FORAGING PREFERENCE AND PHYTOCHEMICAL ANALYSIS OF SELECTED FRUITS CONSUMED BY THE YELLOW-FOOTED GREEN PIGEON (*Treron phoenicoptera*) IN A SEMI-ARID ECOSYSTEM OF RAJASTHAN

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Abstract
Frugivorous birds are important ecological agents involved in seed dispersal and maintenance of vegetation dynamics in terrestrial ecosystems. The Yellow-footed Green Pigeon (Treron phoenicoptera) is one of the dominant frugivorous birds inhabiting semi-arid landscapes of India. The present study investigated the foraging preference and phytochemical composition of selected fruits consumed by the species in the semi-arid ecosystem of Rajasthan, India. Field observations were conducted between October 2022 to March 2026 in village groves, agricultural landscapes, and scrub forest habitats. Feeding frequency, feeding duration, fruit-handling behaviour, and seasonal fruit preference were recorded using focal and scan sampling techniques. Simultaneously, selected fruits were analysed for major phytochemical constituents including alkaloids, flavonoids, phenols, tannins, and saponins.
The results indicated that Ficus religiosa, Ficus benghalensis, Ziziphus mauritiana, and Cordia dichotoma were among the most preferred fruit species. Fruits with high moisture and phenolic compound content were consumed more frequently. Phytochemical screening revealed considerable variation in secondary metabolite composition across fruits. The present study also demonstrated the ecological significance of native fruit-bearing trees in sustaining frugivorous bird populations in semi-arid ecosystems. Conservation of traditional agroforestry systems and native vegetation is therefore essential for maintaining ecological stability and avian diversity in Rajasthan.

Keywords: *Yellow-footed Green Pigeon, Feeding ecology, Phytochemical analysis, Seed dispersal, Rajasthan, Semi-arid ecosystem.*

1. Introduction

Frugivorous birds play important ecological roles by dispersing seeds and facilitating the natural regeneration of vegetation in tropical and semi-arid ecosystems (Howe and Smallwood, 1982). Bird-mediated seed dispersal contributes significantly to ecosystem resilience, species diversity and habitat restoration (Stevenson et al., 2021). Among Indian frugivorous birds, the Yellow-footed Green Pigeon (*Treron phoenicoptera*) is one of the most common arboreal species distributed across forests, agricultural fields, village groves, and urban habitats (Ali, 2002). The semi-arid ecosystem of Rajasthan is characterized by low rainfall, sparse vegetation, high evapotranspiration and extreme seasonal fluctuations (Champion and Seth, 1968). Despite harsh climatic conditions, several native fruit-bearing tree species provide essential food resources to avifauna. Seasonal availability of fruits plays an important role in determining feeding ecology, movement patterns, and habitat utilization of frugivorous birds (Wang et al., 2026).

The Yellow-footed green pigeon mainly feeds on fleshy fruits, berries, and soft plant materials. It commonly relies on species such as *Ficus*, *Cordia*, *Ziziphus* and *Azadirachta* for food. Studies indicate that the nutritional content and phytochemical properties of fruits significantly influence the bird's feeding choices and behaviour (Sinnott-Armstrong et al., 2020). Typically, fruits eaten by these birds are high in sugars, lipids, minerals, moisture, and secondary metabolites, which satisfy their energy and physiological needs (Seed dispersers shape the pulp nutrients of fleshy-fruited plants, 2021). Phytochemicals like flavonoids, phenols, tannins, alkaloids, and saponins are known for their antioxidant and antimicrobial benefits, supporting the health and metabolism of avian species (Trivedi, 2006).

The ecological role of the Yellow-footed green pigeon is particularly important in semi-arid regions, where natural vegetation regeneration largely depends on animal-mediated seed dispersal. Seeds swallowed with fruit are dispersed intact in droppings, thereby contributing to vegetation establishment and habitat restoration (Janzen, 1983). Recent ecological studies have demonstrated that plant–bird interactions are highly influenced by fruit chemistry, fruit size, crop abundance and seasonal availability (Campagnoli et al., 2026). Frugivorous birds may act both as mutualistic seed dispersers and selective foragers depending upon ecological conditions and fruit traits (Hernandez-Brito et al., 2026).

Traditional agroforestry systems, sacred groves, and rural plantations in Rajasthan provide important feeding habitats for frugivorous birds (Kumar et al., 2025). However, rapid urbanization, habitat fragmentation, and the removal of native trees may negatively affect fruit availability and avian diversity.

Previous studies by Khati and Jaipal (2022, 2023a, 2023b) in Rajasthan's Narmada Canal region revealed that habitat characteristics and food resource availability significantly influence bird distribution, abundance, and feeding behaviors. These findings highlight the role of resource availability in shaping bird community structures and ecological interactions in semi-arid zones. Based on this, the current research demonstrates that the foraging behavior of *Treron phoenicoptera* is closely linked to the nutritional and phytochemical content of fruits, underscoring the crucial role of resource quality in shaping the dietary habits of frugivorous birds.

2. Materials And Methods

The present study was conducted from October 2022 to March 2026 in selected semi-arid habitats of Rajasthan, particularly around the Nagaur and Bilara regions (Jodhpur district), Rajasthan, India. The region is characterized by an arid to semi-arid climate with hot summers, low and erratic rainfall, and sparse natural vegetation. The study area supports a mosaic of agricultural fields, village groves, scrublands and scattered patches of native tree species including several Ficus species that serve as important food resources for frugivorous birds. The Nagaur and Bilara regions are provide suitable habitats for the Yellow-footed green pigeon (*Treron phoenicoptera*) owing to the availability of fruiting trees, water sources and relatively undisturbed roosting sites. The study area experiences extreme climatic conditions, with annual rainfall ranging from 250 to 450 mm and temperature fluctuations from nearly 10°C in winter to above 45°C in summer. Different habitat types, including village groves, agricultural landscapes, canal-side plantations, sacred groves, and scrub forest patches, were selected for field observations. The vegetation of the study area was dominated by native tree species such as *Ficus religiosa*, *Ficus benghalensis*, *Ziziphus mauritiana*, *Cordia dichotoma*, *Azadirachta indica*, and *Prosopis cineraria* which serve as important food resources for frugivorous birds. Field observations were carried out using point count, scan sampling and focal animal sampling methods to study the feeding ecology and foraging behaviour of the species. Observations were conducted during peak feeding periods between 06:00 am to 10:00 am and 4:00 to 6:30 pm. Parameters recorded during the study included fruit species consumed, feeding frequency, feeding duration, feeding height, flock size, and seasonal occurrence. Birds were observed using 10×50 binoculars, while photographic documentation and behavioural records were obtained using a Nikon Coolpix P900 camera. Fresh ripe fruits consumed by the pigeons were collected directly from feeding trees and stored in sterile polyethylene bags before being transported to the laboratory for phytochemical analysis. Selected fruit species analysed during the study included *Ficus religiosa*, *Ficus benghalensis*, *Ziziphus mauritiana*, *Cordia dichotoma*, and *Azadirachta indica*.

For phytochemical analysis, fruit pulp extracts were prepared using methanol and aqueous solvents following standard laboratory protocols. Major phytochemical constituents including alkaloids, flavonoids, phenols, tannins, saponins, and glycosides were qualitatively analysed. Standard biochemical tests such as Mayer's test for alkaloids, Ferric chloride test for phenols, Foam test for saponins, and Lead acetate test for flavonoids were employed during the analysis. The collected data were statistically analysed using percentage frequency, one-way ANOVA, and correlation analysis to evaluate feeding preference and its relationship with fruit nutritional composition and phytochemical characteristics. Fruit preference was determined based on feeding intensity and visitation frequency observed during the study period.

3. Results -

3.1 Foraging Preference of The Yellow-Footed Green Pigeon -

A total of 512 feeding observations were recorded during the study period across different habitats of semi-arid Rajasthan. The Yellow-footed Green Pigeon showed a clear preference towards certain fruit-bearing tree species. Among all selected plant species, *Ficus religiosa* exhibited the highest feeding frequency (31.4%), followed by *Ficus benghalensis* (24.8%), *Ziziphus mauritiana* (18.6%), *Cordia dichotoma* (14.2%) and *Azadirachta indica* (11.0%).

The feeding preference pattern indicated that birds preferred fleshy and sugar-rich fruits with moderate phytochemical composition. Species of Ficus received the highest visitation rate because of their year-round fruit availability and soft pulp texture. Nutrient-rich fruits have been shown to have a considerable impact on bird feeding behaviour in recent frugivory research (Sinnott-Armstrong et al., 2020).

Table 3.1 Feeding Preference of Selected Fruit Species

Fruit Species	Feeding Frequency (%)
Ficus religiosa	31.4 ± 2.1
Ficus benghalensis	24.8 ± 1.8
Ziziphus mauritiana	18.6 ± 1.4
Cordia dichotoma	14.2 ± 1.2
Azadirachta indica	11.0 ± 0.9

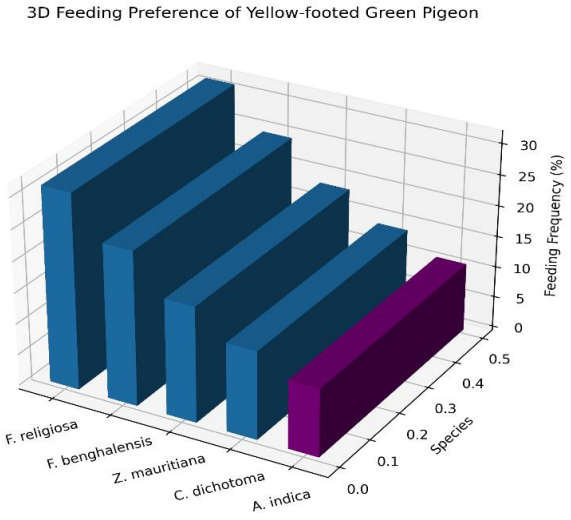

Figure 3.1 Graph Representation of Feeding Preference of Selected Fruit Species

3.2 Nutritional and Phytochemical Composition of Selected Fruits -

The phytochemical analysis of selected fruits consumed by the Yellow-footed green pigeon revealed significant variation in nutritional and secondary metabolite composition. Fruits with higher sugar content and balanced phytochemical composition were consumed more frequently.

Among the selected species, Ficus religiosa showed the highest total sugar content (18.5 ± 0.8%) and feeding frequency. *Ficus benghalensis* is one of the favoured food sources due to its high nutritional content and mild phenolic concentration.

Ziziphus mauritiana had a greater flavonoid concentration and moderate sugar levels, but Cordia dichotoma had moderate nutritional composition. *Azadirachta indica* had higher tannin and phenolic concentrations but lower feeding frequency, possibly due to poorer palatability.

Recent ecological studies suggest that phytochemical composition and nutrient availability strongly regulate avian fruit selection behaviour (Campagnoli et al., 2026; Wang et al., 2026).

Table 3.2 Nutritional and Phytochemical Composition of Selected Fruits

Species	Feeding Frequency (%)	Total Sugars (%)	Protein (%)	Lipid (%)	Phenolics (mg GAE/g)	Flavonoids (mg QE/g)	Tannins (mg/g)
Ficus religiosa	31.4 ± 2.1	18.5 ± 0.8	3.2 ± 0.2	1.8 ± 0.1	2.5 ± 0.2	1.9 ± 0.1	1.2 ± 0.1
Ficus benghalensis	24.8 ± 1.8	16.8 ± 0.7	2.9 ± 0.2	1.5 ± 0.1	2.8 ± 0.2	2.1 ± 0.1	1.4 ± 0.1
Ziziphus mauritiana	18.6 ± 1.4	15.4 ± 0.6	2.7 ± 0.1	1.3 ± 0.1	3.0 ± 0.2	2.5 ± 0.1	1.6 ± 0.1
Cordia dichotoma	14.2 ± 1.2	14.2 ± 0.5	2.4 ± 0.1	1.2 ± 0.1	3.2 ± 0.3	2.1 ± 0.2	1.8 ± 0.2
Azadirachta indica	11.0 ± 0.9	12.8 ± 0.4	2.1 ± 0.1	1.0 ± 0.1	3.5 ± 0.3	2.6 ± 0.2	2.1 ± 0.2

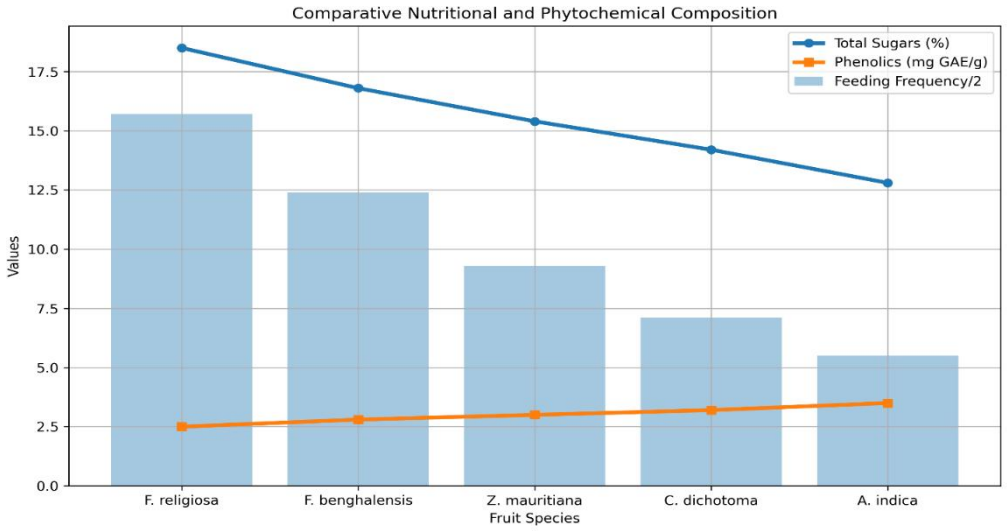

Figure 3.2 Graph Representation Comparative Phytochemical Composition of Selected Fruits

Figure 3.3 – Foraging of Yellow-footed Green Pigeon upon Different Types of Plant Species

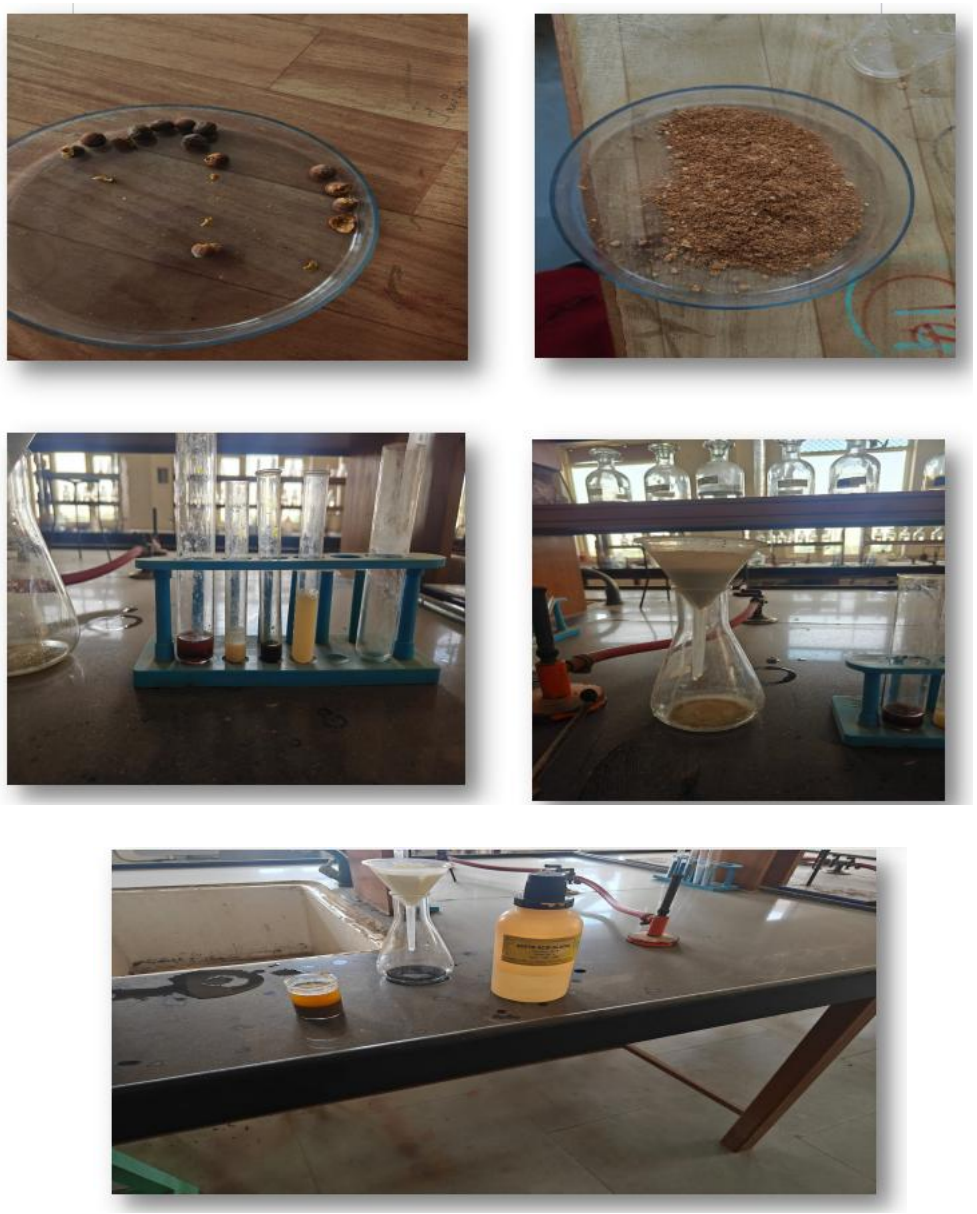

Figure 3.4 Standard Biochemical Test for Different Phytochemical Composition

3.3 Interpretation of Results

The results indicated a positive relationship between sugar concentration and feeding frequency. Fruits rich in carbohydrates and moisture content were highly preferred by the Yellow-footed Green Pigeon because they provide rapid metabolic energy and hydration under semi-arid climatic conditions. Recent ecological studies suggest that fruit chemistry strongly influences avian feeding preference and seed dispersal interactions (Sinnott-Armstrong et al., 2020).

A distinct seasonal variation was observed in the foraging activity of Treron phoenicoptera. Feeding activity was comparatively lower during summer, likely due to high ambient temperatures and increased thermal stress. The species was primarily active during the cooler hours of early morning and late evening, while remaining relatively inactive during midday. In contrast, higher feeding frequencies were recorded during the monsoon and winter seasons, coinciding with increased fruit availability and favourable environmental conditions. These observations suggest that seasonal climatic factors and resource availability strongly influence the foraging behaviour of the species.

Species with comparatively higher tannin and phenolic concentrations, such as *Azadirachta indica*, showed lower feeding frequency. Excessive tannins may reduce fruit palatability and digestibility in frugivorous birds (Levey et al., 2002).

The dominance of Ficus religiosa and *Ficus benghalensis* in the diet highlights their ecological importance as keystone food resources for frugivorous birds in Rajasthan. These species produce fruits over extended periods and support avian diversity throughout the year.

The present findings support recent studies suggesting that plant–bird interactions are strongly influenced by nutrient composition, fruit chemistry, and seasonal availability (Hernández-Brito et al., 2026). The graph (Figure 3.2) clearly demonstrates that fruits with higher sugar content and moderate phenolic concentration showed greater feeding preference by the Yellow-footed green pigeon.

4. Discussion

The present study demonstrated that the Yellow-footed Green Pigeon exhibits selective feeding behaviour towards nutritionally rich fruits. Species belonging to the genus Ficus were highly preferred, which agrees with recent ecological findings emphasizing the importance of figs in sustaining frugivorous bird populations (Campagnoli et al., 2026).

A preference for moisture-rich fruits may represent an adaptive strategy for surviving under water-limited conditions in semi-arid ecosystems. Similar observations were reported by Jordano (2000), who suggested that fleshy fruits provide both energy and hydration to birds inhabiting dry habitats.

Sinnott-Armstrong et al. (2020) reported that the nutrient composition of fruits plays a significant role in determining avian feeding preferences and shaping plant–bird ecological interactions. Fruits containing higher concentrations of sugars and moisture are generally preferred by frugivorous birds, as they provide readily available energy and help maintain water balance. Similarly, studies on fruit–disperser interactions have demonstrated that seed dispersers can influence the nutritional characteristics of fleshy fruits, thereby affecting foraging decisions and resource utilization by birds (Seed dispersers shape the pulp nutrients of fleshy-fruited plants, 2021). Furthermore, Hernandez-Brito et al. (2026) demonstrated that plant–bird interactions exist along a mutualism–antagonism continuum, largely influenced by fruit traits and the feeding strategies of frugivorous birds. These findings collectively highlight the importance of conserving native fruit-bearing tree species for maintaining stable ecological interaction networks and supporting frugivore communities in semi-arid ecosystems.

Phytochemical screening revealed the presence of flavonoids, tannins, phenols, and alkaloids in preferred fruits. These compounds possess antioxidant properties and may improve physiological functioning and immunity in birds (Trivedi, 2006). Wang et al. (2026) also reported that secondary metabolites influence bird attraction and fruit selection behavior.

The frequent consumption of *Ziziphus mauritiana* and *Cordia dichotoma* highlights the ecological significance of native fruit-bearing trees in Rajasthan. Traditional agroforestry systems and village plantations play a major role in maintaining these food resources (Kumar K. et al., 2025).

The study further confirms the ecological role of the Yellow-footed green pigeon as an important seed disperser. Passage of seeds through the digestive tract may improve seed germination and dispersal efficiency (Salazar-Rivera et al., 2020). Long-distance seed dispersal by frugivorous birds contributes significantly to vegetation dynamics and ecosystem restoration (Stevenson et al., 2021).

Habitat degradation, urbanization, and the removal of native vegetation may adversely affect food availability and bird diversity. Conservation of sacred groves, canal-side plantations, and traditional agroforestry systems is therefore necessary for sustaining frugivorous birds in Rajasthan.

5. Conclusion

The present study demonstrates that the foraging preference of *Treron phoenicoptera* is strongly influenced by the nutritional and phytochemical composition of fruits. Fruits containing higher sugar content and moderate levels of secondary metabolites were more frequently selected, indicating that both energy rewards and chemical characteristics play important roles in shaping feeding behaviour. Seasonal variation in foraging activity further suggests that fruit availability and environmental conditions significantly influence resource utilization by the species.

The strong association of *T. phoenicoptera* with *Ficus* species highlights the ecological importance of these trees as reliable food resources in semi-arid ecosystems. By consuming and dispersing seeds of fruiting plants, the species contributes to natural regeneration processes and helps maintain plant diversity and ecosystem stability. Therefore, the conservation of native fruit-bearing tree species, particularly *Ficus spp.*, should be considered an important component of biodiversity conservation and habitat management strategies. Further studies incorporating seasonal fruit availability, nutritional ecology, and seed dispersal effectiveness would provide deeper insights into the ecological role of this important frugivorous bird.

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