STUDY OF FEED PREFERENCE OF ENDANGERED HOG DEER UNDER CAPTIVE CONDITIONS IN PAKISTAN

Bilal KABEER[1,2,3,4,5], Maqsood ANWAR[1], Muhammad RAIS[1], Muhammad Jawad JILANI[1,3,4,5], Muhammad Arslan ASADI[1,4,5], Sadia ABID[1,3,5], Sadaf BILAL[1,3 5], Farukh SALEEM[2], Babar Hilal AHMED[2], Agha Waqar YUNUS[2], Saleem ZAHID[2], Muzamil ANJUM[7], Pavla HEJCMANOVÁ[2], Muhammad Kamal SHEIKH[6], Abid MEHMOOD[1,3 4,5]*

[1] Arid Agriculture University, Department of Wildlife Management, Rawalpindi, Pakistan
[2] National Agricultural Research Centre, Islamabad, Pakistan
[3] Department of Animal Sciences and Food Processing, Czech University of Life Sciences, Prague, Czech Republic
[4] Barari Forest Management LLC, Department of Wildlife and Conservation, United Arab Emirates
[5] Wildbiodiversity Conservation Services, Islamabad, Pakistan
[6] Pakistan Agriculture Research Council, Pakistan
[7] King Saud University, Saudi Arabia

Abstract

Hog deer (Axis porcinus) are an endangered species in Pakistan, and there is little information about their feed preference in captivity. Seven animals were offered weighed amount of feed in two seasonal binary combinations of fresh fodder and one combination of grains. The fresh seasonal fodder included Oat (Avena sativa), Lucerne (Medicago sativa), Sorghum (Sorghum bicolor), and Maize (Zea mays); whereas grains included Wheat (Triticum aestivum) whole-grains and Chickpea (Cicer arietinum) seeds. Thirteen plant samples were collected from the wild habitat of Hog deer in Tunsa Barrage Wildlife Sanctuary. Plant samples from wild and captivity were analysed through proximate analysis for Crude protein, Fiber, Fat and Ash contents. The outcomes concluded that in combination C1, the hog deer preferred Oat over Lucerne ($p < 0.05$) with a mean percentage±standard error (Mean±SE) of 90.757±0.401 percent for Oat and 9.243±0.401 percent for Lucerne. The animals preferred Maize ($p < 0.05$) in combination C2 with mean percentage and standard error of 91.657±0.368 percent compared to Sorghum with mean percentage and standard error of 8.343±3.083 percent. Chickpea was the preferred feed item ($p < 0.05$) against Wheat from the C3 combination with mean percentages and standard error of 92.2±0.453 percent and 7.800±0.453 percent respectively. The results of the proximate analysis revealed that the percentage of Crude Protein was 15.69±4.8 percent and 12.63±1.4 percent for plants in Captivity and plants in the wild respectively. The percentages of Fat content in plants in captivity and the wild were 3.34±0.86 and 3.37±0.41 respectively. The results showed percentages of Ash content in plants both in captive and wild,10.9±5.9 and 32.83±0.98 respectively; whereas, the percentages of fibre contents in the plants in captivity and wild habitats were 21.00±3.9 and 27.01±2.6 respectively.

Keywords: Hog deer; Feed preference; Proximate analysis; Captivity; Axis porcinus.

Introduction

Feed is the fundamental and most essential component of keeping a wild ungulate species in captive conditions. As the wild animals have the liberty to forage from a wide range of plants as an integral part of their diet, it becomes challenging to assess the preferred feed

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* Corresponding author: abid@wildbiodiversity.org

combination for these species in captive conditions. Most species of animals are highly selective in their feeding habits and spend a considerable proportion of their time and energy to search for desired feed items [1]. Differences in palatability and novelty of feed items can also affect animals' foraging behaviour [2]. As the emphasis is on the survival of wild species in captivity rather than on maximum growth rates as in commercial production; the nutrient requirements and allowances do not need to be very precise. However, wild animals show specific behavioural preferences towards specific feed items, and while formulating their feed in captivity, the foraging behaviour of animals requires special considerations [3].

Hog deer (Axis porcinus) belongs to family Cervidae. It is a small deer with short, delicate legs and a rather large body. It is categorised as Endangered under IUCN Redlist of Threatened Taxa [4]. Hog deer are primarily nocturnal in feeding habits, and one of its primary feeds in Pakistan is the young leaves of Euphrates poplar (*Populus euphratica*). They also graze on grasses where accessible rather than browsing, and are fond of Ber tree fruits (*Zizyphus jujuba*) [5].

The habitat and feed habits of hog deer in protected areas of Sub-Himalayan West Bengals were studied by *Bhowmik et al.* [6], by direct observations of forages usually consumed by hog deer in the open grass land habitat. They mainly subsisted on small, soft grasses along with shoots and foliage of various plants. However, during the dry season when such vegetation became limited, the animals were compelled to feed upon soft blades of tall plants. Preferred forage of Hog deer included: *Saccharum longisetosum, S. arundinaceum, S. bengalense, S. narenga, S. spontaneum, Alpinia malaccensis* and *Imperata cylindrica*. Grasses especially Saccharum spontaneum, were the preferred diet of Hog deer inhabiting the alluvial grassland habitat complex in lowland Nepal [7].

The literature lacks specific studies on the feeding preference of captive wild ungulates in Pakistan, and the hog deer is one of the least studied species, in particular. The present study was designed to investigate the feed preference of hog deer using different binary combinations and to compare nutrients values of captive preferred and wild preferred feeds through proximate analysis to assess whether the choice depends on nutritional values. The outcomes of the study will benefit in formulating a well-balanced feed regime for captive hog deer that will include a combination of fresh fodder and grains or seeds.

Material and Methods

Study Site

The study was conducted at an Animal Research Facility of Poultry and Wildlife Research Program under Animal Science Division at National Agricultural Research Centre (NARC), Islamabad (N 33°39'58.86"; E 73°7'21.28"). For the current study, we selected seven adult Hog deer (two males and five females) in five enclosures. Two males and one female were in individual pens whereas, the remaining two units had two females each (Figure 1). Each enclosure had on average 18X38 meters in dimensions and was provided with a shade for protection against harsh weather conditions and with two water basins and two feeding troughs in each enclosure.

Binary combinations in Captivity

To study the feed preference of hog deer in captivity, we adopted and modified the methodology of *Laska et al.* [8] according to the prevailing conditions and seasons of the study area. According to the season and availability of feed items, three binary combinations were formulated (Table 1).

Fig. 1. Experimental animal (Male Hog deer) at Wildlife Research Section, NARC Islamabad

Table 1. Details of binary combinations used to study the feed preference of Hog deer in captivity

S.	Combination Codes	Feed Items	Nature	Seasonal Availability	Weight offered (Grams)
1	C1	Oat (Avena sativa)	Fresh fodder	Winter	5000
2		Lucerne (Medicago sativa)	Fresh fodder	Winter	5000
3	C2	Sorghum (Sorghum bicolor)	Fresh fodder	Summer	5000
4		Maize (Zea mays)	Fresh fodder	Summer	5000
5	C3	Wheat (Triticum aestivum)	Whole-grains	All Seasons	500
6		Chickpea (Cicer arietinum)	Seeds	All Seasons	500

The mentioned seasonally available combinations were accessible to the animals as per schedule viz. feeding the combination of fresh fodder early in the morning and the combination of grains or seeds in the evening; according to the weights mentioned in table 1. Moreover, the feed was re-weighed and removed in each next morning, before offering the fresh one. Each combination was repeated for ten times to minimise the possibility of accidental utilisation of non-preferred feed item [8].

Sample collection from the Natural habitat of Hog Deer

A field survey was designed to observe and collect plant specimens consumed by Hog deer in their wild habitat. For the said purpose, direct observations were recorded, supplemented by interviewing the wildlife wardens and rangers in order to establish the feed preference of hog deer in the wild, in Taunsa Barrage Wildlife Sanctuary, Dera Ghazi Khan Punjab. We collected eleven preferred plant species according to standard sample collection procedures. The plant specimens were later identified and analysed through proximate analysis for their nutrient values.

Proximate Analysis

We air dried the plant samples and then processed them in order to determinate the proximate composition following AOAC [9]. Crude fat was determined on a Fat Extractor (Ankom XT151 Extractor, Macedon, NY) using standardised procedures. The crude protein was determined by digesting the samples on an Auto Kjeldhal System (Digest System K-437, and Auto Kjeldahl Unit K-370; Büchi). Moreover, we manually used conventional Markham still, and burette for titration and distillation and titration were performed manually using.

Data / Statistical Analysis

The statistical analysis was performed through Minitab® version 18.1, using paired T test to assess significant difference within the combinations and each sex of the species. However, a two-sample T test was used to analyse the significance of the difference of preferred feed between the sexes, and the percentages of crude protein, fat, fibre and ash contents between preferred and wild plants. Confidence of interval was chosen at 95% with α = 5%.

Results

The results of the study revealed that in combination C1, the hog deer preferred Oat over Lucerne (p < 0.05) with a mean percentage±standard error (Mean±SE) of 90.757±0.401 percent for Oat and 9.243±0.401 percent for Lucerne (Table 2).

Table 2. Paired T-Test for Preferred Feed Type in Hog Deer under Captivity

Combinations	Feed Items	N	Mean±SE	T-Value	P-Value
C1	Oat (Avena sativa)	70	90.757 ± 0.401	101.63	0.0001
	Lucerne (Medicago sativa)	70	9.243 ± 0.401		
C2	Maize (Zea mays)	70	91.657 ± 0.368	113.05	0.0001
	Sorghum (Sorghum bicolor)	70	8.343 ± 3.083		
C3	Chickpea (Cicer arietinum)	70	92.2 ± 0.453	-93.06	0.0001
	Wheat (Triticum aestivum)	70	7.800 ± 0.453		

The animals preferred Maize (p < 0.05) in combination C2 with mean percentage and standard error of 91.657±0.368 percent compared to Sorghum with mean percentage and standard error of 8.343±3.083 percent. Chickpea was the preferred feed item (p < 0.05) against Wheat from the combination C3 with mean percentages and standard error of 92.2±0.453 percent and 7.800±0.453 percent respectively (Fig. 2).
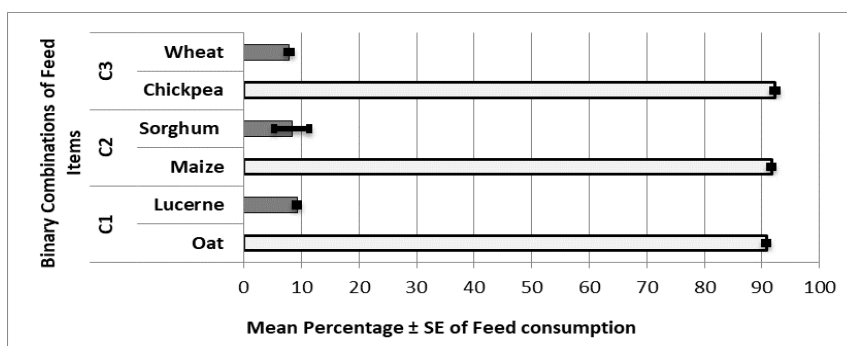

Fig. 2. Comparison of Feed Preference in Binary Combinations by Hog Deer in Captivity

The comparison of preference between males and females showed a significant difference (p > 0.05) in preference. Males showed higher percentages of consumption of the preferred items as compared to the female hog deers (Fig. 3).

The results of the proximate analysis (Table 3) revealed the percentage of Crude Protein as being 15.69±4.8 (Mean ± SE) percent and 12.63±1.4 percent, for plants in Captivity and

plants in the wild respectively. The percentages of Fat content in plants in captivity and the wild were 3.34±0.86 and 3.37±0.41 respectively.
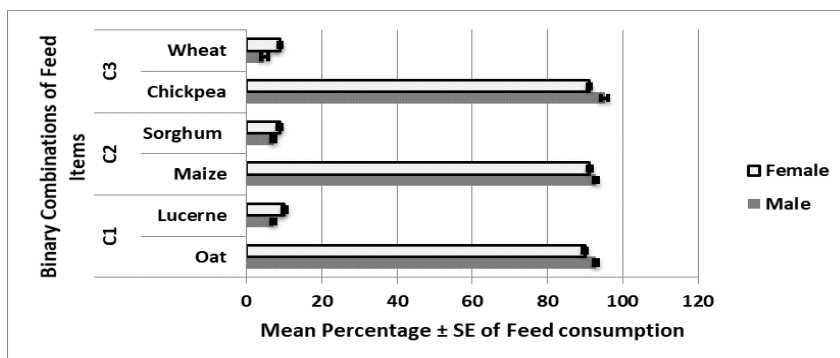

Fig. 3: Comparison of Feed Preference in Binary Combinations by Male and Female Hog Deer in Captivity

Table 3. Percentage Means and SE for Proximate Composition of Plants in Wild and Captivity

Plants	Category	Crude Protein (%)		Fat (%)		Ash (%)		Fibre (%)	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
Zizyphus jujuba	Wild	8.99	1.00	2.04	0.03	33.32	0.05	28.76	0.54
Dalbergia sissoo	Wild	14.66	0.00	3.04	0.08	34.44	0.20	25.74	0.53
Tamarix dioca	Wild	10.60	0.00	2.49	0.34	31.51	0.35	21.87	0.51
Prosopis juliflora	Wild	20.47	0.37	3.16	0.23	32.31	0.30	28.50	0.32
Acacia arabica	Wild	15.73	0.00	3.40	0.27	40.49	0.55	28.46	0.36
Typha latifolia	Wild	6.51	0.00	1.37	0.18	29.89	0.29	44.69	0.37
Calotropis procera	Wild	18.10	0.82	7.39	0.39	32.88	0.29	17.51	0.47
Alhagi maurorum	Wild	7.32	0.00	3.20	0.14	35.72	0.26	37.27	0.67
Arundo donax	Wild	13.34	0.00	4.50	0.30	31.59	0.19	28.43	0.35
Withania somnifera	Wild	16.53	0.00	4.31	0.20	29.36	0.31	9.04	0.55
Panicum repens	Wild	6.80	0.52	2.50	0.23	27.96	0.58	21.64	0.68
Albizzia odoratissima	Wild	18.65	0.50	3.21	0.19	29.64	0.32	20.50	0.72
Saccharum bengalensis	Wild	6.53	0.38	3.24	0.19	37.62	0.29	38.71	0.42
Medicago sativa	Captivity	17.27	0.30	2.55	0.30	8.30	0.16	34.46	0.41
Avena sativa	Captivity	6.18	0.20	4.23	0.45	7.19	0.14	25.42	0.39
Sorghum bicolor	Captivity	16.52	0.38	2.33	0.34	28.22	0.13	24.39	0.25
Zea mays	Captivity	19.06	0.42	1.62	0.31	22.39	0.36	24.39	0.23
Triticum aestivum	Captivity	12.07	0.40	4.39	0.28	2.16	0.09	4.50	0.46
Cicer arietinum	Captivity	21.83	0.29	4.16	0.55	3.14	0.32	13.20	0.06

The results show percentages of Ash content in plants both in captive and wild as being 10.9±5.9 and 32.83±0.98 respectively, whereas, the percentages of fibre contents in the plants in captivity and wild habitats were 21.00±3.9 and 27.01±2.6 respectively. The statistical analysis reveals that there is no significant difference in the nutritional value of the plants in the wild and those offered in captive conditions. Therefore, the plants preferred in captivity by hog deer correspond to the plants preferred in the wild concerning the nutritional values (Fig. 4).
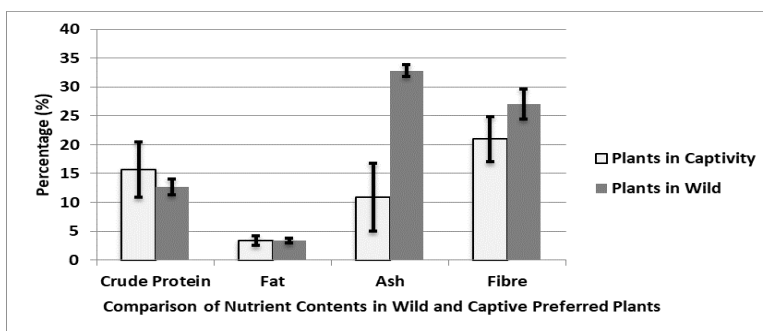
Fig. 4. Comparison of Nutrient Contents in Wild and Preferred Captive Plants

Discussion

The applications of feed preferences on different combinations in captivity allow us to gain further insight into the mechanism underlining herbivores' feed choice as studied by *Laska* [8]. The current study on binary combinations of planted forages offered to Hog deer showed marked feed preferences on a seasonal basis. Hog deer preferred Oat against Lucerne in winter, and Maize over Sorghum in summer. There are reports of seasonal variations of feed choice in various herbivores, especially deer [10].

Wallach et al. [11] also studied seasonal variations in European Roe deer (*Capreolus capreolus*) in Israel. They reported that diet composition varied considerably between seasons and habitats, demonstrating the opportunistic flexibility of the deer. Although the deer fed on most of the plant species, however, they were specific about certain plant species. In addition to this, they also opted out for seeds and fruits in summers. The present study showed that the hog deer preferred 90.757 ± 0.401 percent of Oat as compared to 9.243 ± 0.401 percent of Lucerne in winters. In summers, the hog deer preferred Maize (91.657 ± 0.368 percent) over Sorghum (8.343 ± 3.083 percent). *Davis et al.* [12] studied the diets of five terrestrial mammalian herbivore species including introduced Hog deer using micro histological techniques which consisted mainly of dicots. Deer consumed mostly the native plants and had a wider range of plant species as their diet, which coincides with our results from observations and information collected from the natural habitat of the hog deer, where they preferred thirteen plant species. *Roberts* [5] reported that in feeding habits Hog deer prefer the young leaves of Populous euphratic and fruits of Ber tree (*Zizyphus jujuba*). They also graze grass where this is accessible and show a preference for grazing rather than browsing. Our study revealed that the hog deer preferred Zizyphus jujuba and grasses such as Saccharum bengalensis and Panicum sp. Bhowmik et al. [6] reported that rivers and open grasslands in the two protected areas in Sub-Himalayan West Bengals provided the best grazing ground for the hog deer for food and shelter. Hog deer mainly subsisted on small, soft grasses and shoots and foliage of various fodder plants. However, during the dry season when such grasses became limited, the animals were compelled to feed upon soft blades of tall plants. Plant species identified in the food of hog deer included: *Saccharum longisetosum, S. arundinaceum, S. bengalense, S. nareng, S. spontaneum, Alpinia malaccensis* and *Imperata cylindrica. Wegge et al.* [7] recorded early successional tall grasses especially Saccharum spontaneum as the principal food of hog deer in Nepal. Similarly, the current study revealed that the hog deer was observed to prefer the areas with vegetation of *Zizyphus jujube, Dalbergia sissoo, Tamarix dioca, Prosopis juliflora, Acacia Arabica, Typha latifolia, Calotropis procera, Alhagi maurorum, Arundo donax, Withania somnifera, Panicum repens, Albizzia odoratissima,* and *Saccharum bengalensis*.

The present study showed that Oat with mean percentages and standard error of 6.18 ± 0.20, 4.32 ± 0.45, 7.19 ± 0.14, 25.42 ± 0.39 for crude protein, fat, ash and fibre contents

respectively, was the first and preferred choice over Lucerne. Similarly, Maize with mean percentages and Standard error of 19.06±0.42, 1.62±0.31, 22.39±0.36, 24.39±0.23 39 for Crude protein, fat, ash and fibre contents respectively, was an item of choice over Sorghum. While chick pea (with mean percentages and Standard error of 21.83±0.29, 4.16±0.55, 3.14±0.32, 13.20±0.06 for Crude protein, fat, ash and fibre contents respectively) was preferred over whole wheat grain. The crude protein requirements of deer reported in the literature ranged from 3.8% to 22% [13]. Data from wild habitat showed preference of hog deer for *Zizyphus jujuba* (8.99±1.00, 2.04±0.03, 33.32±0.05, 28.76±0.54 for crude protein, fat, ash and fibre contents respectively). They also preferred *Saccharum bengalensis* (6.53±0.38, 3.24±0.19, 37.62±0.29, 38.71±0.42 for crude protein, fat, ash and fibre contents respectively). Both of these plant species have a sufficient amount of crude protein for animals. growth and survival.

The crude protein offered in the feed during present study was well within the reported requirement of crude protein. *Das et al*. [14] suggested that feeding Oat and berseem in conjunction as roughage source could be a better strategy to feed deer (Family Cervidae) rather than the single feeding of fodders. *Sahoo and Garg* [15] reported that sorghum and maize feed provided 11% crude protein in spotted deer (*Axis axis*) and sheep, whereas, the current study showed 19.06±0.42 percent crude protein content in fresh Maize fodder.

Conclusion

Based on the results, the best feed combination for the Hog deer in captivity was Oat in winter season with the addition of chickpea, whereas, Maize and Chickpea in summer. The proximate analysis showed that there were similarities among the nutrient values of the wild and captive preferred plants. Therefore, the nutrient requirement is best met with the mentioned combinations in both seasons. Males showed a higher consumption of these feed items as compared to the females.

Acknowledgements

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