry, 1977; Greaves and Khan, 1978; Alkon and Saltz, 1985; Roberts, 1997; Khan *et al*., 2000, 2007; Hussain, 2004; Pervez, 2006; Khan, 2010) and cause economic damage to maize, groundnut and potato (Ahmad *et al*., 1987; Brooks *et al*., 1988; Khan *et al*., 1997, 2000), okra, pumpkin, carrot, bitter gourd and onion (Pervez, 2006), and grasses like *Cenchrus ciliaris, Sorghum halepense, Cymbopogon jwarancosa* and *Elionurus hirsutus* (Khan *et al*., 2000).

Gutterman and Herr (1982) recorded more than 17 geophytes and hemicryptophytes in the menu of porcupine. In Balochistan, they regularly excavate the bulbs of *Eremurs aurantiacus,* whereas in the southwestern Punjab, they prefer the bark of Bakain (*Melia azedarach*). They also feed on mulberry (*Morus alba*) and mango (*Mangifera indica*) plants. Trees with thick and rough bark are mostly shunned (Roberts, 1997; Khan *et al*., 2000). Khan *et al*. (2000) reported 30-70% damage to Gladiolus and Dutch Irish plantation in a floriculture farm, Islamabad. Although Bibi *et al*. (2004) and Inayatulla (2006) studied food and feeding habits of Indian crested porcupine in central Punjab and Khyber Pakhtunkhwa, no study of its food and feeding habits in arid lands has been conducted before. This study was designed to provide a complete picture of the diet of this pest from Quaidabad located in the rainfed belt of Thal, Punjab, Pakistan.

Materials and Methods

Study Area: Qaidabad is a part of Thal desert that comprises of Bhakkar, Khushab, Mianwali, Jhang, Layyah, and Muzaffargarh districts. The study area is located between the Jhelum and the Indus rivers near the Pothohar Plateau. Its part in Jhang is on the left flank of the Jhelum river. It extends 304 km north to south while its maximum breadth is 112 near and minimum 32 km. The climate and geology resembles Cholistan and Thar. Wheat, sorghum, barley, legumes, melons, tobacco and groundnut are the main crops cultivated in the study area.

The Indian crested porcupine is listed as pest under Schedule IV of Pakistan Wildlife Acts and there are no restrictions on its hunting or killing by any means. (Roberts, 1997). *H. indica* is a large rodent having scattered populations and hence a limited degree of trapping is possible for obtaining the stomach contents. The fecal pellets however, can be collected from the field and be subjected to study The porcupines were live trapped following Hafeez *et al*. (2007). The study was conducted during January 2008 to June 2010. The entire period was divided into four seasons i.e. spring (February - April); summer (May-August); fall (September - October) and winter (November - January). Stomach contents (n = 5) and fecal pellets (n = 15) samples were studied during each season making total animal sample of 20 for stomach contents and 60 for fecal pellets. The porcupines are cautious, human shy and nocturnal thus hindering direct studies on their feeding behavior.

A total of 45 plant species including xeric ones were recorded from the study area. Vegetative parts of plants were dried and soaked in solution (distilled water, ethyl alcohol and glycerin (1:1:1 v/v) overnight and washed with tap water for preparing reference slides. After grinding in distilled water the contents were poured in micro sieve, 6 cm long hallow cylindrical having 0.05 mm pores and rubber stopper at one end. Then specimens were soaked in sodium hypochloride solution of 5% Clorox and 4 parts of distilled water for 20-30 minutes. Diluted acetic acid was added to neutralize its basic effects and placed in mordant solution for 15-30 minutes. The contents were placed in hematoxylin stain for 10-15 min. A drop of mounting medium (100 mL distilled water and 100 g Arabic gum) was added and spread on a slide (22 × 40 mm). After overnight fastening, the slides were examined under the microscope.

Stomach contents obtained from porcupines were placed in 10% formalin and were put on a white paper having equal sized squares in a Petri dish where fragments of stomach contents were placed and examined microscopically (Ward, 1970).

The fecal pellets after washing over a mesh were put in 70% alcohol for 10 minutes and stained with light green dye. Seven slides were prepared from each fecal pellet to examine under microscope (60X). Plant parts of each species placed in each box were calculated and the total number of the fragments recorded according to the method of Hansen *et al.* (1971).

The overall percent relative frequency was calculated as:

$$Relative\ frequency\ (\%) = \frac{Total\ number\ of\ fragments\ of\ a\ species}{Total\ number\ of\ fragments\ analysed} \times 100$$

The relative frequency of different food items recorded from the stomach content was compared with different seasons to work out the feeding preference of the species. The similar procedure was adopted for fecal pellet analysis.

Results and Discussion

Seasonal variations in the food habits of the Indian crested porcupines at Quaidabad are described below:

Spring: Analysis of the stomach contents of porcupines trapped during spring showed that 18 plant species were consumed. *Tritium aestivum* (23.69 ± 2.17) was the most intensively consumed species. *Bombax ceiba* (11.75 ± 1.91), *Brassica campestris* (11.49±0.09) and *Prosopis juliflora* (10.33 ± 0.20) were recovered with high frequency. *Sorghum halepense* (9.81 ± 1.83), *Solanum melongena* (7.72 ± 1.63), *Morus alba* (6.50 ± 0.90), *Eucalyptus camaldulensis* (5.85 ± 0.77), *Melilotus indica* (5.64 ± 0.30), *Vigna* mungo (5.45 ± 0.92), *Lathyrus aphaca* (5.23 ± 1.44), *Psidium guajava* (4.95 ± 0.00), *Brassica oleracea* (4.95 ± 0.00), *Cynodon dactylon* (4.76 ± 0.22), *Dalbergia sissoo* (4.15 ± 1.18), *Melia azedarach* (3.98 ± 0.02), *Ziziphus jujuba* (3.96 ± 0.00) and *Allium cepa* (1.98 ± 0.00) were consumed in significant proportions. Other matters (2.90 ± 0.35) were found to be less frequent while unidentified (3.17 ± 0.36) and unknown plant parts (9.78 ± 0.65) were found in significant amounts.

Leaves (27.5%) were consumed with higher percentage (Figure 1) followed by spike (21.3%), stem (19.5%) and seed (13.7%). Root (8.1%), flower (5.4%) and pod (4.1%) were also consumed in a significant proportion. It confirmed the findings of Hafeez *et al.* (2011).

The analysis of the fecal pellets collected during the spring (Table-2) suggested that *T. aestivum* (20.45 ± 1.20) was consumed with high frequency. *S. halepense* (13.65 ± 0.84), *V. mungo* (12.19 ± 0.71) and *P. juliflora* (10.80 ± 1.32) appeared in sufficient proportion. *M. sativa* (8.79 ± 2.17), *E. camaldulensis* (8.73 ± 0.85), *M. azedarach* (8.45 ± 1.34), *C. dactylon*(7.92 ± 0.67), *Arachis hypogea* (7.85 ± 1.13), *M. alba* (7.52 ± 1.66), *A. procera* (6.94 ± 0.62), *B. ceiba* (6.17 ± 1.52), *C. rotundus* (5.72 ± 0.08), *Z. jujuba* (5.37 ± 0.92), *L. aphaca* (5.24 ± 0.39), *P. guajava* (5.20 ± 0.36), *D. sissoo* (4.43 ± 0.40), *S. officinarum* (4.29 ± 0.06), *C. jwarancosa* (3.70 ± 0.00) and *S. munja* (3.24 ± 0.63) were recovered with different frequency. Other matters (2.82 ± 0.00) were found to be less frequent while unidentified (7.08 ± 0.58) and unknown plant parts (11.64 ± 0.47) were found in sufficient amount.

Figure 2 shows the consumption of the percentage of different parts of the plant species. Spike (25.4%), stem (19.3%), leaf (14.1%) and seed (12.4%) appeared with higher frequency while tuber (7.6%) and root (6.8%) were consumed with low frequency.

Summer: Table 1 present the summary of the relative frequency of food items recovered from stomachs of porcupines collected during the summer. During this season 17 different plant species were recorded. Among these *Z. mays* (20.36 ± 2.19) was predominant as it constituted the largest percentage of the total stomach contents. *S. vulgaris* (14.50 ± 2.71) and *P. juliflora* (12.92 ± 1.48) appeared less common. Among less intensively consumed plants were: *B .ceiba* (7.23 ± 0.00), *C. dactylon* (6.98 ± 1.23), *M. azedarach* (6.93 ± 0.00),

L. aphaca (6.92 ± 1.04), *C. maxima* (6.76 ± 3.14), *L. esculentum spp.* (5.52 ± 0.78), *Cucumis melo* (5.49 ± 0.54), *E. camaldulensis* (4.75 ± 0.47), *S .halepense* (3.41 ± 0.00), *M. indica* (3.38 ± 0.14), *V. mungo* (3.29 ± 0.32), *Mangifera indica* (3.19 ± 0.22), *D. sissoo* (3.19 ± 0.22), *C. rotundus* (3.19 ± 0.78) and *A. cepa* (1.98 ± 0.00). Other matters (2.54 ± 0.31) which constituted a very small portion of the total contents, while unidentified (5.96 ± 1.24) and unknown plant parts (8.30 ± 0.93) were less intensively consumed.

The analysis of plant parts during the summer season showed (Figure 1) that leaf (21.7%) appeared with higher frequency followed by seed (20.2%), stem (17.3%), spike (16.1%) and root (15.9%) while tuber (5.5%) and pod (3.0%) were consumed at low frequency.

The study on the fecal pellet analysis of the summer samples (Table 2) suggested that 16 types of food items of plant origin were consumed by porcupines: *S. vulgaris* (23.34 ± 1.39) was the most intensively consumed specie. *Z. mays* (16.98 ± 1.58), *P. juliflora* (13.40 ± 0.98), *M. alba* (11.63 ± 1.69), *M. azedarach* (11.37 ± 1.68), *C. dactylon* (10.90 ± 1.55) and *B. ceiba* (10.47 ± 1.89) were recovered in high frequency. *E. camaldulensis* (9.25 ± 0.72), *C. dactylon* (9.03 ± 0.98), *A. hypogea* (8.26 ± 1.41), *S. halepense* (5.33 ± 0.49), *V. mungo* (4.99 ± 0.48), *S. munja* (4.30 ± 0.79), *S. nigrum* (2.78 ± 0.00), *C. jwarancosa* (2.25 ± 0.00), *C. rotundus* (2.17 ± 0.58) and *Z. jujuba* (1.73 ± 0.18) were consumed in significant proportions. Other contents (2.73 ± 0.77) were present in much less frequency while unidentified (10.61 ± 0.88) and unknown plant parts (11.20 ± 0.65) were also found.

In fecal pellet, spikes (23.4%) were recovered in high proportion followed by, stem (22.3%), (17.7%) and leaf (15.8%), tuber (8.7%) and pod (3.0%).

Fall: In the fall season the stomach content analysis showed that 15 types of food items of plant origin were consumed by porcupines. *S. vulgaris* (16.76 ± 3.21) was the most intensively consumed species in this season. *Z. mays* (13.78 ± 0.83), *P. juliflora* (11.93 ± 0.00) and *A. hypogea* (11.00 ± 0.97) appeared in high frequency. *M. azedarach* (9.85 ± 0.68), *D. sissoo* (8.30 ± 0.53), *S. halepense* (8.26 ± 0.00), *B. ceiba* (7.84 ± 1.30), *C. dactylon* (7.25 ± 0.60), *C. rotundus* (5.18 ± 0.88), *S. officinarum* (3.94 ± 0.25), *E. camaldulensis* (3.39 ± 0.57), *M. indica* (3.23 ± 0.93), *C. melo* (3.22 ± 1.38) and *V. mungo* (2.61 ± 0.16) contributed a significant proportion. Other matters (2.25 ± 0.20) were present in much less frequency while unidentified (3.50 ± 0.77) and unknown plant parts (7.38 ± 0.78) were found frequently.

In the stomach contents, leaves (24.2%) were recovered in significantly high proportion followed by seed (20.5%), stem (19.3%), spike (15.1%), tuber (7.1%), flower (2.5%) and pod (2.0%).

The analysis of the fecal pellets (Table 2) revealed that *S. vulgaris* (23.35 ± 1.87) was consumed at the highest frequency. *M. alba* (12.32 ± 0.67), *P. juliflora* (12.20 ± 1.30) and *M. azedarach* (12.19 ± 0.99) were consumed in significant high proportions. *B. ceiba* (11.27 ± 0.00), *C. dactylon* (10.90 ± 1.55), *A. hypogea* (10.18 ± 0.93), *E. camaldulensis* (8.98 ± 0.90), *Z. mays* (8.60 ± 2.02), *V. mungo* (5.76 ± 1.24), *S. halepense* (5.54 ± 0.64), *Z. jujuba* (4.77 ± 0.96), *C. rotundus* (4.44 ± 1.36), *A. procera* (4.44 ± 0.00), *M. sativa* (4.28 ± 0.89), *C. melo* (3.95 ± 0.50), *D. sissoo* (3.70 ± 0.78), *Lathyrus aphaca* (3.23 ± 0.00), *C. jwarancosa* (3.20 ± 0.85), *S. nigrum* (2.93 ± 0.30) and *S. munja* (2.70 ± 0.00) appeared with decreasing frequency. Other matters (2.69 ± 0.32) were found to be less frequent while unidentified (9.09 ± 0.89) and unknown plant parts (11.61 ± 0.61) were found in significant amount.

In fecal pellets stem parts (25.4%) were recovered significantly in high proportion followed by spike (19.7%), pod (16.0%), leaf (12.3%), seed (11.8%) and tuber (6.6%).

Winter: The analysis of the stomach contents of porcupines trapped during winter showed that 18 plant species were consumed (Table 1): *S. halepense* (17.19 ± 0.00) was the most intensively consumed species in this season. *H. vulgare* (14.64 ± 2.71), *T. aestivum* (14.28 ± 2.21), *B. compestris* (13.64 ± 0.00) and *B. ceiba* (10.77 ± 0.30) were also recorded sufficiently. *M. azedarach* (9.03 ± 2.59), *B. oleracea* (8.74 ± 0.63), *A. hypogea* (7.87 ± 1.31), *P. juliflora* (7.81 ± 0.00), *M. alba* (7.47 ± 0.93), *C. dactylon* (6.91 ± 0.61), *Z. jujuba* (6.90 ± 1.44), *S. vulgaris* (5.54 ± 0.14), *S. officinarum* (4.79 ± 1.97), *E. camaldulensis* (3.41 ± 0.00), *C. rotundus* (3.22 ± 1.84), *M. indica* (2.82 ± 0.00) and *D. sissoo* (2.82 ± 0.00) were less frequently obtained. Other contents (1.57 ± 0.16) were present with less frequency while unidentified (3.91 ± 1.19) and unknown plant parts (8.61 ± 0.91) were found in significant frequency.

In fecal pellets, *T. aestivum* (21.27 ± 2.17) was consumed in significant high proportion (Table 2). *S. nigrum* (13.79 ± 0.00), *A. hypogea* (13.58 ± 1.43), *P. juliflora* (13.45 ± 1.18) and *S. vulgaris* (10.85 ± 1.14) showed high frequency. *E. camaldulensis* (9.87 ± 0.67), *B. ceiba* (9.80 ± 1.24), *C. dactylon* (9.72 ± 0.96), *M. azedarach* (9.60 ± 1.40), *M. alba* (9.04 ± 1.96), *D. sissoo* (8.62 ± 1.21), *P. guajava* (7.94 ± 0.00), *S. officinarum* (6.35 ± 0.00), *S. halepense* (4.69 ± 0.00), *S. munja* (4.35 ± 0.46), *C. jwarancosa* (2.56 ± 0.00), *Z. jujuba* (2.27 ± 0.35) and *C. rotundus* (2.17 ± 0.54) appeared with less frequency. Other matters (2.69 ± 0.76), unidentified (8.29 ± 0.89) material appeared less frequently and unknown plant parts (12.21 ± 0.74) with high frequency.

In fecal pellets, stem (29.0%) were recovered in significantly high proportion followed by spike (17.9%), seed (15.2%), tuber (8.8%) and pod (3.0%) which contributed a significant part of total fecal contents. It

confirmed the finding of Hafeez *et al*. (2011), Roberts (1997), Brooks *et al*. (1988).The overall picture of the sample analysis showed the maximum consumption of stem in winter and maximum spike in spring season as part of fecal pellets and stomach contents. Pods were consumed round the year. This confirms the observation of Hafeez *et al*. (2011).

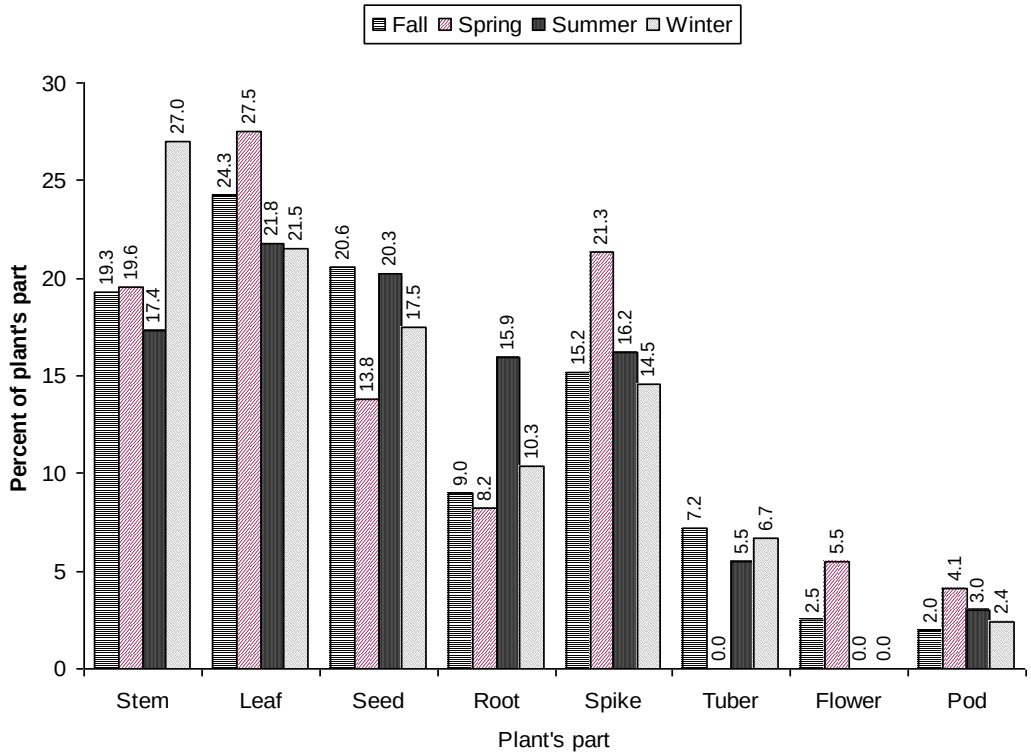

Fig. 1. Percentage of parts of plants recovered from the stomach contents of *Hystrix indica* captured from Qaidabad, Punjab, Pakistan

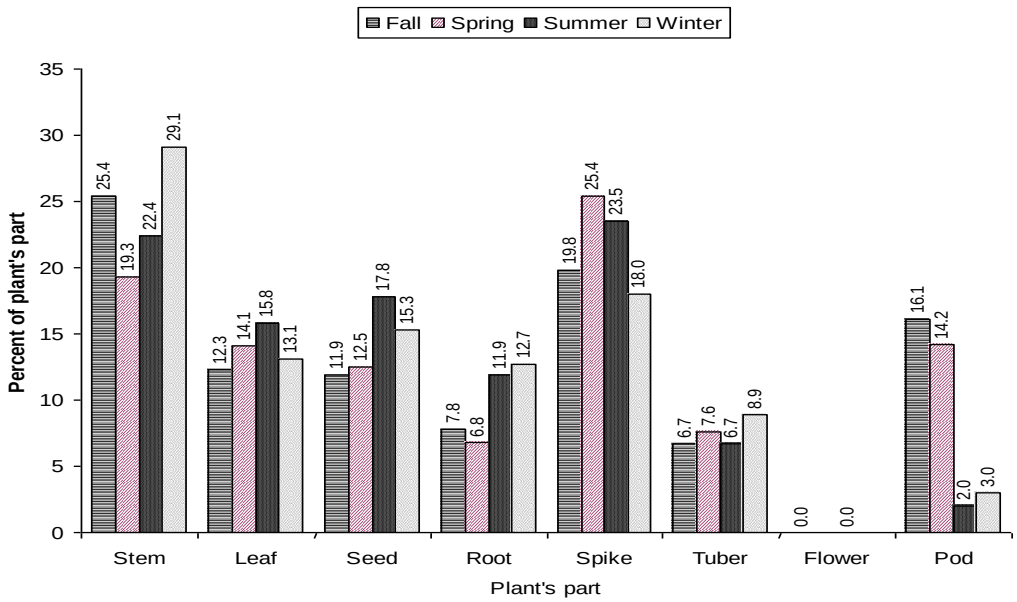

Fig. 2. Percentage of parts of plants recovered from the fecal pellets of *Hystrix indica* collected from Qaidabad, Punjab, Pakistan

S. officinarum, Z. mays, T. aestivum, B. compestris, V. mungo and *A. hypogea* are the cash crops of Pakistan. In spring season, porcupine severely damages *T. aestivum, V. mungo* and *B. campestris*. On the other hand *Z. mays* crop is severely affected by it in the summer season. In fall and winter, V. *mungo, Z. mays* and *T. aestivum* are

attacked by it. *A. hypogeal* is found in its stomach throughout the year and is severely damaged in winter season. Porcupine damaged the bark of trees to a great extent also in winter. Ahmad *et al*. (1987), suggested that the porcupine inflicted a heavy damage to maize and groundnut in irrigated plains and mountainous region of Pakistan.

A study conducted in maize fields in Faisalabad district (Pakistan) also suggested that porcupine damaged 6.37% of the crops (Hafeez, 2011). The presence of fruit and seed of different plants have been previously reported by Arshad (1987), which go partially support of this study. The stems are the third most significantly consumed part. The leaves and the stems have appeared in almost equal frequencies, which appear understandable due to the fact that under normal conditions both stem and leaves are usually picked together by the animal. *A. modest, M. alba* and *P. juliflora* have been previously reported to be consumed by the porcupine (Taber *et al*., 1967; Chaudhary and Ahmad, 1975; Khan *et al*., 1992.). The vegetable (*B. oleracea, A. cepa*), grasses (*C. rotundus, C. dactylon*) and cultivated crops (*H. vulgare, V. mungo, Z. mays, S. vulgare, T. aestivum* and *A. hypogeal*) also appeared in the contents. Roots of *Z. mays, A. cepa, B. compestris* and *C. rotundus* have been recovered from the stomach contents, analyzed under the present study, which was in line with previous reports of Arshad (1987) and Chaudhry (1970). Arshad *et al*., 1990 analyzed the gut contents which showed the presence of leaves, fruit, bark, roots of different crops, vegetable, grasses and trees. Inayatullah (2006) conducted a study in Tarbela watershed areas and reported that porcupine depends upon minimum of 29 cultivated and wild plant species, and the preferable species included *M. azedarach, P. roxburghii, Z. mays, S. halepense and T. aestivum.* Hafeez *et al,* (2011) studied the food habits of the *H. indica* and identified twenty seven different plants species from fecal pellets and stomach contents and they observed that *H. indica* is the serious pest of agricultural crops and trees of the area. The food habits data of this study indicated that *H. indica* is largely herbivorous in diet and serious pest of seasonal vegetables, fruits, trees, crops and grasses.

Table 1. Relative Frequency of different Food items Recovered from the Stomach Contents of *Hystrix indica* Captured from Quaidabad, Punjab, Pakistan.

Food items	Spring	Summer	Fall	Winter
Allium cepa	1.98 ± 0.00	1.98 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
Arachis hypogeal	0.00 ± 0.00	0.00 ± 0.00	11.00 ± 0.97	7.87 ± 1.31
Bombax ceiba	11.75 ± 1.91	7.23 ± 0.00	7.84 ± 1.30	10.77 ± 0.30
Brassica campestris	11.49 ± 0.09	0.00 ± 0.00	0.00 ± 0.00	13.64 ± 0.00
Brassica oleracea	4.95 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	8.74 ± 0.63
Cucumis melo	0.00 ± 0.00	5.49 ± 0.54	3.22 ± 1.38	0.00 ± 0.00
Cucurbita maxima	0.00 ± 0.00	6.76 ± 3.14	0.00 ± 0.00	0.00 ± 0.00
Cynodon dactylon	4.76 ± 0.22	6.98 ± 1.23	7.25 ± 0.60	6.91 ± 0.61
Cyperus rotundus	0.00 ± 0.00	3.19 ± 0.78	5.18 ± 0.88	3.22 ± 1.84
Dalbergia sissoo	4.15 ± 1.18	3.19 ± 0.22	8.30 ± 0.53	2.82 ± 0.00
Eucalyptus camaldulensis	5.85 ± 0.77	4.75 ± 0.47	3.39 ± 0.57	3.41 ± 0.00
Hordeum vulgare	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	14.64 ± 2.71
L. esculentum	0.00 ± 0.00	5.52 ± 0.78	0.00 ± 0.00	0.00 ± 0.00
Lathyrus aphaca	5.23 ± 1.44	6.92 ± 1.04	0.00 ± 0.00	0.00 ± 0.00
Mangifera indica	5.64 ± 0.30	3.19 ± 0.22	3.23 ± 0.93	2.82 ± 0.00
Melia azedarach	3.98 ± 0.02	6.93 ± 0.00	9.85 ± 0.68	9.03 ± 2.59
Melilotus indica	0.00 ± 0.00	3.38 ± 0.14	0.00 ± 0.00	0.00 ± 0.00
Morus alba	6.50 ± 0.90	0.00 ± 0.00	0.00 ± 0.00	7.47 ± 0.93
Prosopis juliflora	10.33 ± 0.20	12.92 ± 1.48	11.93 ± 0.00	7.81 ± 0.00
Psidium guajava	4.95 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
Saccharum officinale	0.00 ± 0.00	0.00 ± 0.00	3.94 ± 0.25	4.79 ± 1.97
Solanum melongena	7.72 ± 1.63	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
Sorghum halepense	9.81 ± 1.83	3.41 ± 0.00	8.26 ± 0.00	17.19 ± 0.00
Sorghum vulgaris	0.00 ± 0.00	14.50 ± 2.71	16.76 ± 3.21	5.54 ± 0.14
Triticum aestivum	23.69 ± 2.17	0.00 ± 0.00	0.00 ± 0.00	14.28 ± 2.21
Vigna mungo	5.45 ± 0.92	3.29 ± 0.32	2.61 ± 0.16	0.00 ± 0.00
Zea mays	0.00 ± 0.00	20.36 ± 2.19	13.78 ± 0.83	0.00 ± 0.00
Ziziphus jujuba	3.96 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	6.90 ± 1.44
*Other	2.90 ± 0.35	2.54 ± 0.31	2.25 ± 0.20	1.57 ± 0.16
**Unidentified	3.17 ± 0.36	5.96 ± 1.24	3.50 ± 0.77	3.91 ± 1.19
Unknown plant	9.78 ± 0.65	8.30 ± 0.93	7.38 ± 0.78	8.61 ± 0.91

*Other = Quill, Hair and Thread. ** Unidentified = Unidentified material. Values are Means ± S.D.

Table 2. Relative Frequency of different Food items Recovered from the Fecal pellets of *Hystrix indica* Captured from Quaidabad, Punjab, Pakistan

Food items	Spring	Summer	Fall	Winter
Albizia procera	6.94 ± 0.62	0.00 ± 0.00	4.44 ± 0.00	0.00 ± 0.00
Arachis hypogeal	7.85 ± 1.13	8.26 ± 1.41	10.18 ± 0.93	13.58 ± 1.43
Bombax ceiba	6.17 ± 1.52	10.47 ± 1.89	11.27 ± 0.00	9.80 ± 1.24
C. jwarancosa	3.70 ± 0.00	2.25 ± 0.00	3.20 ± 0.85	2.56 ± 0.00
Capsicum annuum	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
Cucumis melo	0.00 ± 0.00	0.00 ± 0.00	3.95 ± 0.50	0.00 ± 0.00
Cynodon dactylon	7.92 ± 0.67	9.03 ± 0.98	10.90 ± 1.55	9.72 ± 0.96
Cyperus rotundus	5.72 ± 0.08	2.17 ± 0.58	4.44 ± 1.36	2.17 ± 0.54
Dalbergia sissoo	4.43 ± 0.40	0.00 ± 0.00	3.70 ± 0.78	8.62 ± 1.21
E. camaldulensis	8.73 ± 0.85	9.25 ± 0.72	8.98 ± 0.90	9.87 ± 0.67
Lathyrus aphaca	5.24 ± 0.39	0.00 ± 0.00	3.23 ± 0.00	0.00 ± 0.00
Medicago sativa	8.79 ± 2.17	0.00 ± 0.00	4.28 ± 0.89	0.00 ± 0.00
Melia azedarach	8.45 ± 1.34	11.37 ± 1.68	12.19 ± 0.99	9.60 ± 1.40
Morus alba	7.52 ± 1.66	11.63 ± 1.69	12.32 ± 0.67	9.04 ± 1.96
Prosopis juliflora	10.80 ± 1.32	13.40 ± 0.98	12.20 ± 1.30	13.45 ± 1.18
Psidium guajava	5.20 ± 0.36	0.00 ± 0.00	0.00 ± 0.00	7.94 ± 0.00
Saccharum munja	3.24 ± 0.63	4.30 ± 0.79	2.70 ± 0.00	4.35 ± 0.46
Saccharum officinale	4.29 ± 0.06	0.00 ± 0.00	0.00 ± 0.00	6.35 ± 0.00
Solanum nigrum	0.00 ± 0.00	2.78 ± 0.00	2.93 ± 0.30	13.79 ± 0.00
Sorghum halepense	13.65 ± 0.84	5.33 ± 0.49	5.54 ± 0.64	4.69 ± 0.00
Sorghum vulgaris	0.00 ± 0.00	23.34 ± 0.00	23.35 ± 1.87	10.85 ± 1.14
Triticum aestivum	20.45 ± 1.20	0.00 ± 0.00	0.00 ± 0.00	21.27 ± 2.17
Vigna mungo	12.19 ± 0.71	4.99 ± 0.48	5.76 ± 1.24	0.00 ± 0.00
Zea mays	0.00 ± 0.00	16.98 ± 1.58	8.60 ± 2.02	0.00 ± 0.00
Ziziphus jujube	5.37 ± 0.92	1.73 ± 0.18	4.77 ± 0.96	2.27 ± 0.35
*Other	2.82 ± 0.00	2.73 ± 0.77	2.69 ± 0.32	2.69 ± 0.76
**Unidentified	7.08 ± 0.58	10.61 ± 0.88	9.09 ± 0.89	8.29 ± 0.89
Unknown plant	11.64 ± 0.47	11.20 ± 0.65	11.61 ± 0.61	12.21 ± 0.74

*Other = Quill, Hair and Thread. ** Unidentified = Unidentified material. Values are Means ± S.D.

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