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Reference range of serum thyroid hormones profile in domestic cats

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Abstract

The present investigation was undertaken to establish reference ranges of serum thyroid hormones in adult domestic cats. A total of 300 clinically healthy cats irrespective of breed and sex were categorized into three age groups: 1–5 years, 5–10 years, and above 10 years. Serum concentrations of total triiodothyronine (TT₃), total thyroxine (TT₄), and free thyroxine (fT₄) were estimated using radioimmunoassay. Reference ranges were derived by the non-parametric percentile (25th–75th percentile) method. The established reference range for TT₃, TT₄, and fT₄ were 48.67–72.81 ng/dL, 1.33–2.81 µg/dL, and 1.09–1.50 ng/dL, respectively. TT₄ showed a significant age-related increase ($P < 0.05$), whereas TT₃ and fT₄ remained statistically unaffected by age. Free thyroxine level was found in very narrow range, may indicated as the sensitive biomarker for assessment of thyroid function in cats. The established reference ranges provide baseline values for accurate interpretation of thyroid function in domestic cats under Indian conditions.

Keywords: Thyroid hormones, triiodothyronine, thyroxine, free thyroxine, reference range, RIA, domestic cats

Introduction

Thyroid hormones are essential regulators of basal metabolism, growth, thermoregulation, and energy balance in cats. Among feline endocrine disorders, hyperthyroidism is one of the most commonly reported conditions, particularly in middle-aged and geriatric cats (Peterson *et al.*, 1983; Peterson, 2015) [4, 8]. Thyroxine (T₄), the principal hormone secreted by the thyroid gland, functions largely as a prohormone and is converted peripherally to the biologically active triiodothyronine (T₃) (Thoday *et al.*, 1984) [9]. Only the free, non-protein-bound fraction of thyroid hormones is metabolically active and reflects true thyroid status (Thoday *et al.*, 1984; Wakeling *et al.*, 2020) [9, 10].

Cat population in India is steadily increasing in recent years. Also the endocrine related disorders reported by the private veterinary clinics are increasing, considering the demand from veterinarians it is necessary to establish physiological reference of various hormone levels in cats for proper interpretation of laboratory reports. Interpretation of thyroid function tests in cats is complicated by age-related variation, hormone fluctuation, and the suppressive effects of non-thyroidal illness (Peterson *et al.*, 1987; Peterson *et al.*, 1990) [5, 6]. Moreover, population-specific reference ranges are essential, as environmental, dietary, and methodological differences influence hormone concentrations (Naik, 2016; Alborough *et al.*, 2022) [3, 2]. Information on physiological reference ranges for thyroid hormones in domestic cats in India is limited. Hence, the present study was conducted to establish reference ranges for serum TT₃, TT₄, and fT₄ in clinically healthy domestic cats.

Materials and Methods

The study was conducted at the Department of Veterinary Biochemistry, Mumbai Veterinary College, Parel, Mumbai, with radioimmunoassay facilities at the Radiation Medicine Centre, Bhabha Atomic Research Centre, Mumbai (INDIA).

A total of 300 clinically healthy cats of either sex were selected during June–December 2025 from veterinary hospitals, NGOs (Non-Government Organization), private practitioners, and pet owners. Cats were categorized into three age groups: 1–5 years, 5–10 years, and above 10

years. Animals showing clinical or laboratory evidence of systemic or endocrine disease were excluded. Approximately 3 mL of blood was collected aseptically from the jugular vein. Serum was separated by centrifugation at 3000 rpm for 15 minutes and stored at -20°C until analysis. Serum TT_3 , TT_4 , and fT_4 concentrations were estimated using BRIT-BARC radioimmunoassay kits following standard protocols. Reference ranges were established using the non-parametric percentile (25th–75th percentile) method. Age-wise comparison was carried out using one-way ANOVA.

Results and Discussion

As depicted in fig.1 the Mean $\pm$ SE of serum TT_3 concentration in cats was 63.47 ± 1.14 ng/dL. The box plot revealed T-bars ranging from 21 to 107 ng/dL, with an interquartile range (25th–75th percentile) of 48.67–72.81 ng/dL and a median value of 62.11 ng/dL. The reference range established for TT_3 aligns with earlier observations that serum T_3 levels show relatively narrow physiological variation in cats. As depicted in Table 1. Mean $\pm$ SE The mean TT_3 concentrations (ng/dl) in the age groups 0–5 years, 5–10 years, and more than 10 years were 64.87 ± 1.46 , 60.16 ± 2.03 , and 61.92 ± 3.41 respectively. The levels of TT_3 in present study are within the range reported by Thoday *et al.* (1984)^[9]; Peterson *et al.* (1987)^[5] in healthy cats. There was no significant difference ($P > 0.05$) in TT_3 levels among different age groups of cats. Although younger cats (0–5 years) showed slightly higher values, age did not significantly influence circulating TT_3 levels in clinically healthy cats.

As depicted in fig.2 the Mean $\pm$ SE of serum TT_4 concentration was 2.06 ± 0.05 $\mu\text{g/dL}$, with an interquartile

range of 1.33–2.81 $\mu\text{g/dL}$ and T-bars extending from 0.40 to 4.13 $\mu\text{g/dL}$ & median as 2.03 $\mu\text{g/dL}$. TT_4 concentrations increased significantly with advancing age ($P < 0.05$). As depicted in Table 1. The Mean $\pm$ SE levels of TT_4 ($\mu\text{g/dl}$) in cats aged 1–5 years, 5–10 years, and more than 10 years were 1.95 ± 0.06 , 2.26 ± 0.10 , and 2.51 ± 0.21 , respectively. Similar age-associated alterations in TT_4 have been reported previously and may reflect subclinical thyroid stimulation or early hyper functional changes in older cats. The levels of TT_4 in present study are within the range reported by Thoday *et al.* (1984)^[9], Peterson *et al.* (1990)^[6], Naik, (2016)^[3] in healthy cats.

As depicted in fig.3 the Mean $\pm$ SE of serum fT_4 concentration was 1.30 ± 0.01 ng/dL, with an interquartile range of 1.09–1.50 ng/dL and T-bars ranging from 0.63 to 1.94 ng/dL & median as 1.30 ng/dL. As depicted in Table 1. The Mean $\pm$ SE values of serum fT_4 ($\mu\text{g/dl}$) in cats aged 1–5 years, 5–10 years, and more than 10 years were 1.28 ± 0.02 , 1.31 ± 0.02 , and 1.34 ± 0.06 , respectively. Free thyroxine values did not show significant age-related variation, supporting its stability as a diagnostic marker. Previous studies have emphasized the diagnostic superiority of fT_4 in differentiating euthyroid and thyroid-diseased cats, particularly in borderline cases. The levels of fT_4 in present study are within the range reported by Peterson *et al.* (1994)^[7] & Wakeling *et al.* (2020)^[10] in healthy cats.

Overall, TT_4 emerged as the most age-responsive thyroid hormone, whereas TT_3 and fT_4 remained relatively stable across age groups. These findings are consistent with earlier reports describing hormonal fluctuation, overlap, and the importance of population-specific reference intervals for accurate diagnosis of feline thyroid disorders (Peterson *et al.*, 1987; Aldridge *et al.*, 2015)^[5, 1].

Table 1: Levels of serum thyroid hormones in different age groups of domestic cats.

Sr. No.	Parameters	1 to 5 years	5 to 10 years	More than 10 years
1	TT_3 ng/dL (Mean $\pm$ SE)	64.87 ± 1.46	60.16 ± 2.03	61.92 ± 3.41
2	TT_4 $\mu\text{g/dL}$ (Mean $\pm$ SE)	1.95 ± 0.06	2.26 ± 0.10	2.51 ± 0.21
3	fT_4 ng/dL (Mean $\pm$ SE)	1.28 ± 0.02	1.31 ± 0.02	1.34 ± 0.06

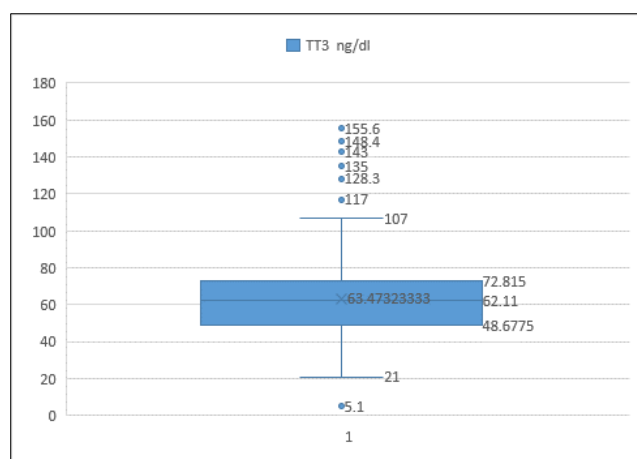


Fig 1: Box plot depicting TT_3 concentration in cats (25th–75th percentile).

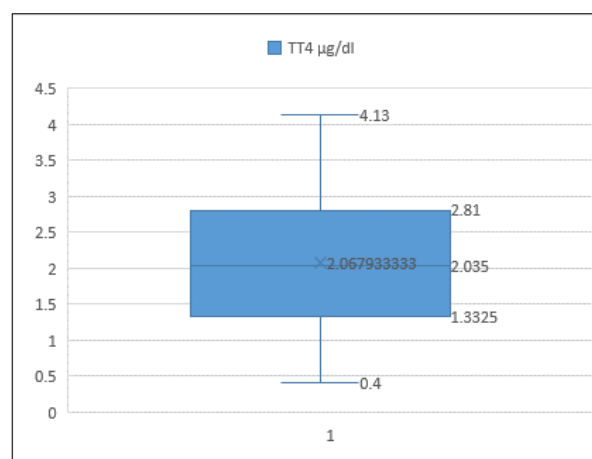


Fig 2: Box plot depicting TT_4 concentration in cats (25th–75th percentile).

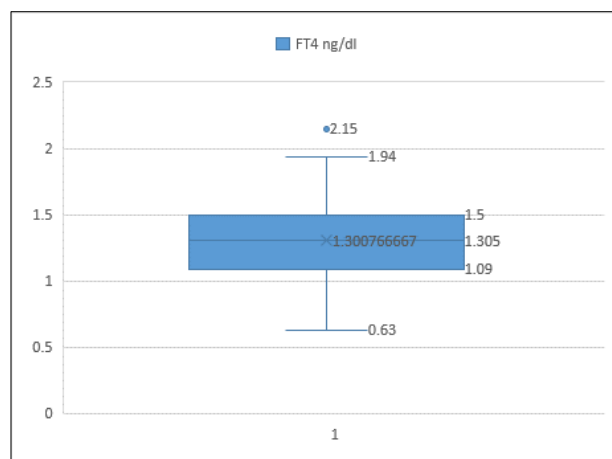


Fig 3: Box plot depicting fT₄ concentration in cats (25th–75th percentile).

Summary and Conclusion

The present study established reference ranges for serum thyroid hormones in domestic cats in India as 48.67–72.81 ng/dL, 1.33–2.81 µg/dL, and 1.09–1.50 ng/dL for TT₃, TT₄, fT₄ respectively. Among the thyroid parameters evaluated, TT₄ exhibited significant age-related variation, whereas TT₃ and fT₄ remained comparatively stable. These reference ranges provide reliable baseline data for clinical evaluation and diagnosis of thyroid dysfunction in cats under Indian conditions.

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