Indian J. Anim. Nutr. 2022. 39 (2): 200-204
doi: 10.5958/2231-6744.2022.00025.1

Indian Journal of Animal Nutrition

Nutritional Composition of Wild Fruits and Flowers Eaten by Lion Tailed Macaque (*Macaca silenus*) at Silent Valley National Park, Kerala, India

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ABSTRACT

Lion-tailed Macaque is listed as an Endangered (IUCN, 2020) species and endemic in the rain forests of the Western Ghats and found mainly in silent valley national park located in southern part of Western Ghats in the border of Mannarkkad Taluk of Palakkad district, Nilambur Taluk of Malappuram district, Kerala and Nilgiris district of Tamil Nadu. During field survey, it was found that Lion-tailed Macaques preferably eat flowers and seeds of Cullinea exarillata (Wild durian), flowers of Litsea floribunda (Pattuthali), fruits of Ficus rescimosa (Cluster Fig) and Ficus exasperate (Sand paper), ripened and un-ripened fruits of Artocarpus heterophyllus (Jack fruit), Artocarpus hirsutus (Wild Jackfruit), Mangifera indica (Mango) and Psidium guajava (Guava). The items consumed by Lion-tailed Macaque was analysed for its chemical composition and found that highest per cent of fibre (42.01%), crude protein (21.79%), crude fat (5.09%), calcium (6.09%) and phosphorus (8.66%) were found in Ficus microcarpa, Artocarpus hirsutus, Ficus beddomei,Ficus exasperata respectively.

KEYWORDS: Flowers, Ficus species, Calcium, Lion Tailed Macaque, Proximate composition, Phosphorus, Wild fruits,

Article received : 15 June 2022; Article accepted: 30 June 2022

INTRODUCTION

The Lion-tailed macaque an endemic species in the Western Ghats, habitat in the evergreen rainforest, deciduous, contiguous, and fragmented forests faced a shortage of feed to meet its nutrient requirements, drastic variation in food composition and availability, instead of feeding on fruits and flowers, leaves, they forced to passing through plantations, roads and human settlements for the search of food causes animal- man conflicts that extinction is imminent. Though lion-tailed macaques are considered endangered, comprehensive information on the quality of food consumed is not readily available.

Different studies reported that over 50% of the lion-tailed macaque population is distributed within <20 km2 area in habitat fragments in the Western Ghats *viz* in Silent Valley National Park (SVNP), Parambikulam Wildlife Sanctuary in Kerala (Ramachandran and Joseph, 2001), Sirsi and Honnavara Forest Divi-sions (Kumara and Singh, 2004), Kudremukh National Park and the adjoining sanctuaries (Kumara and Singh, 2008) and Kalakad-Mundanthurai Tiger Reserve in Karnataka and Anamalai Tiger Reserve (Ravichanran and Mahaly, 2020) and Megamalai Wildlife Sanctuary in Tamil Nadu.

It is a well-known fact that primate species are very selective in their diet, omnivorous in nature, 60 % of the diet is fruits, fruits, and flowers of *Cullenia exarillata* and mainly Ficus spp fruits (Kumar, 1987; Sushma et al., 2014). Further, composition of fruits and flowers are varying in every degree coordinate of the location, and macaques are forced to select their required food items to meet its nutrient requirements due to variation in rainfall pattern, temperature variation, and forest fire restrict the foraging activities of LTM,

leads a greater risk of extinction (Harcourt and Parks, 2003).They predominantly eating fruits and flowers from December to February and May to July (Kurup and Kumar, 1993) and other months moving across the forest to look for fruiting trees. When their favoured food trees are not in fruiting and macaques depend on the flowers of Cul-lenia and a seasonal and non-synchronous fruits of Ficus. Thus, the objective of the present study is to analyse the nutritional composition of fruits and flowers eaten by a group of Lion-tailed macaque habitats in evergreen forest in Silent Valley National Park Kerala.

MATERIALS AND METHODS

The flowers and seeds of *Cullinea exarillata* (Wild durian), flowers of *Litsea floribunda* (Pattuthali), fruits of *Ficus rescimosa* (Cluster Fig) and *Ficus exasperate* (Sand paper), ripened and un-ripened fruits of *Artocarpus heterophyllus* (Jack fruit), *Artocarpus hirsutus* (Wild Jackfruit), *Mangifera indica* (Mango) *and Psidium guajava* (Guava) samples were collected from the Sairandri and Panthanthode camps of Silent Valley National Park which is endemic area for Lion tailed macaque, geographically located in Palakkad district of Kerala state between latitude 11° 22 and 11° 142 N and longitude 76° 202 and 76° 322 E during the field survey conducted during behavioural studies of LTM.

The food items selected for consumption, parts eaten was noted by using binoculars (Olympus 8-16 X 40 ZOOM DPS I) during the focal sampling technique as stipulated by (Altmann 1974). Totally, 10 minutes were allotted to focus the particular macaque or till it moved from one canopy to another. Macaques are basically omnivores, fed upon leaves, stems, flowers, bud, fungi, insects, lizards and tree frogs, however, floral diets of LTM were only collected for the analysis. Non-plant materials (tree frogs, insects, soils) observed eaten by study animals were excluded.

Totally 60 samples of different flowers, fruits and seeds consumed by the LTM were collected during Jan–Feb'2020 for 25 days at Sairandri camp and another 40 days from December'20 to January'21 at Panthanthode camp area at Silent Valley National Park, Kerala. The samples collected in a sealed container were shifted to feed analytical lab immediately after collection. Samples were dried, powdered in a sampling Willey mill and kept in airtight sample container for estimation of chemical composition *viz* moisture, crude protein, crude fibre, ether extract, total ash, acid insoluble ash, calcium and phosphors (AOAC, 2016).

RESULTS AND DISCUSSION

In this study, it was observed that Lion-tailed macaques have selected a variety of faunal and floral diets include leaves, stems, buds, fungi and invertebrates. However, during December, January and February month of our field survey, commonly assigned as winter season with less rain fall and low temperature in Silent Valley park, Kerala (Ramachandran, 1998). LTM have mainly selected Ficus species ripened fruits, seeds and Cullinea flowers. Ramachandran (1998) clarified that, selection of fruits, flowers, seeds and other items were significantly varied based on the season in Silent Valley Park and availability of fruits. The flowers for feeding were available during February and November months. Seeds availability and feeding was moderate in all seasons. In rainforest like silent valley, flowering of Cullenia species occurs during February–April periods, when fruits scarcity and most of the other plant species do not flower (Ganesh and Davidar.,1994) and similarly in the present study during February month macaques were heavily fed on Cullenia flowers.

Kassim et al. (2017) mentioned that Long-tailed macaques (*Macaca fascicularis*) commonly consuming *Arenga pinnata*, *Areca catechu*, *Terminalia catappa*, *Elaeis guineensis*, *Lagerstroemia tomentosa*, *Mangifera indica*, *Cascabela thevetia*, *Muntingia calabura*, *Musa* sp., *Artocarpus heterophyllus*, *Ficus tinctoria* ssp. *gibbosa* and *Ficus microcarpa* and parts eaten by Long-tailed macaques (*Macaca fascicularis*) are similar to Lion tailed macaques as reported in this study. While comparing selection of fruits by LTM,

four Ficus species namely *Ficus beddomei*, *Ficus nervosa*, *Ficus microcarpa* and *Ficus tsjahela* were eaten by LTM (Ramachandran,1998), which is similar to our findings and preferring pulp of mature fruits. The chemical composition of collected fruits and seeds are presented in (Table 1). Like that, collected flowers chemical composition is presented in Table 2.

Table1. Nutrient Composition of fruit items consumed by Lion Tailed Macaque (LTM) in Silent Valley National Park, Western Ghats, Kerala, India (%, Dry matter basis)

Common Name	Botanical Name	Moisture	CF	CP	EE	TA	AIA	Ca	P
Fruits									
Jack fruit (RF)	*Artocarpus heterophyllus*	67.7^{c}	4.15^{b}	15.2^{d}	0.91^{abc}	11.4^{ef}	0.32^{ab}	0.33^{a}	1.45^{a}
Jack fruit (URF)	*A. heterophyllus*	79.5^{d}	6.77^{c}	10.8^{b}	0.47^{abc}	11.0^{e}	0.48^{ab}	0.58^{ab}	1.44^{a}
Wild Jackfruit (RF)	*Artocarpus hirsutus*	69.7^{c}	7.01^{c}	16.2^{e}	5.09^{e}	11.1^{ef}	1.32^{b}	0.39^{a}	0.33^{a}
Wild durian (RF)	*Cullinea exarillata*	39.4^{b}	4.89^{b}	8.61^{a}	0.75^{abc}	3.34^{a}	0.03^{a}	0.83^{ab}	1.03^{a}
Cluster Fig (RF)	*Ficus rescimosa*	85.4^{de}	22.4^{f}	15.1^{d}	1.61^{d}	11.0^{e}	1.77^{cd}	0.83^{ab}	1.47^{a}
Cluster Fig (URF)	*Ficus rescimosa*	92.4^{e}	20.7^{e}	13.0^{c}	0.82^{abc}	12.6^{f}	0.78^{b}	0.83^{ab}	1.94^{a}
Thavittal (RF)	*Ficus beddomei*	83.2^{de}	31.0^{f}	10.8^{b}	0.23^{abc}	8.44^{bc}	2.49^{de}	0.99^{bc}	6.09^{ab}
Sandpaper (RF)	*Ficus exasperata*	90.9^{e}	23.0^{f}	21.7^{f}	0.55^{abc}	9.27^{d}	2.97^{de}	0.99^{bc}	8.66^{ab}
Indian laurel tree (RF)	*Ficus microcarpa*	67.5^{c}	42.0^{h}	10.8^{b}	1.94^{d}	6.96^{c}	0.08^{a}	0.58^{ab}	2.26^{a}
Mango (URF)	*Mangifera indica*	83.6^{ed}	8.62^{d}	14.0^{d}	0.75^{bc}	14.6^{g}	0.08^{a}	1.25^{c}	1.33^{a}
Guava (RF)	*Psidium guajava*	85.1^{ed}	32.9^{g}	10.8^{b}	2.06^{d}	3.39^{a}	0.25^{ab}	0.19^{a}	5.23^{ab}
SEM		3.5	0.49	0.47	0.39	0.47	0.09	0.18	0.43
p-Value		0.00*	0.01*	0.01*	0.00*	0.00*	0.00*	0.05**	0.05**

CF-Crude Fibre, CP -Crude Protein, EE-Ether extract, TA-Total Ash, AIA- Acid Insoluble Ash, Ca- Calcium, P- Phosphorus, RF-Ripened Fruit, URF-Un Ripened Fruit

^{a,b,c,d,d,e,f} Mean values with different superscripts within a column differ significantly. *Significance at p<0.01; **Significance at p< 0.05

Table 2. Nutrient Composition of flower items consumed by Lion Tailed Macaque (LTM) in Silent Valley National Park, Western Ghats, Kerala, India (%, Dry matter basis)

The moisture content of the *Cullinea exarillata* fruits was estimated at 39.4% and all most all other fruits having more than 65.00 per cent. Bello et al.(2014) reported a crude protein value of 11.38 per cent, and a crude fibre value of 16.78 per cent in *Ficus exasperate* fruit commonly known as sand paper plant and values reported in the present study was comparatively higher.

Kassim et al. (2017) mentioned that chemical analysis of the samples collected in the revealed fibre content of 52.7 per cent, protein content of 9.9 per cent, fat content of 77.2 per cent and ash content of 8.5 per cent were found in *A. catechu*, *T. catappa*, *E. guineensis* and *C. thevetia*, respectively. In this present study, 42.0 per cent of crude fibre was found in *Ficus microcarpa* (Indian Laurel tree) fruits.

Dierenfeld and McCann (1999) compared that non human primates like LTM and ring-tailed lemurs feeding behaviour and found that both consume low protein and higher fibre rich fruits, seeds, flowers and forages and macaques selected food items low in calcium and copper rich food items compared to ring-tailed lemurs. In this study, it was noted that the required calcium and phosphorus were met from the consumption calcium and phosphorus rich Ficus species ripened fruits.

The present study values of crude fibre content among Ficus species were differed significantly ($P<0.01$) and found Indian laurel tree (*Ficus microcarpa)* ripened fruits having higher values of crude fibre and lower values of crude protein. Apart from this, fruits and flowers macaques are consuming leaves, barks and spent comparatively lesser time on feeding.

CONCLUSION

It could be concluded that, highest crude fibre content was reported in Ficus species ripened fruits and during the month of February they had consumed Cullinea flowers and the chemical composition did not have either more crude fibre or crude protein compared to Ficus species fruits.

ACKNOWLEDGMENT

The authors would like to express their sincere thanks to the staff of Silent Valley National Park, Forest Division, Mannarcaud, Palakkad, Kerala. The field visit and experimental funds was utilized from DST- WOS-A project funded by Department of Science and Technology, Government of India, New Delhi, India.

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