



## A PRELIMINARY STUDY OF THE FOOD AND FEEDING BEHAVIOR OF CAPTIVE AFRICAN ELEPHANTS IN THE SAFARI PARK AND KARACHI ZOOLOGICAL GARDEN

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### ABSTRACT

This study examined the foraging behavior of elephants kept at Safari Park and Karachi Zoological Garden over a period of one year. There are four African elephants (*Loxodonta africana*) maintained in captivity at Karachi city. In the Safari Park, elephants are housed in a large enclosure made up of cement-flooring occupying the area of 68000 sq ft, however they spend most of their time in resting area which is located within the enclosure, and they take walk for about four hours in the morning and two hours in the evening per day outside the sand flooring area. While in the Zoological Garden they are housed in an enclosure comprising the area of 15534 sq ft which is separated from resting area comprising of 1978 sq ft. It was recorded that each elephant in Safari Park consumes about 221.5 kg of food per day, while each elephant housed in Karachi Zoo consumes about 265 kg of food per day which includes 58.6% of plant matter and 41.3% of supplementary diet. Zoo captive elephants, in particular have been the subject of several debates, related to walking, foot health, and stereotypic behavior. This study shows that the food provided to them fulfills the basic nutritional requirements. Elephants did not show any aggressive behavior during the study period. The actions and movements of the trunk by the elephants during their daily activity were also noted.

**Keywords:** *Loxodonta africana*, foraging behavior, captivity, enclosure, trunk.

### INTRODUCTION

Elephants are the largest intelligent, strong and social land mammals on earth. They possess the quality of altruism and also bear other emotionally intelligent skills (Uhlenbroek, 2008). Globally there are three species of elephants: the African savanna or bush elephant (*Loxodonta africana*), the African forest elephant (*Loxodonta cyclotis*), and the Asian elephant (*Elephas maximus*). In the year 2000 the African forest elephant was recognized as a separate species, and is smaller than the savanna elephant. Asian elephant includes three subspecies: the Indian (or mainland) (*E. maximus indicus*), the Sumatran (*E. maximus sumatranus*), and the Sri Lankan (*E. maximus maximus*) (Shoshani and Tassy, 2005; Shoshani, 2020). The African bush elephant (*Loxodonta africana*) is the largest land mammal present on earth.

The African savannah elephant (*Loxodonta africana*) possesses very large and straight ears and larger body size with two fingers like projections at the terminal end of its

trunk. African forest elephant (*Loxodonta cyclotis*) is different from savannah's elephant by the means of its smaller body size, rounded and smaller ears and straighter downward projecting tusks. While Asian elephant (*Elephas maximus*) is smaller as compared to its African counterparts and it has only one finger like projection at the terminal end of its trunk. Slight hump is present on its back. Ears are very small and slightly curved from upper side. Males generally possess tusks, while in most females, tusks are absent (Johnson, 2013).

The African elephant possess four toes in front feet and three toes in their back feet as compared to other Asian elephants that have five toes on the front feet and four toes on the back feet (Animal corner, 2005).

Feeding behavior of African Savanna elephants (*Loxodonta africana*) comprises of a variety of food including grass, leaves, twigs, fruits, barks, herbaceous material and soil (Kabigumila, 1993; Dierenfeld, 2008). Herbivore animals usually feed on a variety of vegetation over 400 species but regional and seasonal effects may alter the choice of food. Principal choice of African

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elephants are grass and seasonal vegetation while they are also dependent on fruits and barks (Kabigumila, 1993).

Elephants have shorter digestive tract as compared to other herbivorous mammals. The intestinal tract of Asian elephants is longer as compared to their African relatives (Clauss *et al.*, 2007). Asian elephants might intake higher quantity of grasses as compared to the African elephants (Boehlke *et al.*, 2017). African elephants are mixed feeders, including variable quantities of grass and browse into their diets (Codron *et al.*, 2006). A baby elephant drinks about 11.4 liters of its mother's milk per day which is equal to the 12 big cartons (Johnson, 2013).

Table 1. List of Captive Elephants in Pakistan.

S. No.	Centre of Captivity	Given Name	Scientific Name	Gender	Province	City
1.	Safari Park	Malika	<i>Loxodonta africana</i>	Female	Sindh	Karachi
2.	Safari Park	Sonu	<i>Loxodonta africana</i>	Male	Sindh	Karachi
3.	Karachi Zoo	Noor Jahan	<i>Loxodonta africana</i>	Female	Sindh	Karachi
4.	Karachi Zoo	Madhu Bala	<i>Loxodonta africana</i>	Female	Sindh	Karachi

Table 2. List of Safari Parks in Pakistan.

S. No.	Safari Park	Province	City
1.	Jallo Wildlife Park	Punjab	Lahore
2.	Lahore Zoo Safari	Punjab	Lahore
3.	Lohi Bher Wildlife Park	Punjab	Rawalpindi
4.	Murree Wildlife Park	Punjab	Murree
5.	Safari Park	Sindh	Karachi

Karachi Safari Park (longitude 67.1076314, latitude 24.9254611, elevation 46m) is situated at the main University road Karachi with area of about 400 acres (Khan *et al.*, 2017) and has 14 species of mammals in captivity (Table 3).

Table 3. List of Mammals in Safari Park.

S. No	Common Name	Scientific Name
01	African elephant	<i>Loxodonta africana</i>
02	Zebra	<i>Burchelli burchelli</i>
03	Fallow deer	<i>Dama dama</i>
04	Red deer	<i>Cervus elaphus</i>
05	Sambar deer	<i>Rusa unicolor</i>
06	Hog deer or Para	<i>Axis porcinus</i>
07	White fallow deer	<i>Cervus dama</i>
08	Spotted deer or Cheetal	<i>Axis axis</i>
09	Mouflon	<i>Ovisaries orientalis</i>
10	Chinkara or Gazella	<i>Gazella bennetti</i>
11	Blue bull or Nilgai	<i>Boselaphus tragocamelus</i>
12	Black buck	<i>Antilope cervi capra</i>
13	Urrial	<i>Ovis orientalis vignei</i>
14	Sindh ibex	<i>Capra aegagrus blythi</i>

Currently, there are a total of four elephants housed in the captivity centers in Pakistan. All four elephants are kept in Karachi, and were imported from Tanzania in 2009 (Ilyas, 2015). Brief information about the elephants that are housed in the captivity centers of Pakistan has been provided in Table 1.

Safari Parks are the important centers for the conservation of Critical Endangered, Endangered and Vulnerable wild species (Khan *et al.*, 2017) and they play important role in tourism and are economically beneficial for the country (see the list of Safari Parks in Pakistan Table 2).

The Karachi Zoological Garden was officially open for public in 1873 and covers an area of 33 acres. From all of the Pakistan's Zoos, Karachi Zoological Garden is the 2<sup>nd</sup> oldest one.

In June 2009, one male and three female calves of elephant were imported from Tanzania and kept at Karachi Safari Park. The age difference between these calves were 6 months each. During the initial six months of their arrival, elephant trainers / keepers stayed all day and night with these elephants to settle them in new environment. After six months, two female calves were shifted to Karachi Zoological Garden. The remaining pair of elephants is still housed in Safari Park, Karachi.

Upon arrival, one male elephant was 5 years old, two female elephants were about 5.6 years old and one female elephant was 6.2 years old. First, they were kept in small enclosure of Safari Park, just behind the present resting area, then after 6 months two female elephants were shifted to the Karachi Zoo. In 2013 remaining two elephants were shifted in the large enclosure within the Safari Park. [The reason behind their shifting was to provide them better house according to Zoo standard and their needs].

Since 2009, there have been two elephant trainers / keepers in the Safari Park, while three elephant trainers / keepers are at Karachi Zoo. The elephant keepers do communicate with elephants in Urdu and Marwari language, they also use hand gestures which are easily understandable by these elephants and these elephants obey their instructions.

African elephants are categorized as mixed feeders as they consume a mixture of both C3 browse and C4 grass species (Forrer and Leslie, 2017). The feed of these elephants include green and dry fodder, seasonal fruits, some vegetables, Lucerne Grass, Sugarcane, Chapatti (Bread), Maize, Jaggery, Boiled Rice and Parched Gram (Hussain K, personal communication, SP). There is no scientific work reported on the captive African elephants (*Loxodonta africana*) food and feeding behavior in Pakistan. The present study examined the food and feeding behavior of two elephants in Safari Park and two elephants housed at Karachi Zoological Garden.

## MATERIALS AND METHODS

### STUDY AREA

The present study took place at the Safari Park and Karachi Zoological Garden during June 2017- June 2018.

#### Safari Park

Two elephants housed in the captivity at Safari Park were selected for the study of food and feeding behavior. Both elephants are housed in a large enclosure of about 68000 sq ft cement-flooring area including a little pool of 29 x 22 sq ft for bathing purpose and resting area which is divided into two portions, one for female and another portion for male elephant (Fig. 1). The resting area is made up of concrete and steel bars of 6 inches each while the gaps between each bar is 8 feet 11 inches. For the construction of that enclosure Pak Rupees 20 million were spent in 2013 by the Local Government (Hussain, K, personal communication, Safari Park Karachi).

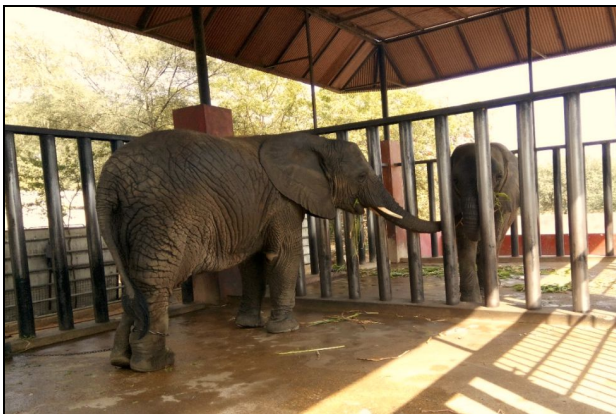


Fig. 1. Elephants (male and female) in Safari Park.

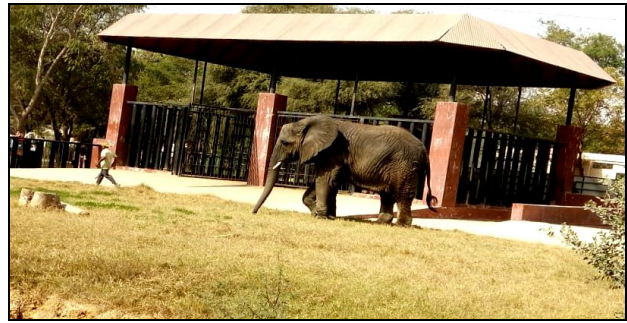


Fig. 2. Female Elephant outside of resting area of Safari Park.

#### Karachi Zoological Garden

Two elephants that are housed at Karachi Zoological Garden were selected for food and feeding behavior study. Both elephants are housed in a large enclosure of area of about 15534 sq ft. There is a little pool of 706 sq ft for bathing purpose and 1978 sq ft area for resting for elephants. The resting area is made up of concrete and steel bars (Fig. 3) which was constructed under the supervision of Government of Sindh (Abida, R. and Aamir I, personal communication, Karachi Zoo).



Fig. 3. Two Female Elephants in Karachi Zoological Garden.

## METHODS

The feeding behavior of elephants was studied by conducting regular visits during June 2017 to June 2018 by observing them from a distance from their enclosure during their feeding activity.

Based on our observations it was noted that they were eating different plant species such as Lucerne grass, dry and green fodder and the plant matter remaining after tree pluming. The elephant keepers also provided them other food stuff likewise Gram parched, Banana, Apple, Chapati (Bread) and Sugarcane.

Indirectly their diet was also recorded through personal communications with elephant keepers, the other staff and the veterinary doctor who treats elephants and other animals of Safari Park and Karachi Zoo.



### ETHICAL NOTE

During the research, observations were taken following the rules of the Safari Park and Karachi Zoological Garden and from the security zone, following the distance from the bars and the elephants. No interactions were made by the observer with the animals occurred during observations. Elephant's keepers only had their normal and usual interactions (i.e. moving them, giving them food, and talking to them).

### RESULTS AND DISCUSSION

Nutrition of all captive animals needs at least four important elements to ensure that zoo-housed animals get standard nutrition for good health and welfare: background, diet evaluation, diet implementation, and diet update (AZA Nutrition Advisory Group, 2001). Over a period of one year the food and feeding behavior of one pair of elephants in Safari Park and two female elephants housed at Karachi Zoological Garden were observed.

It was also noted that the elephants used their trunk to express their emotions and feelings by different movements during their activities (Figs. 4,5,6,7). Preliminary observations allowed us to record several behaviors displayed in different contexts: body care, playing, resting, feeding and social behaviors.

Generally, Elephant's diet is dependent on plant materials likewise leaves, grass and barks (Johnson, 2013). Several studies have reported that wild elephants spend the majority of their day foraging, feeding up to 16 hours per day on a variety of leaves, grasses, bark, twigs and roots (Hatt and Clauss, 2006; Laws, 1970; Shepherdson, 1999). The diet of captive elephants includes some vegetables, seasonal fruits, Sugarcane, Chapati (Wheat-flour breads), Jaggery, green and dry fodder and sometimes boiled rice. Before eating, the elephants first identified the food item and adapted their movement to manipulate it efficiently.



Fig. 4. The Elephant keeper do communicate with elephants in Urdu and Marwari language. They also use the hand gestures which are easily understandable by

these elephants and these elephants obey their instructions.

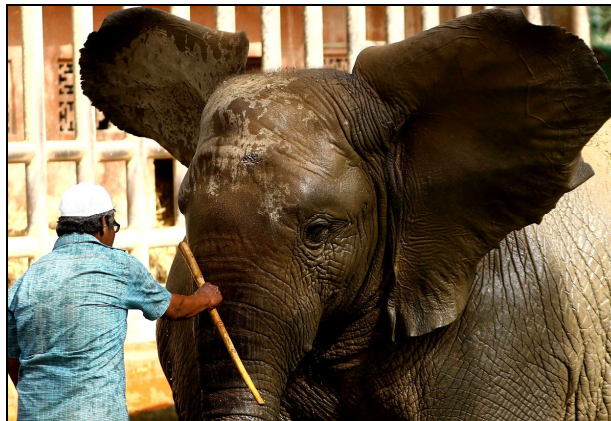


Fig. 5. Safari Park and Karachi Zoo Elephant keeper they also use the hand gestures which are easily understandable by these Elephants and these Elephants obey their instructions.



Fig. 6. Elephant understand Elephant keeper instructions during the bath.



Fig. 7. Another view Elephant understand Elephant keepers instructions during the bath.



During the study period, it was observed that these elephants grip the Maize plant (green fodder) between the two finger like projections of their trunk from the surface (Fig. 8) and then roll up their trunk slightly to grip tightly their food (Fig. 9) and then by the help of their trunk they transfer the food directly into the mouth and after chewing, they swallow the food. Sometimes, they place a little amount of green fodder on their head during feeding. Elephant's food piled up near their enclosures in the morning at Safari Park and Karachi Zoo. They were fond of eating different fruits like Apple, Banana, Carrot, Watermelon and Sweet potato.



Fig. 8. Trunk slightly roll up to tightly grip their food.



Fig. 9. Another view Trunk slightly roll up to tightly grip their food.

Elephant keepers used pipes to supply water to these elephants for drinking and bathing purposes. During drinking they showed playing behavior with water by splashing it around and upon their selves. By the help of their trunks, they also squirt the water in their mouths.

Their happiness was displayed by different kinds of behavior including running, producing distinct sounds, splashing water or playing with mud.

They walk about four hours per day outside of their resting area within their enclosures. While walking outside of resting area, in the fenced ground these elephants also feed on trees and grass present within the boundaries of ground. While these elephants roaming in the ground within their enclosures, they interact with local people and this activity help elephants to develop the bond with humans and get habitual (Park visitors).

During the time of direct interaction of elephants with public (Park and Zoo visitors), elephant keepers provide food continuously i.e. Banana, Orange, Jaggery and other fruits to prevent any aggressive behavior towards public.

Usually, elephant keepers provide the food to both elephants at the same time in Safari Park but once for the study purpose, green fodder was provided to female elephant and was not provided to the male to note down the behavior of male elephant. The male elephant was continuously moving its head from left to right and vice versa, he swung his trunk and was stretching his feet.

At night elephant keepers provide lots of food material including green and dry fodder which they also spread on the floor so these elephants can easily take rest upon it also use as a food and sugarcane is also placed near these elephants at night for feeding purpose.

#### DIET CHARTS

In the Safari Park the diet chart of elephants from the time of arrival till July 2016 was strictly followed by the elephant keepers and that chart was made by the Veterinary doctor of Safari Park (Table 4) according to which each elephant consumed 315 kg of food per day.

But from July 2016, their diet has been modified by the Veterinary doctor because of their age and nutritional requirements. Elephant keepers are trained and serve food according to the elephants' need and behavior (Table 5).

According to the new modified diet chart the food consumption of each elephant in Safari Park is 221.5 kg per day.

Table 4. Former Diet chart of two Elephants of Safari Park.

S. No.	Name of items	Quantity / day	Timings
1.	Banana	50 kg	09:00 AM
2.	Carrot	25 kg	12:00 PM
3.	Jaggery	02 kg	01:00 PM
4.	White rice	03 kg	01:00 PM
5.	Bhutta (corn) whole	20 kg	02:00 PM
6.	Apple	20 kg	03:00 PM
7.	Watermelon	30 kg	04:00 PM
8.	Sweet potato	25 kg	04:30 PM
9.	Seasonal fruit	05 kg	05:00 PM
10.	Lucerne grass	50 kg	06:00 PM
11.	Sugarcane	150 kg	06:30 PM
12.	Green fodder	150 kg	06:30 PM
13.	Dry fodder	100 kg	06:30 PM
	<b>Total</b>	<b>630 kg</b>	

Table 5. Present Diet chart of two Elephants of Safari Park.

S. No.	Name of items	Quantity per day
1.	Lucerne grass	60 kg
2.	Green fodder	120 kg
3.	Sugarcane	100 kg
4.	Banana	20 kg
5.	Watermelon	10 kg
6.	Apple	10 kg
7.	Seasonal fruit	10 kg
8.	Wheat flour (chapati)	10 kg
9.	Cucumber	05 kg
10.	Beet root	05 kg
11.	Bhutta (corn) whole	02 kg
12.	Jaggery	05 kg
13.	Gram parched	06 kg
14.	Dry fodder	80 kg
	<b>Total</b>	<b>443 kg</b>

According to the given diet chart of Karachi Zoo's elephants each elephant consumed up to 265 kg of food per day (Table 6).

An adult African elephant can consume up to 272 kg of food per day and can drink up to 200 liters of water per session (Elephant-World, 2021). Due to large physical body, these herbivores require large amount of food, as their body only digests about 40% of what they eat, leaving the other 60% undigested (Elephant-World, 2021).

Table 6. Present Diet chart of two Elephants housed at Karachi Zoological Garden.

S. No.	Name of items	Quantity per day
1.	Sugarcane	180 kg
2.	Fodder	120 kg
3.	Lucern grass	30 kg
4.	Dry grass	30 kg
5.	Banana	49 kg
6.	Carrot	24 kg
7.	Maize (Bhutta)	20 kg
8.	Sweet Potato	24 kg
9.	Water Melon	25 kg
10.	Apple	20 kg
11.	Rice	06 kg
12.	Jaggery	02 kg
	<b>Total</b>	<b>530 kg</b>

Two elephants, *Loxodonta africana* and *Elephas maximus* that are housed in captivity in San Diego Zoo, consumed about 57 kilograms of food each/per day (San Diego Zoo Wildlife Alliance, 2021). While according to the present diet chart, each elephant of Safari Park consumed an average of 221.5 kg and elephants in Karachi Zoological Garden consumed an average of 265 kg of food per day including grass, fruits, vegetables and rice.

Elephants of northern Kruger National Park consumed 40% grass in dry season and up to 50% of grass in wet season. In another study Brindley (2017) reported that the elephants of Nepal consumed about 24% grass and 65% browse in dry season, while the elephant of Karachi Safari Park consumed up to 58% of plant matter throughout the year.

The diet of elephant at Ngorongoro Crater, Tanzania consisted of at least 36 species of plants. While the Forest elephants of Lope Reserve, Gabon, ate more than 307 plants species, and more than 72 species of fruits, as they lived in forest area (Brindley, 2017).

In captivity, there is less pressure for elephants to find food. Elephants of Karachi Safari Park and Karachi Zoo feed on limited species of plants and depend on species of plants provided to them by the Keepers or available in their enclosure, while they are walking within the boundaries of their enclosures.

In new modified diet chart of elephants housed at Karachi Safari Park, boiled rice has been replaced with chapati (wheat-flour breads) because in the captivity most countries provide chapati instead of boiled rice. According to veterinary doctors of these elephants, chapati is good for the gastrointestinal tract. No change

was observed in the behavior of elephants because the modified chart was applied gradually. Whereas, rice is still included in the diet chart of elephants housed at Karachi Zoo.

The modifications in diet chart of elephants at Safari Park were according to their age as in the growing age they need more nutrients that is why old diet chart had increased quantity of food items especially fruits but now they need green material in large amounts as compared to fruits. That's why in previous diet chart the quantity of fruits and supplements is more (52.3%) and the quantity of plant material is less (47.6%), while in new modified chart the quantity of supplements is less (41.3%) and quantity of plant matter is greater (58.6%).

Food of elephants is stored in a store room where it is prevented from spoilage. In extreme weather conditions i.e. 36°C or more the stored food becomes spoiled but they also have made alternate arrangements for this situation, as they store extra amount of food stuff for that situation.

It was found that the elephants in both localities were less aggressive and more friendly with keepers and visitors, as the elephants were in good environment with proper resting areas and comfortable daily routine activities including walking, bathing, medical checkup, feeding and playing.

## CONCLUSION

It was concluded that elephants of Safari Park consume about 221.5 kg of food per day which includes 58.6% of plant matter and 41.3% of supplementary diet, while each elephant housed in Karachi Zoological Garden consumes about 265 kg of food per day. During drinking they looked happy and showed playing behavior with water by splashing it around and upon their selves. By the help of their trunks, they also squirt the water in their mouths. The elephant keepers and veterinary doctors provide suitable environment, proper food and comfort zone to these elephants so there is no sign of aggression found in these elephants.

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