Preference and Proximate composition of Foods Offered to Captive Non-human primates at Zoological Garden, University of Lagos , Lagos, Nigeria

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Abstract

Preferred foods that meet the nutritional needs of captive non-human primates (NHPs) must be provided for their nourishment and welfare. Using the NHPs in the University of Lagos' Zoological Garden, food preference, nutritional contents of provided foods, the relationship between preference and nutritional components, and the predictive effect of nutrient on food preference were assessed in this study. Feeding tests were conducted using two adults and a young mona monkey (Cercopithecus mona), one adult each of green monkey (Chlorocebus sabaeus), and baboon (Papio anubis). The NHPs were offered banana fruit, carrot root, coconut flesh, cucumber fruit, dried maize grains, garden egg fruit, green pea seeds, pawpaw fruit, and sweet potato roots in batches for five weeks to determine food preference, re-acceptability and coefficient of preference (COP). Preferred foods were those with COP ≥1. The food samples were analysed for moisture, crude protein (CP), ether extract (EE), crude fibre (CF), ash, and nitrogen free extracts (NFE). Correlation analysis was used to determine the relationship between food preference and nutrient contents. C. mona and C. sabaeus exhibited preference for banana and cucumber (COP=1.01). However, P. anubis preferred garden egg (COP=1.05). Green peas contained 21.94% CP, while coconut contained 18.93% EE. There was a positive correlation between COP and CP, EE and CF values of 0.42, 0.37, and 0.30, respectively. A significant predictor of COP was EE (β=0.048, t=2.697, p=0.027). Another predictor was CF (β=0.017, t=1.159, p=0.28). Banana, cucumber and garden egg, could be used with animal food sources in feeding captive NHPs.

Keywords: Captive feeding, coefficient of preference, food preference, non-human primates, nutrient content

Running Title: Captive non-human primates' food preference

Préférence et composition proximale des aliments offerts aux primates non humains captifs au Jardin zoologique de l'Université de Lagos, Lagos, Nigéria

Résumé

Les aliments préférés, qui satisfont les besoins nutritionnels des primates non humains (PNH) captifs, doivent être fournis pour leur alimentation et leur bien-être. En utilisant les PNH du Jardin zoologique de l'Université de Lagos, la préférence alimentaire, les contenus nutritionnels des aliments fournis, la relation entre la préférence et les composants nutritionnels, ainsi que l'effet prédictif des nutriments sur la préférence alimentaire ont été évalués dans cette étude. Des tests d'alimentation ont été réalisés avec deux adultes et un jeune singe Mona (Cercopithecus mona), un adulte de chaque espèce de singe vert (Chlorocebus sabaeus) et de babouin (Papio anubis). Les PNH ont reçu des fruits de banane, des racines de carotte, de la chair de noix de coco, des fruits de concombre, des grains de maïs séchés, des fruits d'aubergine, des graines de pois verts, des fruits de papaye et des racines de patate douce, en lots pendant cinq semaines afin de déterminer la préférence alimentaire, la réacceptabilité et le coefficient de préférence (COP). Les aliments préférés étaient ceux ayant un COP =1. Les échantillons alimentaires ont été analysés

pour leur teneur en humidité, en protéines brutes (PB), en extrait éthéré (EE), en fibres brutes (FB), en cendres et en extraits non azotés (ENA). Une analyse de corrélation a été réalisée pour déterminer la relation entre la préférence alimentaire et les composants nutritionnels. C. mona et C. sabaeus ont montré une préférence pour la banane et le concombre (COP=1,01). Cependant, P. anubis préférait l'aubergine (COP=1,05). Les pois verts contenaient 21,94 % de PB, tandis que la noix de coco contenait 18,93 % d'EE. Une corrélation positive entre le COP et les valeurs de PB, EE et FB a été observée avec des coefficients de 0,42, 0,37 et 0,30 respectivement. Un prédicteur significatif du COP était l'EE (ß=0,048, t=2,697, p=0,027). Un autre prédicteur était le FB (ß=0,017, t=1,159, p=0,28). La banane, le concombre et l'aubergine pourraient être utilisés en complément d'aliments animaux pour nourrir les PNH captifs.

Mots-clés : Alimentation captive, coefficient de préférence, préférence alimentaire, primates non humains, contenu nutritionnel

Introduction

As important as food is to the survival of an animal, animals do not eat every food and therefore are very selective in what they eat (Kyriazakis *et al*., 1999; Rose, 2024). What animals select when feeding are determined by their digestive structure, physiological state, fluctuations in seasonal availability and abundance, among other factors, as nutritional densities of food items (Parrish *et al.,* 2020). Animals demonstrate their food preference by which ones they eat, the ratio of intakes when foraging, or given a choice, if held in captivity (Forbes and Kyriazakis, 1995; Ganas *et al.*, 2008; Olaleru and Babayemi, 2020; Martins *et al.*, 2022). Animals are capable of choosing a balanced diet from two or more foods to meet their nutritional requirements and avoid obnoxious ones (Duncan and Gordon, 1999; Catanese *et al*., 2009; Johnson, 2024). Captive species could be limited to the foods offered to them.

Food preference is the first measure of foraging behaviour exhibited by animals and are monitored by their selection. It is a primary determinant of dietary intake and behaviour, and could persist, especially in humans (Beckerman *et al.,* 2017). Food preference studies are used as a tool to estimate some aspects of feeding behaviour in animals (Alegría-Morán, 2019). Animals acquire preferences for foods that meet their nutritional needs. Nutrition is crucial in animal food choices, and has been regarded as an important aspect of captive animal welfare (Villalba *et al.*, 2010).

Non-human primates (NHPs) are social animals that exhibit high sense of intelligence (Ejidike and Salawu, 2009), and do make food choices when foraging. They are selective feeders displaying marked preferences for some foods (Laska *et al.,* 2000; Lalremruati and Solanki, 2018). Some are frugivorous omnivores (feeding on a wide variety of fruits, and animals), while others are folivorous (feeding measuredly on leaves and other plant parts).

During feeding, an animal's foraging strategies are affected by nutritional requirement, spatial and temporal availability of food, and the amount of energy and time required to locate and consume food resources (Plante *et al*., 2013; Vogel *et al*., 2017; Rodríguez-Malagón, 2018). There are three basic measures of foraging behaviour exhibited by animals, namely; food preference, food choice, and food selectivity (Ganas *et al.,* 2008). Food preference measures food consumption based on the assumption that there is no variation in the availability of food items in the animal's diet. It is the first measure of foraging behaviour exhibited by animals, controls for differences in accessibility and afterward determines which food species would be picked over another (Olaleru and Babayemi, 2020). It is established based on choices made,

order of selection, and amounts consumed during experimental trials (Remis, 2002).

Most non-human primates (NHPs) have a mixed diet, plenty of plant based sources, and animal sources (omnivores). Most NHPs have been reported to be highly intelligent and display marked preferences for some foods when they forage (Laska *et al.,* 2000; Lalremruati and Solanki, 2018). The foraging strategies of animals are affected by their nutritional requirement, the spatial and temporal availability of food, and the amount of energy and time required to locate and consume food resources.

Outside their natural habitats, captive NHPs depend on humans for food. Insufficient knowledge on the food preferences NHPs may limit effective conservation of these animals (Alarape *et al.,* 2018). This is quite crucial for captive species that access only provisioned foods. Foods preferred by NHPs in captivity could be served to those that are sick or recovering from sickness or surgery. In order to provide the foods that they prefer and which also meet their nutritional needs, it is important to determine the food preference and nutritional contents of these foods. The correlation between food preference and the nutritional content of food items preferred could offer solutions to meeting the nutritional requirements of captive NHPs.

In several food preference studies using captive non-human primates, food were offered in binary sets to an individual or two of the same species (Lalremruati and Solanki, 2018), several individuals of the two sexes of the same species (Silveria *et al*., 2024), or several individuals of the two sexes of two species (Laska, 2001). However, in practice captive NHPs are often served different food types at their feeding time. With this practical method of feeding, their preference for the foods they are served regularly need to be understood, given these items contain nutrients in different proportions.

The objective of the study was to assess the foods captive NHPs preferred most. The objectives of the study were to determine food selection order, and preference, the nutrient contents, and the connection between food preference and nutritional content of nine food samples provided to captive NHPs at the Zoological Garden, University of Lagos, Nigeria.

Materials and Methods

Study site and animals

This study was conducted at the Zoological Garden, University of Lagos, Akoka, Lagos, Nigeria. The University is located in the northeastern part of Yaba, and lies between 6^{o} 31 0' N and 3^{o} 23 10' E to 6^{o} 30 52' N and 3^{o} 24 18' E (Olaleru, 2016). The animals used for study were non-human primates (NHPs) made up of: two adults and a young mona monkey (*Cercopithecus mona*), one adult each of green monkey (*Chlorocebus sabaeus*), and baboon (*Papio anubis*). All these animals were donated in 2021 to the Zoological Garden by the Nigerian Armed Forces Rehabilitation Centre, Oshodi, Lagos.

Nine food samples: banana fruit (*Musa sapientum*), carrot root (*Daucus carota sativus*), cucumber fruit (*Cucumis sativus*), coconut flesh (*Cocos nucifera*), dried maize grains (*Zea mays*), garden egg fruit (*Solanum melongena*), green pea seeds (*Pisum sativum*), pawpaw fruit (*Carica papaya*), and sweet potato roots (*Ipomoea batatas*) were used for the studies. The food items, obtained from local markets, were the ones usually offered to the NHPs in the Zoological Garden, University of Lagos.

Data Collection

Food preference studies

The food preference study adopted the cafeteria method used by Olaleru and Babayemi (2020). The nine foods were fed to the NHPs in batches for five weeks. Each of the food samples was weighed (300g for each monkey and 600g for the baboon) and portioned in separate feeding bowls. The feeding bowls were randomly placed in

strategic locations inside the cages of the animals. The colours of the feeding bowls were changed daily to check the animals from associating the colours of the feeding bowls to any food sample. The food samples were offered in five batches. Four batches were used to determine the most consumed food over a period of four weeks. The fifth batch was used for re-acceptability to determine the overall food preference. The food samples were matched per batch. Each batch was offered for seven days – two days for acclimatization and five days for feeding trials. The animals were fed at 10:00 am every day and were provided with water *ad libitum*. The order of selection of the foods was observed for each batch and each animal.

Batch 1: The animals were fed with carrot, banana, green peas, garden egg, and dried maize grains.

Batch 2: The animals were fed with sweet potato, cucumber, green peas, and coconut.

Batch 3: The animals were fed with carrot, pawpaw, banana, and cucumber.

Batch 4: The animals were fed with pawpaw, sweet potato, coconut, and garden egg.

Batch 5: Foods with coefficient of preference (COP) ≥1 (banana, cucumber, garden egg and pawpaw) were used for re-acceptability studies according to Olaleru and Babayemi (2020).

Estimation of Food Intake

The food samples were weighed before the experiment and 24 hours after. The food leftovers were collected and weighed using a weighing balance. The food intake was determined as the difference between the food offered and the leftover. Food intake was determined using the equation below:

Food intake = The weight of food offered – the weight of leftovers

Nutrient analysis of food samples

The nine food samples were subjected to proximate analysis which was conducted in the Biochemistry Laboratory, College of Medicine, University of Lagos. Moisture, crude protein, crude fat (ether extract), crude fibre, and ash were determined using methods of AOAC (2017). Carbohydrate (Nitrogen free extract) was determined by difference. The details of these analyses are explained in Olaleru (2016).

Ranking of food samples based on nutrient contents

The first three food samples with the highest values of each of the food nutrients were listed. These were then ranked based on the number of times they occurred in each nutrient category. Those that appeared thrice or twice were then valued based on their position in the rank. If a plant sample occurred thrice for instance, their ranking was then arranged. The one with the least sum of ranking was regarded the one with the best nutrient value.

Data Analysis

Data collected from the feeding trials were analyzed using descriptive analysis to determine the average of each food consumed and were presented using Tables. Food preferred by the NHPs studied was determined from the coefficient of preference (COP) value. The value was calculated from the ratio between the intakes for each food divided by the average intake of the foods.

The COP for each food was determined using the equation below:

COP (A) = (Intake of food (A))/ (Mean of the food intakes) (Olaleru and Babayemi, 2020).

Correlation analysis of coefficient of preference and nutrient composition

The COP and nutrient analysis data were analyzed and summarized using inferential statistics such as independent sample t-test, Pearson correlation and multiple regression analysis.

Results

Coefficient of preference of foods offered in Batches 1 to 4 and the re-acceptability trials

Tables 1 to 5 showed the respective COP for foods offered to the three species in Batches 1 to 4, and re-acceptability feeding trials. In Table 1, dry maize grains was the least preferred. *Chlorocebus sabaeus* had the least preference for carrot root, while *P. anubis* did not prefer green pea seeds. With COP > 1, banana fruit and garden egg fruit were accepted by all the three NHP species.

For foods offered in Batch 2, green pea seed was the least preferred (Table 2). Coconut flesh was preferred by only *P. anubis*, while all of them preferred cucumber fruit. Both *C. mona* and *C. sabaeus* did prefer sweet potato roots.

Table 1: Coefficient of preference of foods offered in Batch 1 to the three species of NHPs

Food Sample	COP for *C. mona*	COP for *C. sabaeus*	COP for *P. anubis*
Banana fruit	1.09	1.19	1.28
Carrot root	1.04	0.86	1.25
Garden eggs fruit	1.14	1.19	1.44
Green pea seeds	1.07	1.18	0.81
Dried maize grains	0.67	0.56	0.21

Table 2: Coefficient of preference of foods offered in Batch 2 to the three species of NHPs

Food Sample	COP for *C. mona*	COP for *C. sabaeus*	COP for *P. Anubis*
Cucumber fruit	1.14	1.18	1.25
Coconut flesh	0.82	0.93	1.10
Green pea seeds	0.96	0.86	0.96
Sweet potato roots	1.06	1.02	0.49

Table 3: Coefficient of preference of foods offered in Batch 3 to the three species of NHPs

Food Sample	COP for *C. mona*	COP for *C. sabaeus*	COP for *P. anubis*
Banana fruit	1.01	1.00	0.93
Carrot root	0.97	0.97	0.99
Cucumber fruit	1.01	1.00	1.04
Pawpaw fruit	1.01	1.00	1.04

Table 4: Coefficient of preference of foods offered in Batch 4 to the three species of NHPs

Food Sample	COP for *C. mona*	COP for *C. sabaeus*	COP for *P. anubis*
Coconut flesh	0.62	0.59	0.64
Garden egg fruit	1.31	1.31	1.44
Pawpaw fruit	1.31	1.31	1.44
Sweet potato roots	0.75	0.78	0.48

Table 5: Coefficient of preference of foods offered for re-acceptability to the three species of NHPs

Food Sample	COP for *C. mona*	COP for *C. sabaeus*	COP for *P. anubis*
Banana fruit	1.01	1.01	1.05
Cucumber fruit	1.01	1.01	1.05
Garden egg fruit	1.01	1.01	1.05
Pawpaw fruit	0.98	0.98	0.85

Order of selection of foods

It was difficult to effectively establish the order of selection among the three mona monkeys. This was because they were together (1 adult male, 1 adult female and a young one). Due to their social ranking, if the adult male fed on one food, the adult female and her baby fed on next available ones.

The green monkey and baboon consumed garden egg first followed by banana, and lastly on dried maize grains on all the days in Batch 1. In Batch 2, the green monkey and baboon consumed cucumber first followed by green peas on days 1 to 3. On days 4 and 5, they consumed green peas first followed by coconut. Sweet potato was the last they both consumed during the five days. The baboon consumed pawpaw first followed by cucumber throughout Batch 3. The green monkey consumed pawpaw first on days 1 to 4, but consumed cucumber first on day 5. Banana was consumed last by the baboon and green monkey. In Batch 4, the green monkey and baboon consumed pawpaw first followed by garden egg for all the five days. Sweet potato was consumed last by both species throughout the five days. During the re-acceptability, the baboon and green monkey consumed cucumber first for all the days. The baboon consumed garden egg next. The green monkey consumed banana second.

Nutrient content of assessed foods

The proximate composition of the nine food samples are presented in Table 6. Cucumber had 80.18% moisture content which was the highest of all nine foods, but had the lowest ether extract, crude fibre, ash, and carbohydrate contents. Green peas had the highest ash content and carrot had the highest crude fibre content with 5.77% and 17.88% respectively. The foods had low crude protein contents, except for green peas that had the highest amount of protein with 21.94%. Coconut had the highest ether extract content with 18.93%. Maize had the highest amount of carbohydrate with 68.89% followed by sweet potato with 58.98% and was closely followed by banana with 55.23%. The average CP and CF contents were both 7.23%. That of NFE was 47.39%.

Table 6: Proximate composition of the food samples offered to captive non-human primates

Food samples	Moisture (%)	Crude protein (%)	Ether extract (%)	Crude fibre (%)	Ash (%)	NFE (%)
Banana fruit	25.84	4.66	4.51	4.04	6.36	55.23
Carrot root	10.74	8.00	5.28	17.88	4.76	53.34
Coconut flesh	10.58	1.57	18.93	14.67	2.37	51.91
Cucumber fruit	80.18	2.13	0.09	1.79	0.34	15.49
Garden egg fruit	35.08	13.13	2.13	4.96	5.00	39.72
Green pea seeds	13.42	21.94	3.39	3.86	5.77	51.70
Maize grain (dry)	19.46	4.92	0.43	3.03	3.28	68.89
Pawpaw fruit	64.35	0.19	0.14	2.39	1.65	31.29
Sweet potato roots	14.48	8.53	0.36	12.49	4.80	58.98

Ranking of food samples based on nutrient composition

The first three food samples with the highest nutrient contents are presented on Table 7. These were further ranked based on whether they occurred three or two times or once. Using that order, carrot was ranked first, followed by banana and garden eggs. Pawpaw was ranked last.

Table 7: Ranking of foods based on their nutrient contents

Nutrient	Food sample	Content (%)	Food sample	Ranking	Position
	Cucumber fruit	80.18	Occurred three times		

Moisture	Pawpaw fruit	64.35	Carrot root	3,2,1 (6)	1
	Garden egg fruit	35.08	Banana fruit	3,1,3 (7)	2
	Green pea seeds	21.94	Garden egg fruit	3,2,3 (8)	3
Crude Protein	Garden egg fruit	13.13			
	Carrot root	8.00	Occurred two times		
	Coconut flesh	18.93	Green pea seeds	1,2 (3)	4
Ether Extract	Carrot root	5.28	Coconut flesh	1,2 (3)	4
	Banana fruit	4.51	Sweet potato roots	3,2 (5)	6
	Carrot root	17.88			
Crude Fibre	Coconut flesh	14.67	Occurred once		
	Sweet potato roots	12.49	Cucumber fruit	1	7
	Banana fruit	6.36	Maize grain	1	7
Ash	Green pea seeds	5.77	Pawpaw fruit	2	9
	Garden egg fruit	5.00			
Nitrogen Free Extract	Maize grain	68.89			
	Sweet potato roots	58.98			
	Banana fruit	55.23			

Correlation analysis of re-acceptability coefficient of preference and nutrient composition

Table 8 showed the correlation between the re-acceptability COP and nutrient contents of the foods. There was a positive correlation between COP and carbohydrate (r = 0.12), crude protein (r = 0.42, ether extract (r = 0.37), and crude fibre (r = 0.30). These were not significant (p > 0.05).

Table 8: Correlation between re-acceptability coefficient of preference, and nutrient contents of foods

Components	r (Correlation)	p- value
Coefficient of preference	1	
Nitrogen free extracts	0.12	0.71
Crude protein	0.42	0.18
Ether extract	0.37	0.24
Crude fibre	0.30	0.34

Predictive Effect of Nutrient Content on Food Preference

The prediction model of COP, using regression analysis, on NFE, EE, and CF, showed that EE the highest beta value of 0.048, t - value of 2.697 and p value of 0.027. This was followed by CF with beta value of 0.017, t - value of 1.159 and p value of 0.28. Nitrogen free extract had a negative predictive relationship with COP with a beta value of - 0.006, a t- value of - 2.635 and p value of 0.03. This implied that an increase of 1 unit in carbohydrate will result in 0.006 decrease in preference.

Discussion

The selection of any particular food depended on the combination of foods offered. The selection of garden eggs, banana, and maize by green monkeys and baboon showed their choice for foods that have seeds that require mastication, and the one rich in energy. When seeds and nuts were offered, their choice switched to cucumber, green peas, and coconuts, foods that were succulent and rich in protein, and oils.

The most preferred foods of the NHPs in this study were banana, cucumber and garden egg. These food items had COP values above unity. As frugivores, these three NHPs species exhibited the preference for these plants that are botanically regarded as fruits. A fruit is a matured or ripened ovary (Dutta, 1998). The present results indicated that captive frugivorous NHPs could be offered these fruits, especially when they are ill or recuperating from some illness or operation. It would likely activate their appetite for food. Their preference for cucumber and garden egg, may be due to the seeds these fruits contain, and which could be rich in proteins and fats. This was similar to what Martins *et al.* (2022) reported where zoo-housed white-faced sakis (*Pitheca pithecia*) preferred seeds and nuts. In a previous study involving only *C. mona,* Olaleru and Babayemi (2020) reported *Musa sapientum, Zea mays*, and *Solanum melongena* as the most preferred foods. In the present study *Z. mays* was not preferred. The *Z. mays* used in the previous study was fresh while the one used in the present study was dry. The ease of consuming fresh maize could have attributed to the high COP. In a study in India using captive Northern pigtailed macaques (*Macaca leonina*), babana, pawpaw, and apple were the first three most preferred food when offered in binary combinations (Lalremruati and Solanki, 2018). Banana, as the most preferred food was also observed among captive Southern brown howler monkey (*Alouatta guariba clamitans*) by Silveira *et al.,* (2024). So whether in Africa, Asia, or South America, banana is the most readily accepted food to NHPs.

In terms of nutrient ranking, carrot was the first vegetable with most balanced proportion of nutrients, but it was not the most preferred. Other factors do modulate what an animal selects to eat. Among 12 food items offered to captive ring tailed lemurs, Hansell *et al.,* (2020) reported carrot as the fifth preferred food. Carrot was the fourth food preferred by western lowland gorillas (*Gorilla gorilla gorilla*) from among eight offered to them (Vonk *et al.,* 2022).

The low and insignificant correlation between food preference and carbohydrates was at variance with the significant correlation observed by Hansell *et al.* (2020), Jildmalm *et al.* (2008) in *Hylobates lar*, *Lemur catta*, and *Macaca nemestrina* reported a very high and positive correlation between food preference and carbonhydrate content. Laska (2001) reported a positive correlation between food preference and carbohydrate, protein and ether extract contents in *S. sciureus*, and a a positive correlation between food preference and carbohydrate content in *M. nemestrina*. In these other studies, only two sets of foods that were relatively soft and succulent were offered to the species. Most NHPs prefer succulent foods with high moisture content, which allows for easy mastication and digestion as well as reduced dehydration (Murad and Nyc, 2016).

The low positive but non-significant correlation between the COP and nutrient composition was at variance with that reported by Olaleru (2016), where there was a significantly negative correlation between CF and the COP. The use of three species of NHPs in the present study as supposed to a single species (*C. mona*) may be attributable to this difference. The number and type of food items could have caused the variance. Nine food items were used in the present study, whereas six were used in the previous study.

Internal factors like body size, basal metabolic rate, digestive adaptations, nutritional and energy requirements are major determinants of food preference (Olaleru and Babayemi, 2020). As monogastric animals, baboons, mona monkeys and green monkeys require low fibre foods for easy digestion. The three preferred foods, in this study, were high in carbohydrate and low in fibre and protein.

The highest predictive value of EE on COP implied that EE was the significant predictor of

COP. Since the second and third most preferred foods had seeds, they may be good sources of EE. Martins *et al.* (2022) observed that white-faced sakis (*Pitheca pithecia*) had high preference for seeds and nuts. The negative predictive effect observed of carbohydrate on COP could be the reason why dry maize seeds and sweet potato which had the highest carbohydrate contents were not among the preferred foods. Handell *et al.* (2020) showed sweet potato as the second most preferred food by *Lemur catta*. Although primates need energy for their activities, some species need metabolizable energy as observed in *M. nemestrina*, which are readily available from fruits, while others may require total energy as observed in *S. sciureus* (Laska, 2001).

In the wild, frugivorous and folivorous NHPs may differ in their food selection. When in captivity where they are provided with mostly domesticated foods consumed by humans, their preference may be similar. As frugivorous animals, the baboon, green monkey, and mona monkeys exhibited preference for these plants, would normally have less secondary metabolites that could be harmful to them.

Conclusion and Recommendation

The non-human primates in the Zoological Garden, University of Lagos exhibited preference for banana, cucumber and garden egg. Food preference also had statistical relationship with the nutritional contents of the foods. The few members of the three species studied were generalist feeders that maximized their use of all food sources that are high in carbohydrates, protein and ether extract. Banana, cucumber, and garden egg, could be used with animal sources of foods in the nutritional management of captive NHPs. Since nuts and seeds are high in protein and oils, needed for growth, repairs of worn out tissues, and energy could also be provided.

Acknowledgement

The authors are grateful to Mrs. Olubunmi Adeyemo and Mr. Dennis Mongbe (now retired), technical staff members in charge of the animals. They assisted in food storage, measurement and service.

Conflict of Interest

We declare that there was no conflict of interest.

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Date received: 27th November, 2024

Date accepted: 9th March, 2025