ASSESSMENT OF FEEDING BEHAVIOUR OF BABOONS (*PAPIO ANUBIS*) IN HONG HILLS ADAMAWA STATE, NIGERIA

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ABSTRACT
This study was designed to assess the feeding behaviour of baboons of Hong hills. Direct observation method was used for the study. Data was collected for a period of eight months. The results indicate high diversity and abundance of food items for baboons in the study area. A total of 16 food plants, 4 invertebrates (millipedes, earthworms, grasshopper and crabs); 2 vertebrates (goats and sheep) and 4 crop plants (groundnuts, guinea corn, maize and beans) were observed to be eaten by baboons in the study area. Wet season food plant species include Annona senegalensis Parkia biglobosa, Ficus capensis, Syzigium guineense, Vitex doniana, Vitellaria paradoxa, Haemastostaphis barteri, Grewia molis and Nauclea latifolia while dry season food plant include Adansonia digitata, Magnifera Indica, Oxytenanthera species, Ficus platyphylla, Cactus species and Borassus aethiopum. A total of 8 food plants viz Adansonia digitata, Parkia biglobosa, Magnifera indica, Cactus species, Oxytenanthera species, Nauclea latifolia, Annona senegalensis, and Vitellaria paradoxa were observed to be preferred by baboons in the study area. The result of nutritive value of the preferred food plant indicated that the highest percentages of dry matter content (83.0%), crude protein (22.6%), crude fibre (29.0%), ether extract (4.5%) and ash (27.0%) were found Adansonia digitata, Magnifera Indica, Annona senegalensis, Vitellaria paradoxa, and Adansonia digitata respectively. In this study area, baboon food resources appeared to be adequate representing a potential for good carrying capacity.

***Keywords*:** *Feeding behavior, baboon, food items, nutritive value, Hong hills*

INTRODUCTION

The primate is one of the highest order of mammals which includes humans (man), apes, monkeys and lemurs. The study of primates has generated considerable attention because they are closest phylogenetic relatives of humans (Silk and Boyd, 1978). Humans and other primates share a common evolutionary descent. For this reason, primates have always fascinated scientists because their physical features, social organization, behavioural patterns and fossil remains provide clues about our earliest human ancestors. Although some species such as humans, have since taken to the ground, all primates share features that are related to their tree climbing ancestry (Maynard, 1995).

Nigeria ranks eighth in the world for primates diversity with twenty three species and thirteen genera (Mittermeier, 1985; Oates, 1986). African primates are of particular interest because they are the key components of the continent's tropical ecosystems, often comprising a large proportion of the mammalian biomass in these ecosystems (Butynski, 1997). Many species of primates and other mammals exist in Adamawa State, though the distribution of the species is not uniform in various parts of the State (Adebayo and Tukur, 1999). Baboons still exist in relatively large numbers in Hong hills of Hong Local Government Area of Adamawa State.

Most primates spend feeding time on five types of food: insects, gums and saps, fruits,

seeds, leaves and underground herbs. These dietary variations are referred to as insectivory, gumnivory, frugivory, grainivory and foliovory respectively (Richard, 1998). Examples of insectivorous primates are *Aretocebu calabarensisis,* and *Galago demidonvi* (Peter,1977). Frugivorous primates include the chimpanzee (*Pan troglodytes*). The gumnivorous include pygmy marmoset (*Cebuella pygmaca*) and fork-crowned lemur (*Parmer furciter*) (Bearder and Martin, 1980).

Baboons (*Papio anubis*) eat various worms, eggs, insects, reptiles, crabs, mollusks, small mammals, fruits and young shoots (Encarta, 2006). The *Papio spp* exploit underground plant parts including roots, tubers, rhizomes, corns and bulb. All these serve as storage organs which contain water, carbohydrates in the form of simple sugar, starches and proteins (Noy-meir, 1973; Hatley and Kappelman, 1980). On the African grasslands, baboons spend long hours extracting and eating grass corms, the swollen underground bases of stems . For example , some baboon populations at Gilgal, Kenya have been observed to feed heavily on grass corms in the dry season. Wrangham *et al.* (1980) noted that *Papio* species routinely exhibit a full range of diet types across their geographic range, with fruit, foliage or underground items (such as roots and bulbs) predominant in their diet. The Gelada baboon (*Theropithecus gelada*) is a true grazer that feeds exclusively on grasses (Dunbar, 1977). Baboons also hunt small ungulates and even medium-sized primates (Strum, 1981; Davies and Coulishaw, 1966). Accounts of predation in baboons suggests that hunting is more characteristic of dry (i.e. poor quality) habitats than the wet season (Dunbar, 1988). Hausfater (1976), reported a significant increase in predation during the dry season in the Amboseli baboons. This seems to reflect a broadening of diet in response to a seasonally impoverished habitat. Baboons are omnivorous, although with a preference for fruits (Jolly, 1966). Grass is the principal food in open areas and fruits in forests. Resins and gums act as buffer in the dry season (Kingdom, 1987).

Hong hills derives its importance from the presence of relatively large number of baboons it contains. The perpetuation of the baboons on Hong hills requires that conservation strategies be put in place, such as provision and preservation of important food items of the animal. This is because the quality of forage in terms of nutrients composition in addition to their quantity and diversity by season is of great importance in the overall performance of animals (Dietz, 1976). However, there is lack of information in the literature on the feeding behaviour of baboons of Hong hills and forage adequacy in terms of quality, quantity and diversity. A study of the feeding behaviour of baboon is therefore vital to develop appropriate strategies for the management and conservation of the baboons in Hong hills. Hence, the design of this research work in which the objectives were to identify the food items eaten by baboons in the study area, investigate the seasonal variability and availability of baboon foods, determine the food plants preferred by baboons in wet and dry seasons and evaluate the nutritive value of food plants preferred by baboons in wet and dry seasons in the study area.

MATERIALS AND METHODS

The study area

Location*:* The Hong Hills is in Hong Local

Government area of Adamawa State. Hong lies between latitude 12 ^{o}48 and 14 ^{o}24N and longitude 10 ^{o}24E (fig.1) and it is located in the northern part of Adamawa State. The state is located at the north eastern part of Nigeria. It lies between latitude 11 ^{o}21 and 13 ^{o}12N of the equator and between longitude 11 $2^{o}3$ east of the Greenwich meridian. It shares boundary with Taraba State in the south and west, Gombe in the North West and Borno State to the north (Adebayo and Tukur, 1999). Hong Hills is of significance to Kilba (Hoba) ethnic group because it is one of the earliest settlements of the people. The Hills is still inhabited by people, though the human population density is very low. Hong Local Government Area lies in northern Guinea savanna zone. The mean annual rainfall in the area ranges from 700mm to 1000mm while the mean monthly temperature range is from 26.7 ^{0}C to 27.8 ^{0}C.

The vegetation is the open savanna type. Adebayo and Tukur (1999) reported the following dominant woody plant species: *Aflezia africana, Vitellaria paradoxa, Terminalia laxiflora, Terminalia glaucescens, Annona senegalensis, Burkey africana, Prosopis africana, Abizia zygia, Ficus exasperata, Pterocarpus luscens, Balanite aegyptica, Khaya senegalensis, Ziziphus spina-christi and Tamarindus indica.* Other plant species includes *Haematostaphis baryeri, Ficus platyphylla, Borassus aethiopum, Grewia molis, Vitex doniana, Diosphyrus mespiliformis, Nauclea latifolia, Parkia biglobosa, Magnifera indica, Oxytenanthera species and Cactus species.*

Wild animals commonly sighted in the area as reported by Akosim and Ijeoma (1999) include : *Cercopithecus tantalus , Erythrocebus patas, Papio anubis, Galago sengalensis, Cricetomys gambianus, Hysterix cristata, Myomys Dalton, Loxodonta africana, Hippotraqu, equines, Lepur capensis, Numida meleagris, Crocuta crocuta, Panthera leo and Xerus erytrhropus,*

Reconnaissance Survey for the Determination of Feeding Sites and Feeding Habit of Baboons

Three days were used for the preliminary survey during which the study area was toured to determine the feeding sites of the baboons and a focal group with the guidance of a local hunter. The baboon troop that was chosen for the study consists of 43 members 35 adults and 8 Juveniles. However, sexes were not determined due to the fact that the baboons were not habituated and close monitoring was not possible.

STUDY DESIGN AND DATA COLLECTION:

Feeding behaviour investigation

The direct observation method was used in the field to obtain information on the feeding behaviour of the baboons (Karen 1992). Data were collected for 8 months on the food items eaten by the baboons and the parts utilized.

Determination of relative density of forage plant species (% forage availability)

Six 100 x 100m (one hectare) plots were randomly marked out within the study area to determine the relative density of identified forage species (woody plant food species). The density of each species was determined by counting the total number of each species present in the six plots and mean (average) obtained (Kershaw, 1979). The Percentage food availability was assessed in terms of the density of each species relative to every other species.

Determination of percentage utilization:

The percentage utilization of a species was obtained thus:

$$\frac{\text{Total number of sightings of feeding on a forage species}}{\text{Total number of sighting for all species eaten}} \times \frac{100}{1}$$

Determination of preference

Preference was determined using the following formula outlined by Tomlinson (1980).

$$\text{Preference} = \frac{\%\ \text{utilization}}{\%\ \text{availability}}$$

Preference ranking

Selectivity ratios obtained ware ranked according to their order of magnitude from highest to lowest, thus providing a preference ranking for each species.

Determination of nutritive value of the preferred forage species.

The nutritive value of the preferred forage plants (crude fibre, crude protein, ether extract, ash, dry matter and nitrogen free extract) were determined by A.O.A.C (1980) method.

Statistical Analysis

Descriptive statistics was used to analyze the food items eaten by baboons and the seasonal variability and availability of food plants. Preference ranking was by Tomlinson (1980) method and by the use of Pearson correlation analysis. Nutritive value of food was analysed by graphical method.

RESULTS

Identified food items eaten by baboons in the study area

The result of food items eaten by baboons in Hong Hills are presented in Table 1. The results indicate that baboons fed on various food items which range from plant materials to animals. This includes 18 food plants, 4 invertebrates, 2 vertebrates and 4 crop plants.

Table 1: Identified food items eaten by baboons in the study area

Plant materials	Parts eaten
Annona senegalensis	Ripe fruits and seeds
Haemastostaphis barteri	Ripe fruits/seeds
Vitex doniana	Ripe fruits sometimes unripe fruits eaten
Nauclea latifolia	Ripe fruit
Parkia biglobosa	Pulp of ripe fruits and seeds
Vitellaria paradoxa	Ripe fruits. Seeds are discarded
Oxytenanthera species	Sap/juice from stem
Cactus species	Juice/sap from stem
Syzygium guineense	Ripe fruits
Ficus capensis	Ripe fruits
Grewia molis	Ripe fruits
Borassus aethiopum	Pulp of ripe fruits seed is discarded
Ficus platyphyla	Ripe fruits

Diospyrus mespiliformis	Ripe fruits and seeds
Magnifera indica	Ripe/unripe fruit seeds are discarded
Adansonia digitata	Mature fruit/seeds

Crops consumed by Papio anubis on farms

Groundnuts	seeds (mature and immature; germinating cotyledons especially at the onset of rains.
Guinea corn	immature stem/stalk are chewed to extract the sweet juice; seeds.
Maize	immature stem/stalk chewed to extract sweet/sugary juice.
Beans	immature pods; seeds.

Invertebrate consumed by Papio anubis (Baboons)

Millipedes	whole
Earthworm	whole
Grasshopper	whole
Crab	soft parts

Vertebrates consumed by Papio anubis

Goat	offals/viscera (intestine, eyes, lung and liver)
Sheep	offals/viscera (intestine, eyes, lung and liver)

Seasonal variability and availability of baboon foods in the study area

The results indicate that some food plants are only available during certain seasons. The values are shown in percentages. Nine (9) forage plants were available and eaten by the baboons in the wet season while 7 were available and eaten by the baboons during the dry season. The food plants available during wet season include *Annona senegalensis, Syzygium guineense, Parkia biglobosa, Ficus capensis, Vitex doniana, Vitelleria paradosa, Haemaestophis barteri, and Nauclea latifolia.* While those available in dry season include *Adansonia digitata, Magnifera indica and Cactus species.*

Table 2: Seasonal variability and availability of baboon foods in the study area

Foods	Wet season (% availability)	Dry season (% availability)
Annona senegalensis	9.13	-
Adansonia digitata	-	36.54
Syzygium guineense	12.25	-
Parkia biglobosa	13.35	-
Ficus capensis	12.92	-
Magnifera indika	-	15.88
Oxytenanthera species	-	17.51
Vitex doniana	10.46	-
Vitellaria paradoxa	9.13	-
Haemastophis barteri	10.47	-
Grewia molis	9.49	-
Ficus platyphyll	-	12.82

Diospyrus mespiliformis	-	11.71
Cactus species	-	9.02
Borassus aethiopum	-	10.61
Nauclea latifolia	13.79	-

Key: (i) - = absent during a particular season

(ii) The figure under each season represents the relative density of the forage plants.

The influence of food availability on food utilization by baboons in Hong hills

The results of the correlation coefficient between food availability and utilization by baboons were r = 0.62 and r = 0.28 for wet and dry season respectively. These results indicate that there is a positive or direct relationship between food availability and utilization by baboons during the wet and dry season respectively. A test of significance of the r value showed that the correlation coefficient for wet season was significant ($p<0.05$) while that of dry season was not significant ($p>0.05$).

Preference ranking of forage plant species consumed by baboons in the wet and dry seasons

The results of food preference of baboons in Hong hills during wet and dry season are presented in Tables 3 and 4 respectively. The four most preferred plant materials in the wet season are: *Parkia biglobosa, Nauclea latifolia, Annona senegalensis and Vitelleria paradoxa,* while *Adansonia digitata, Magnifera indica, Oxytenanthera species* and *Cactus species* are the four most preferred plant materials in the dry season.

Table 3: Preferred ranking of plant food materials consumed by baboons in the wet season

Food item/forage Plant species	% Utilization	% availability	% Preference	Preference Ranking
Naclea latifolia	22.81	13.79	1.65	2
Annona senegalensis	7.41	9.13	0.81	3
Parkia biglobosa	23.71	13.35	1.77	1
Syzygium giuneese	6.50	12.25	0.53	6
Ficus capensis	6.58	12.92	0.51	8
Vitex doniana	4.70	10.46	0.38	9
Vitellaria paradoxa	7.40	9.13	0.81	4
Haemastosphis barteri	10.10	10.47	1.02	5
Grewia molis	11.01	9.49	1.16	7

Table 4 : Preference ranking of plant food materials consumed by baboons in the dry season

Food item/forage Plant species	% utilization	% availability	% Preference	Preference ranking
Adansonia digitata	36.54	11.35	3.21	1
Magnifera indica	31.21	15.88	1.96	2
Oxytenanthera species	13.91	17.51	0.95	3
Ficus platyphlla	6.70	12.82	0.52	7
Cactus species	8.50	9.02	0.57	6
Borassus aethiopum	8.53	10.16	0.59	5
Diospyrus mespiliformis	6.73	11.71	0.92	4

The Nutritive Value of Food Plants Preferred By Baboons in Hong Hills

Results of the nutritive value of food preferred by baboons in Hong Hills are presented in figures 2 to 6. For the dry matter content (figure 2), *Adansonia digitata* (83.3%) and *Parkia biglobosa* (81.3%) scored higher while *Cactus species* (23.6%) and *Magnifera indica* (18.8%) had the least of dry matter content. *Magnifera indica* (22.6%) and *Adansonia digitata* (21.4%) had higher crude protein content (figure 3) , *Annona senegalensis* (29.0%) and *Vitellaria paradoxa* (28.1%) contained the highest crude fibre (figure 4). Ether extract occurred more in *Vitellaria paradoxa (4.5%) and Adansonia digitata (4.1%) (*figure 5) while ash content (figure 6) was found highest in *Adansonia digitata* (27.0%) and *Cactus species* (26.3%).

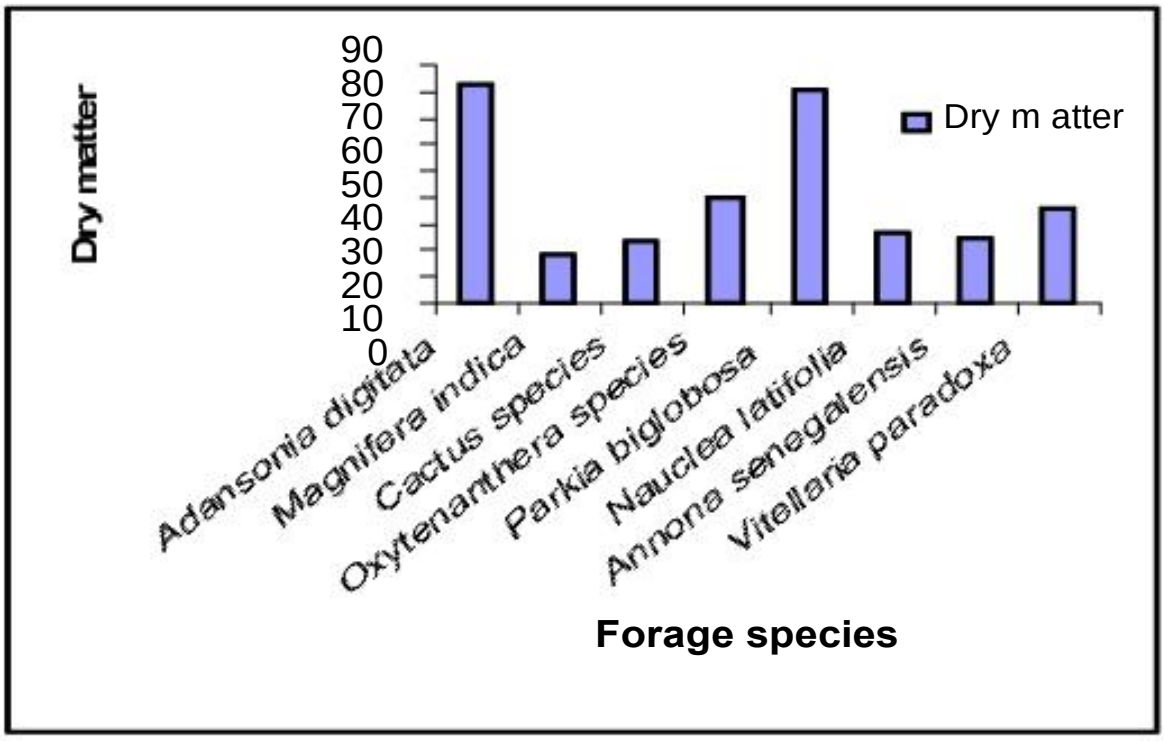

Figure 2: percentage dry matter content of preferred forage plant species

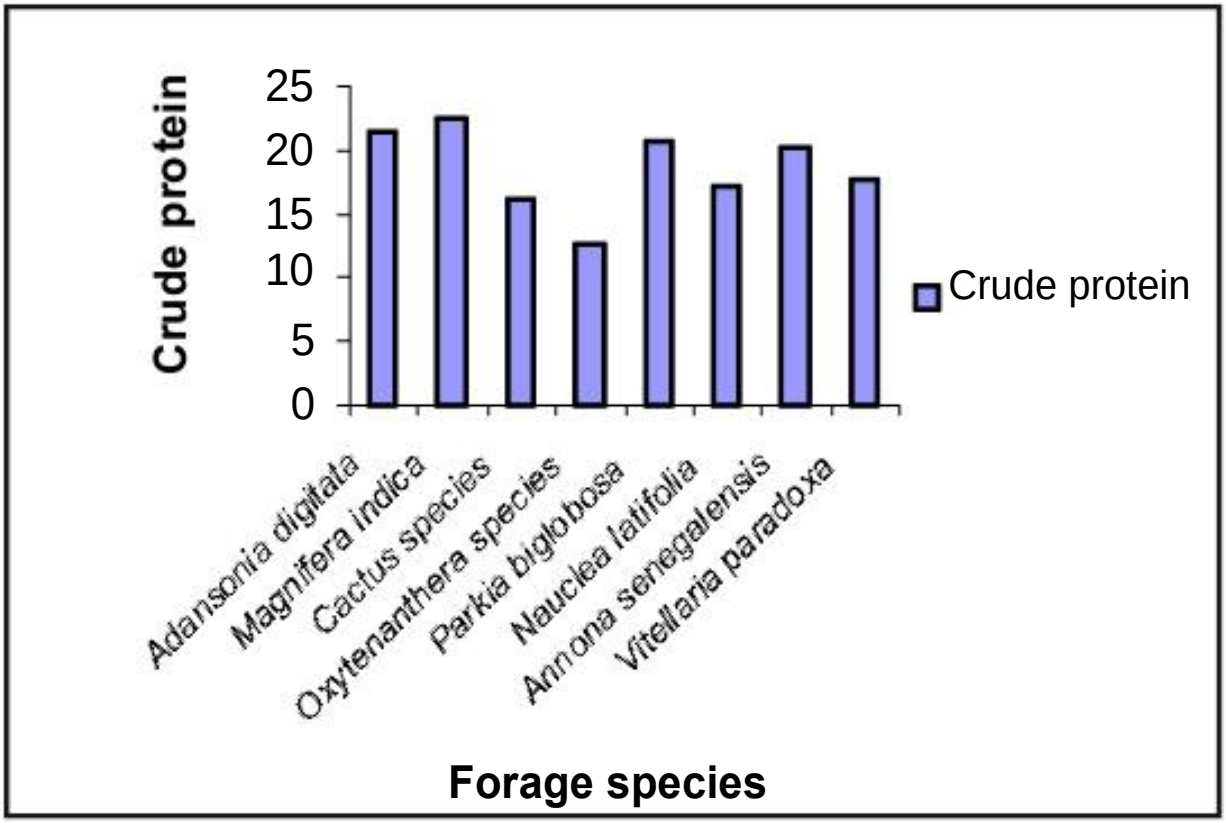

Figure 3: percentage crude protein content of preferred forage plant species

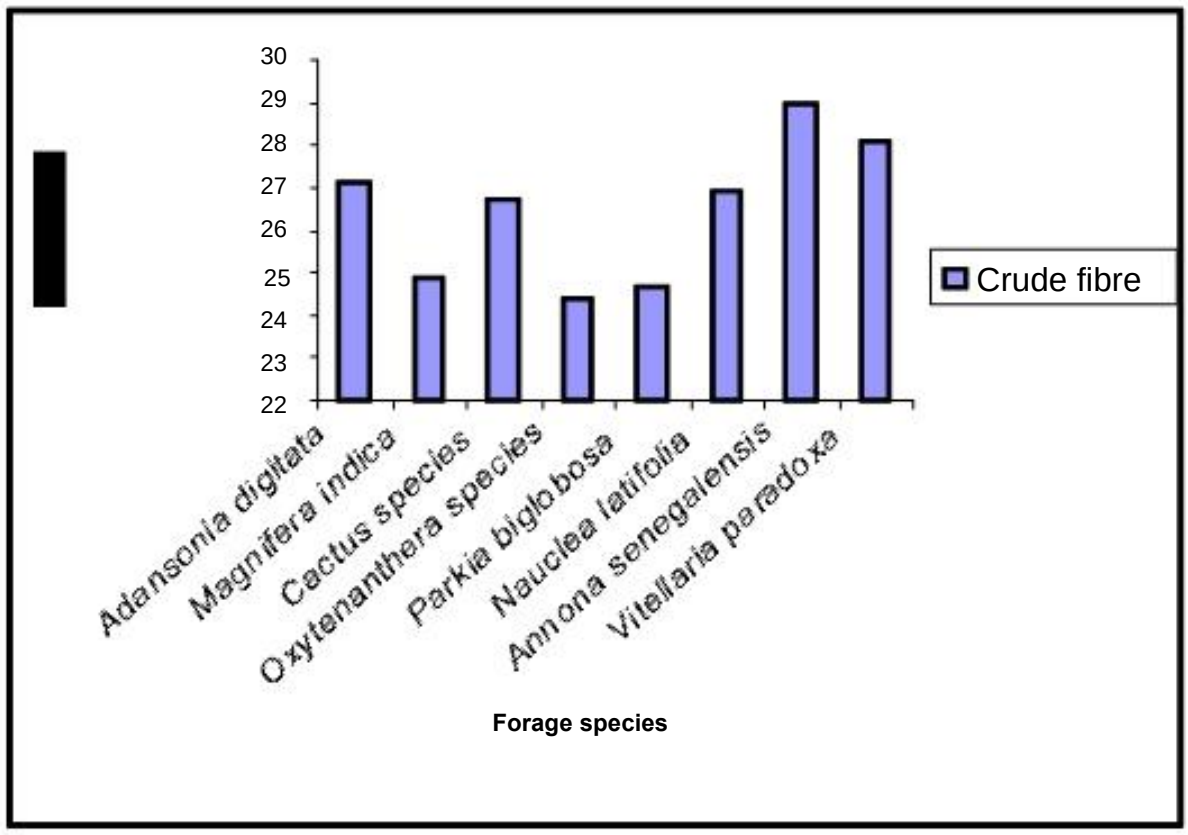

Figure 4: percentage crude fibre content of preferred forage plant species

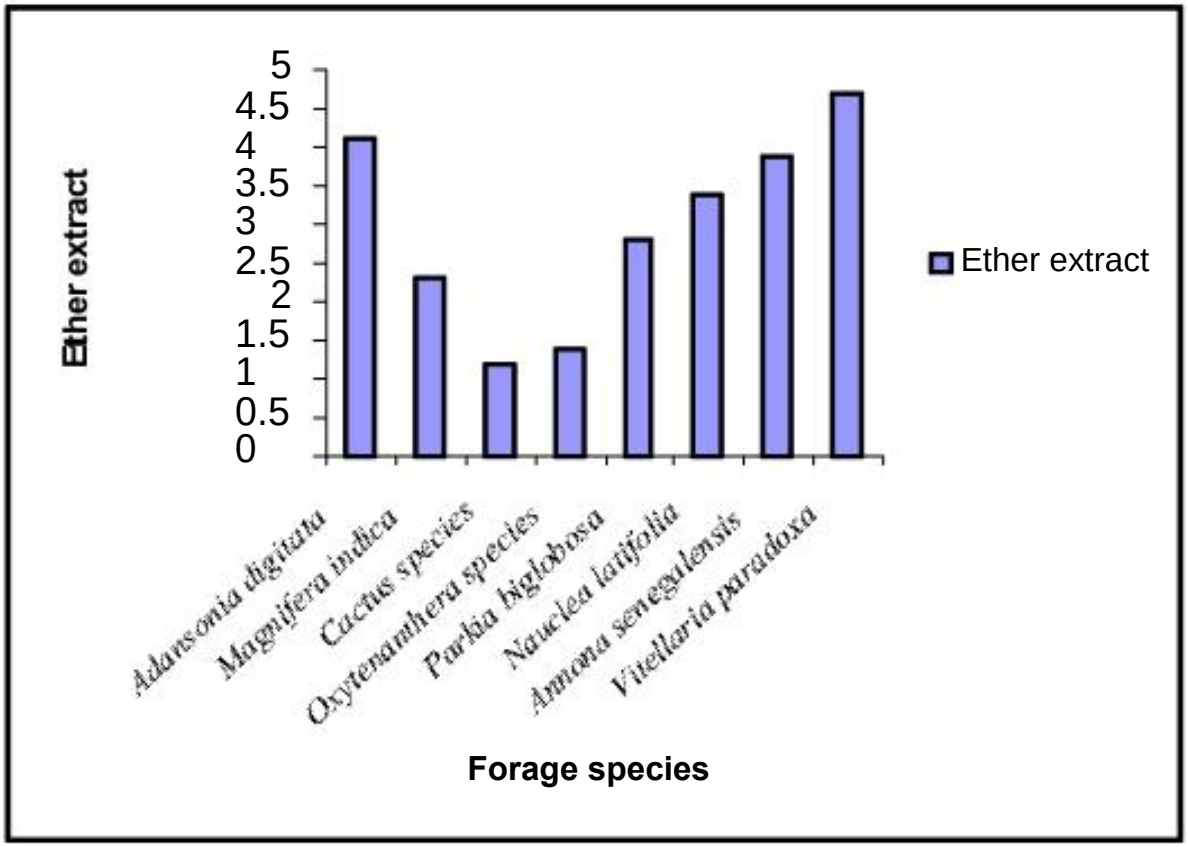

Figure 5: percentage ether extract content of preferred forage plant species

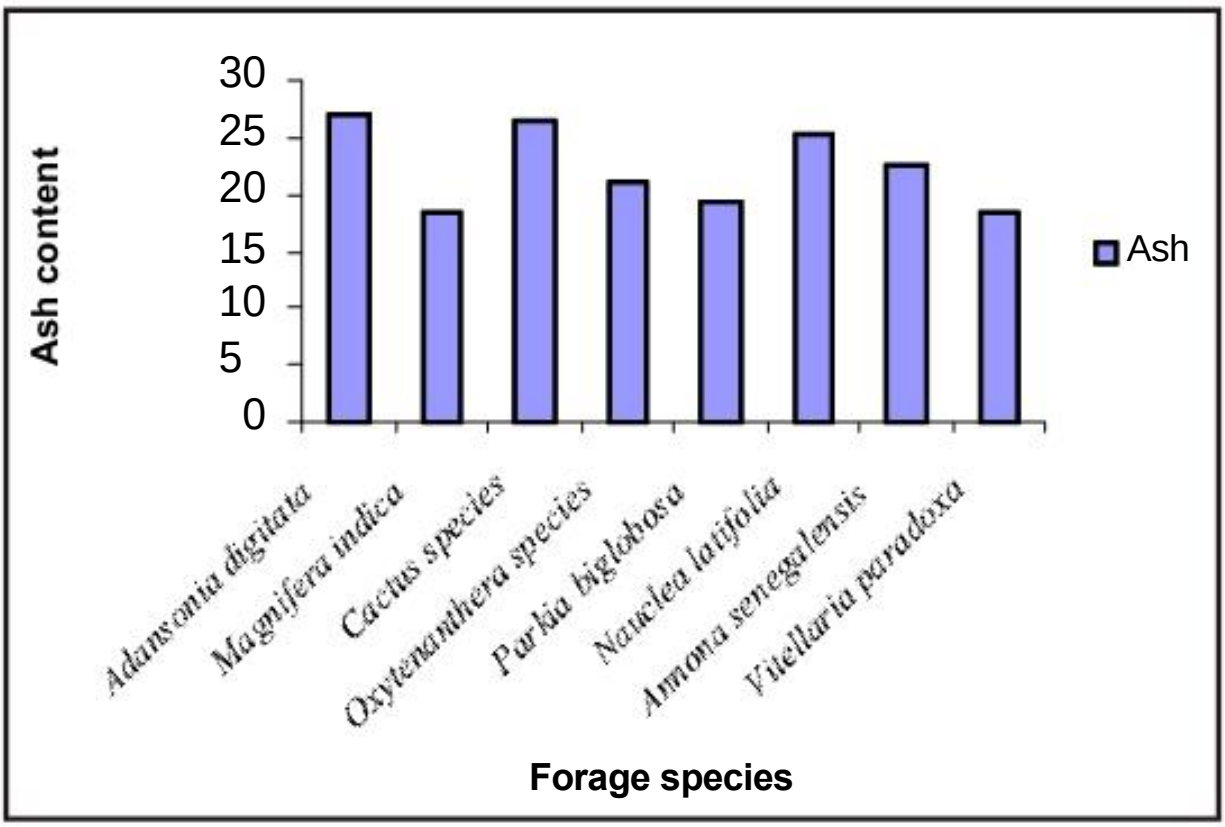

Figure 6: percentage Ash content of preferred forage plant species

DISCUSSION

Identified food items eaten by baboons in the study area

The predominant food items of baboons in both dry and wet seasons in the study area were fruits. This finding agrees with the earlier reports of Richard (1998), Aubrey and Marian (1999) that fruits are the favorite food of primates in general. They also feed on stems and seeds. The stems of *Cactus* and *Oxytenanthera* species were utilized in the dry season only. This is probably due to the high water content of this part of the plant during the dry season, when water scarcity is usually experienced in the area. The result also indicates that the variation in the food plants of the Baboons was determined largely by availability. Food plant availability was largely a function of plants phenology.

Invertebrates observed to be fed upon by baboons in the study area include earthworm, millipedes, crabs and grasshoppers. The low diversity of invertebrates in the study area might have restricted the baboons to only earthworms and grasshoppers. Furthermore, two species of vertebrates were observed to be fed upon by baboons indicating their ability to feed on diverse animal species. The invasion of baboons' territory by farming activities must have compelled the baboons to become crop raiders. Series of successful raids of human crops by baboons were observed on maize, beans, groundnut and guinea corn. Baboons spent more time patronizing farm lands than foraging on wild plants during the cropping season probably because of its high quality and low toxicity. This agrees with the report by Richard (1999) who observed that baboons prefer human crops because of their nutritive value and low toxicity.

Seasonal Variability and Availability of Baboon foods

The result of seasonal variability and availability of baboon foods indicate that food plants availability varies during wet and dry season. It was observed that while some fruit are available in the dry season others occur in the wet season. This agrees with the findings of Richard (1998) that in tropical Savanna, plants synchronize their cycle of production with the cycles of rainfall. Although, some food plant species in the study area e.g *Cactus species* can grow in both the dry and wet season, the availability is low in the dry season possibly because of some anthropogenic factors particularly the influence of indiscriminate bush burning. The locations prone to fire attack tend to have a marked decrease in food plant abundance. It is evident therefore that fire play a role in the availability of food plants in time and space in the study area as observed by Dunbar (1996).

The less important baboon food in the area notably millipedes, earthworm, grasshoppers and crabs were also found to be more abundant during a particular seasons. Crabs and earthworms were available only during the wet season while grasshoppers were available in both seasons but mainly during the wet season. The result of coefficient of correlation between food availability and utilization by baboons ($r=0.26$) for the wet season and ($r=0.28$) for the dry season indicated a significant correlation coefficient ($p<0.05$) for wet season only. Furthermore, r^2 for wet season =38% while that of dry season =7.6%. The implication of these results is that the baboons utilize more of the forage resources during the wet season than in the dry season. The low utilization of forage

resources in the dry season is accounted for by the relatively high availability of crop residues such as groundnuts, beans, guinea corn and maize during the dry seasons which are usually preferred by the baboons to the forage resources.

Preference Ranking Of Food Plant Species Consumed By Baboons During Wet And Dry Season

The trends of preference shown for food by the baboons may possibly be attributed to the following factors: the nature of fruit, the more fleshy/succulent and big fruits. These factors could explain the high preference shown for *Adansonia digitata*, *Magnifera indica* and *Nauclea latifolia* fruits. However, big and succulent fruit of *Borassus aethiopium* and *Vitex doniana* have low ranking of preference probably because of factors such as difficulty of accessibility to the fruits or the fear of predators and hunters. Also, the food preference may have been influenced by the nutritive value as well as micro climate and topography as reported by Petrides (1975). For example, the low ranking of preference for *Cactus species* (ranking 7) may be as a result of the fact that the plants grow in mountain tops which pose accessibility difficulties. The preference shown for particular plant species may be attributed to the presence of essential nutrients. Petrides (1975) observed that animals generally prefer foods rich in essential nutrients. Secondary compounds (tannins and alkaloids) which are potentially harmful to animals may be present in the food plants that are not preferred much by the baboons.

Nutritive Values of Preferred Food Plants

Results of the dry matter content of the food plants agrees with the findings of Schmidt-Nielson (1975) that dry matter content constitutes 20-30% of most plant parts, the rest being water which make up 70-80%. Therefore, the dry matter content of baboon foods which range from 23.6%-39.9% for most of the food plants indicated that the food materials are adequate in terms of dry matter content. The result of crude protein content of the preferred food plants in Hong hills is adequate with values ranging from 12.6%-22.6% indicating a high potential for growth, reproduction and regulation of body functions of the animals. The energy requirements of the animals are also likely to be met. Munro (1969) reported that about 12% of caloric or energy needs of most mammals is provided or supplied by protein apart from its usefulness for growth, reproduction and body function regulation. The high protein content might explain why these foods are preferred by baboons. The percentage crude fibre content indicated highest values of 29.0% for *Annona senegalensis* and lowest value of 24.4% for *oxytenanthera species*. The values obtained are in conformity with the report by Hladik (1975) that the crude fibre content of primate foods (fruits, stem and leaves) on the Colorado island ranges from 10% to as high as 74.5%. the crude fiber is nutritionally significant as it forms a good component of the died (roughages) essential for animals. The crude fibre content ranging from 24.4%-29.0% of baboon foods in Hong hills is therefore generally adequate. Percentage ether extract value scored highest for *Vitellaria paradoxa* (4.7%) and lowest for Cactus species (1.2%). The ether extract of food plants in Hong hills may be said to be high when compared with the findings by Richard (1998) who reported values of ether

extract ranging from 1.8%-2.5%. It may therefore be concluded that the preferred baboon foods in Hong hills are nutritionally of high value in view of the high crude protein and dry matter content of the preferred food plants.

CONCLUSION

The findings of this study indicate that forage resources in the study area are adequate for baboons in terms of diversity, availability and distribution. Sixteen forage plant species were identified, most of which produce fruits which are available either in the wet or dry season. The density of the important forage species is adequate. Therefore, food abundance may be attained in the study area if the available fruit trees are protected from fire and indiscriminate cutting. The nutritive value of foods preferred by baboon was also high in view of their high crude protein, dry matter, nitrogen free extract and ash content. The attendant effect of the presence of abundant food resources of high quality has a potential for growth in baboon population particularly when poaching is prevented.

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