Peertechz

International Journal of Veterinary Science and Research
submitpaper@peertechz.com

INTERNATIONAL JOURNAL OF Veterinary Science and Research OPEN ACCESS JOURNAL

ISSN: 2640-7604 DOI: https://dx.doi.org/10.17352/ijvsr

Research Article

Juvenile Crested Gecko (*Correlophus ciliates*) Growth Rate on a Calcium-dusted Dubia Roach and Papaya Diet Versus a Commercial Diet

Cord M Brundage[1]*, Seza Atamian[2] and Jessica Vasquez[2]

[1]Department of Biology, College of Science and Health, University of Wisconsin La Crosse, 1725 State Steet, La Crosse, Wisconsin, 54669, USA

[2]Department of Animal and Veterinary Sciences, College of Agriculture, California Polytechnic State University, 3801 W. Temple Avenue, Pomona, California, 91768, USA

Received: 03 July, 2024
Accepted: 11 July, 2024
Published: 12 July, 2024

***Corresponding author:** Cord M Brundage, MS, PhD, DVM, Department of Biology, College of Science and Health, University of Wisconsin La Crosse, 1725 State Steet, La Crosse, Wisconsin, 54669, USA,
E-mail: cbrundage@uwlax.edu

ORCiD: https://orcid.org/0000-0001-9032-7792

Keywords: Crested gecko; Reptile; Husbandry; Nutrition; Dubia roach; Papaya; Pangea

Abstract

Crested Geckos (*Correlophus ciliatus*) are common in the United States pet trade despite limited information on their specific physiology and nutrition. Suboptimal husbandry may be detrimental to animal growth, quality of life, and lifespan. Commercial diets are available; however, many hobbyists prefer feeding calcium-dusted fruit and insect alternatives. There is a general lack of published literature evaluating the effect of either option on gecko development. A food trial was conducted for 5 weeks on juvenile Crested Geckos fed a diet of calcium-dusted Dubia Roaches and fresh papaya (n = 30) or a commercial diet (Pangea Crested Gecko Diet; n = 30). Body length and weight were measured weekly on their fourth feeding day. Animals on both diets grew in length and weight over the 5-week feeding trial ($p < 0.05$) however the roach/papaya-fed geckos experienced almost twice the weight gain 0.81 g (24.35%) than the commercially fed geckos (0.42 g) and (13.07 %; p = 0.002). No differences in behavior of activity were noted between either diet. These results suggest that a calcium-dusted Dubia Roach and papaya diet may be more advantageous than a commercial diet during Crested Gecko juvenile development.

Introduction

Crested geckos (*Correlophus ciliatus*, formerly *Rhacodactylus ciliatus*) were rediscovered in the tropical forests of southern New Caledonia in 1994 [1] Since that time the Crested Gecko has increased in popularity more than any other reptile [2,3]. Despite their popularity, very little information has been published about their physiology and ecology [4]. A common factor in the high mortality rates of household pets is poor nutrition [5]. An evaluation of the stomach contents of wild Crested Gecko in New Caledonia included arthropods, other small reptiles (geckos, and skinks), and plant matter (flower parts, and nectar) [6]. Experimentally, Cooper identified that geckos were attracted to both prey and plant chemical stimuli [7]. It was not clear how dietary preferences change if at throughout animal development.

In captivity, geckos are particularly susceptible to Metabolic Bone Disease (MBD) resulting in pathologic fractures, reproductive challenges, and death [8]. MBD is due to either nutritional vitamin D deficiency, a lack of sufficient vitamin D production from inadequate UV exposure, and/or deficient dietary calcium [9,10]. It is reasonable to assume that there may be other nutrient requirements that may be better met with a standardized commercial diet and natural food sources are not always logistically feasible. The large and dynamic nature of pet food industries can make the identification and selection of appropriate commercial reptiles' diets difficult. The commercial diet formulations and their justification are not always published or available. A 2016 feeding study compared Gargoyle Geckos (*Rhacodactylus auriculatus)* between three commercial diets (Pangea, GeckoPro, and Repashy) they identified Pangea as the best option for growth and long-term animal maintenance [11] The Pangea Gecko Diet used was

Citation: Brundage CM, Atamian S, Vasquez J. Juvenile Crested Gecko (*Correlophus ciliates*) Growth Rate on a Calcium-dusted Dubia Roach and Papaya Diet Versus a Commercial Diet. Int J Vet Sci Res. 2024;10(3):029-033. Available from: https://dx.doi.org/10.17352/ijvsr.000147

reportedly comprised of 60% fruit and 40% protein isolate fortified with additional essential nutrients (i.e. vitamins D, E, A, B complex, calcium, zinc) and included the highest minimum crude protein (21%) out of the three diets tested [11].

We hypothesized that Crested Gecko fed the same Pangea commercial diet would demonstrate faster growth and development than those fed an insect and fruit-based diet. We anticipated the standardization and complexity of a formulated diet would provide more consistent nutritional support. Juvenile animals were selected to evaluate a period of increased metabolic need, growth, and development. Insect and fruit-fed geckos were fed calcium-dusted juvenile Dubia Roaches and pureed papaya. This diet was selected based on ease and availability for pet owners and hobbyists. Papaya is a common fruit additive in commercial diets and this insect/fruit combination was meant to reasonably replicate the reported wild natural diet [6].

Materials & methods

Animals

This study design was approved by the Cal Poly Pomona Institutional Animal Care and Use Committee (19.006). Sixty juvenile Crested Geckos were obtained from a single breeder (Lil Monsters Reptiles, Los Angeles, CA). All animals were genetically related and estimated to be ~3.5 months old (3.25 g ± 0.61 g) at the start of the food trial. All animals were size-matched at the onset of the study and were considered in healthy condition by a licensed veterinarian. Before the onset of the study, all animals were fed the same commercial diet (Pangea Gecko Diet -With Insects) provided to them by the breeder (Pangea, Zeeland, MI). Using a random number generator, half of the animals (n = 30) were randomly selected to receive the insect/papaya diet, and the remaining animals (n = 30) continued on the commercial diet.

Husbandry

Each crested gecko resided individually in a labeled, hole-punched individual plastic container, measuring about 33 cm in length, 20 cm in width, and 15 cm in height (Rubbermade, Atlanta, GA). Each container was furnished with a paper towel base (Bounty, Proctor & Gamble, Cincinnati, OH), green plastic plant (Zoo Med, San Luis Obispo, CA), egg carton piece (10 cm x 10 cm section, Uline, Pleasant Prairie, WI), plastic food dish and plastic water dish (both clear round 2 cm tall x 2 cm diameter, by Zoo Med, San Luis Obispo, CA). All animals were housed in the same temperature and humidity monitored and controlled facility (temperature 21 °C ± 1.2 °C, humidity 70% ± 10%) for the same 5-week experimental period. On feeding days, each gecko had a clean water dish replaced, received a new paper towel, and received a standardized misting of the habitat.

Feeding

Before beginning the food trial, the three feed samples (commercial diet, roaches, and papaya) were submitted to a nutrient analysis laboratory according to their sample size guidelines and shipping instructions (Cumberland Valley Analytical Services, Inc., Waynesboro, PA). This tool was utilized to provide more information on the macronutrient content, testing for percent fat, protein, moisture, ash, and fiber. Geckos were fed 2 g of their respective diets, every other day for 5 weeks. The Pangea commercial Gecko Diet-With Insects was a powder formula that required reconstitution per the manufacturer's instructions with a 1:2 ratio of powder to water. Both distilled water and powder were combined and shaken in a dispensing bottle to create a paste. For each feeding, the commercial diet geckos received 2 g of the paste in their food dish.

The insect and papaya-fed gecko were fed on the same day. Juvenile Dubia Roaches (~1 cm, DubiaRoaches.com, LLC., Wichita, KS) were pre-fed (gut-loaded) with a nutrient-rich substrate (Total Bites, Nature Zone, Chico, CA). Roaches were crudely examined and weighed before gecko feeding so that each gecko received roaches (2 - 3) smaller than their head that collectively weighed 1 g total. Roaches were placed in the plastic feeding cup (2 cm height and 2 cm diameter) and were dusted with 0.1 gram of calcium powder (ReptiCalcium with D3, Zoo Med, San Luis Obispo, CA). In addition to the roaches, this feeding group received 1 g of blended papaya in their feeding dish. Fresh papaya was obtained from a local grocer each week; peels and kernels were discarded. Papaya was blended and placed in a wide-mouth dispensing bottle, then refrigerated. The papaya was used with each feeding and replaced with a new blended papaya at the end of the week. It was estimated that each animal consumed an average of 80% ± 10% of food per feeding in both groups, desiccation and waste prevented more precise quantification.

Measurements

Data was collected once a week, every Sunday. On data collection days, a protocol of minimal handling was set in place, to prevent gecko stress and loss of tail. Animals were first monitored for signs of distress or abnormal behavior. Each gecko was then removed from its habitat, and placed on a scale (AC Pro-200, American Weigh Scales, Cumming GA). After obtaining body weight, the gecko was placed on a laminated grid paper and a photo was taken directly above the gecko, 90 degrees to the table. These photos were used to confirm a total body length measurement using image analysis software (Image J, National Institutes of Health, Bethesda, MD). Before returning the gecko to its enclosure each animal was briefly physically evaluated for indications of poor health: jaundice (yellowing of eyes, mucous membranes, or scales), dryness of scales, appearance of spine, loss of tail, and reduced motility.

Statistics

Data presented in this manuscript includes mean values ± standard deviation unless otherwise indicated. Mean values, weekly gains and percent changes in weight and length were compared between weeks (1 factor) and between diets (2nd factor) using a Two-way repeated measure ANOVA (SigmaStat, Systat Software Inc., San Jose, CA). This parametric test assumes a normal distribution. If a Shapiro-Wilk normality test failed, a Kruskal-Wallis H test (one-way ANOVA on ranks was performed in its place). Significance was considered for P

Citation: Brundage CM, Atamian S, Vasquez J. Juvenile Crested Gecko (*Correlophus ciliates*) Growth Rate on a Calcium-dusted Dubia Roach and Papaya Diet Versus a Commercial Diet. Int J Vet Sci Res. 2024;10(3):029-033. Available from: https://dx.doi.org/10.17352/ijvsr.000147

values < 0.05, in the event of significant variance, a Bonferroni post-hoc multiple comparison test was performed to identify the relationship between treatment groups.

Results

Nutritive analysis for the Dubia Roaches, papaya, and the tested commercial diet are included in Table 1. The commercial diet is supplied as a powder and is fed as 1 part powder to 2 parts water. This would suggest that 2 g of reconstituted commercial diet slurry would have approximately 0.17 g of protein, 0.09 g of fat, and 0.04 g of fiber. The 2 g insect/papaya diet has approximately 0.3 g of protein (0.21 g from roaches and 0.09 g from papaya), 0.08 g of fat (0.2 g from roaches and 0.06 g from papaya), and 0.18 g of fiber (0.3 g from roaches and 0.16 g from papaya) as fed.

Body weight

Average starting weights, weight gain, and percentage change for both feeding groups are included in Table 2. All animals grew heavier during the 5-week feeding trial. Juvenile Crested Geckos fed a diet of calcium-dusted Dubia Roaches and papaya (1 g of each every other day) gained more weight and experienced greater weight changes than geckos maintained on (2 g every other day) of their commercial diet (p = 0.011). Geckos on the commercial diet gained an average of 0.42 g over that study period which was a 13.07 % increase. Crested Geckos on the roach and papaya diet gained an average of 0.81 g which was a 24.35 % increase. Table 3 includes the mean weight ± standard deviation for each week for the feeding trial. Time was a significant factor influencing weight gain for both groups (p < 0.001), the effect of diet was not significant until the 4th week of the study. Geckos in the insect/papaya group were significantly higher weights in both week 4 (p = 0.010) and week 5 (p = 0.016) of the study (Figure 1).

Body length

The mean body length ± standard deviation for each week for the 5-week feeding trial is included in Table 3. All animals grew longer during the 5-week feeding trial. Time was a significant factor influencing body length for both groups (p = 0.003)., the effect of diet was not a significant influencer of weight over the 5-week study period (p = 0.493; Figure 2).

Other measures

No evidence of negative health effects was noted in either group. No tails were lost, and all geckos appeared healthy based on physical examination findings activity level and behavior were not appreciably different between either group or across the experimental period (Table 4).

Table 1: Nutrient Analysis of Dubia Roaches (*Blaptica dubia*), Papaya (*Carica papaya*) and Commercial Pangea Gecko Diet- With Insects.

Feed	Dry Fat (%)	Moisture (%)	Dry Protein (%)	Dry Ash (%)	Dry Fiber (%)
Dubia Roaches (wet, as fed)	6.1	71.5	21.4	1.3	2.6
Papaya (wet, as fed)	2.5	92.7	9.0	0.6	15.8
Commercial diet (dry)	4.6	7.4	25.5	7.4	1.9

Table 2: Comparison of Crested Geckos' Mean Starting Weight, Mean Weight Gain, and Body Percent Increase in Insect/Fruit Diet vs. Commercial Diet Groups.

Group	N	Mean Starting Weight (g)	Mean Weight Gain (g)	Total Body Percent Increase (%)
Insect/ papayaDiet	30	3.24 ± 0.67	0.81 ± 0.52	24.35 ± 14.27
Commercial Diet	30	3.26 ± 0.55	0.43 ± 0.31	13.07 ± 9.23

Table 3: Comparison of Crested Geckos' Mean Group Weight per Week in Insect/ Fruit vs. Commercial Diet Groups.

	Insect/Fruit Diet (g)	Commercial Diet (g)
Week 1	3.24 ± 0.67	3.26 ± 0.55
Week 2	3.41 ± 0.96	3.36 ± 0.87
Week 3	3.58 ± 1.06	3.45 ± 0.87
Week 4	3.82 ± 1.27*	3.48 ± 0.90*
Week 5	4.06 ± 1.24*	3.68 ± 0.95*

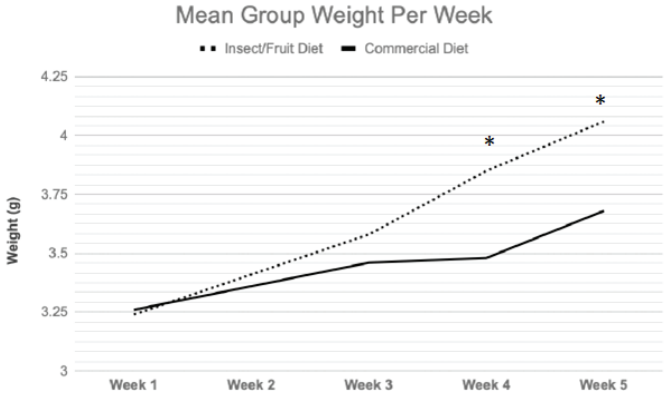

Figure 1: Average weight per week from week 1 through week 5. The average weights of juvenile Crested Gecko on the insect/fruit (roach/papaya) diet and the commercial diet were approximately the same at the beginning of the study. The weights of both groups increased significantly with time (p < 0.001). The weight change was different between diets (*p = 0.011). Comparison between weeks were significantly different at week 4 (p = 0.010) and week 5 (p = 0.016).

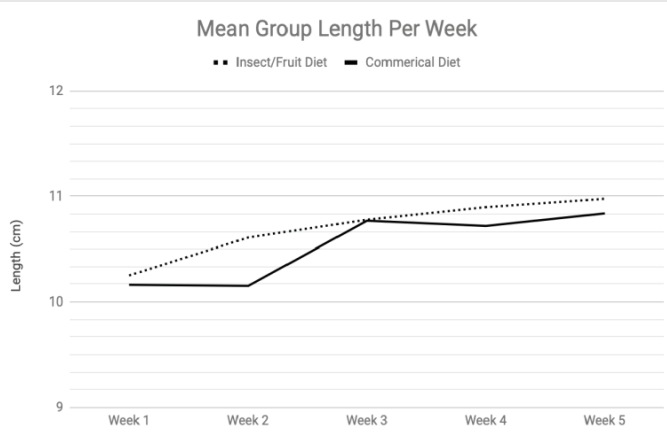

Figure 2: Average length per week from week 1 through week 5. The average body lengths of juvenile Crested Gecko on the insect/fruit (roach/papaya) diet and the commercial diet were approximately the same at the beginning of the study. Lengths of both groups increased significantly with time (p = 0.003). There was no difference in the length changes between the diet groups (p = 0.493).

Citation: Brundage CM, Atamian S, Vasquez J. Juvenile Crested Gecko (*Correlophus ciliates*) Growth Rate on a Calcium-dusted Dubia Roach and Papaya Diet Versus a Commercial Diet. Int J Vet Sci Res. 2024;10(3):029-033. Available from: https://dx.doi.org/10.17352/ijvsr.000147

Table 4: Comparison of Crested Geckos' Mean Group Length per Week in Insect/Fruit *vs.* Commercial Diet Groups.

	Insect/Fruit Diet (cm)	Commercial Diet (cm)
Week 1	10.25 ± 1.43	10.16 ± 1.05
Week 2	10.61 ± 1.05	10.15 ± 0.89
Week 3	10.78 ± 1.35	10.77 ± 1.37
Week 4	10.9 ± 1.27	10.72 ± 1.55
Week 5	10.98 ± 0.95	10.84 ± 0.93

Discussion

Juvenile Crested Geckos gained significantly more weight over the 5-week study period on a calcium-dusted roach and papaya diet than they did on the tested commercial diet. This was in contrast to and did not support our hypothesis that the fortified and standardized commercial diet would provide the greatest growth in our study population. We selected the Pangea commercial diet because an earlier study comparing commercial diets indicated that it had the highest nutrient levels and was the best option (of the three tested) for gecko growth [11]. That study did not test a live insect- and fruit-based diet. Nutrient analysis of the commercial diet exceeded the company's guaranteed analysis [11]. The commercial diet was 25.5% protein and included insect protein, however, the commercial diet is mixed with water before feeding, which decreases the nutrient profile on an as-fed basis. Consequently, the mixture of roaches and papaya had a larger percentage of as-fed protein and fat. The increased micronutrient density of the roach and papaya diet likely contributed to the significant increase in gains.

The variability in the hydration level of fresh fruit and live prey makes a direct comparison difficult; all three diets lost hydration in the feed dish. We chose to feed the same mass of food on an as-fed basis. In all feeding studies, it is important to consider dry matter, mineral content, and prey size, as it alters digestibility per individual [12]. We were only able to evaluate differences in macronutrients between diets, the significance of vitamin, mineral, and micronutrient profile differences is unknown. That makes the comprehensive comparison between dietary profiles especially challenging.

In the natural environment, Crested Geckos have adapted to an insect and plant-based diet [6]. Despite individually living in a relatively small range in the wild, there is more heterogeneity in nutritional sources than in captivity [6,7]. It is not unreasonable to suppose that a natural diet can provide adequate nutritive support for growth and maintenance. We do not know the digestibility of different food products and it may be that components of the commercial diet may not be as bioavailable as the tested insect/fruit diet.

Although all animals were fed 2 g of food at each feeding in this study, the actual consumption rates of each are unknown. This is a significant limitation of this study. Consumption was visually evaluated and estimated with each feeding. The overall average was estimated to be 80% ± 10% of food per feeding in both groups with a lower consumption rate of papaya. Based on the continual dehydration of the food items and animal waste it was not feasible to calculate the consumption profile between feeding groups. Physiologically, both diets included an insect-based protein source which likely had a similar digestibility [13]. Pet owners may not be able to calculate consumption for similar reasons. Understanding how growth is affected on an ad-fed basis is of practical value [14]. Fecal analysis and blood chemistries can provide some insight into the digestibility of different food products but were also beyond the scope of this study.

The mobility of the live roaches and the chemical signature of each diet may have influenced consumption rates. Crested geckos do demonstrate dietary preferences between different animal protein and plant sources [6]. In a small feeding trial, Heldman et al. found that adult Crested Geckos preferred insect-based diets to other food types [13]. All animals in that study as well as this one were from a single breeder with similar genetic lines. There may also be individual or developmental differences in food preferences.

Richards's (2016) commercial diet feeding study lasted 14 weeks [11]. Differences between feeding groups in that study were significant at 4 weeks. Similarly, in this study, differences between diets were significant at 4 weeks. Although the 4 – 5 week study interval appears to be adequate to compare gross morphological differences, longer study durations may be needed to understand how dietary selection impacts long-term health and gecko longevity.

Animals used in this study were close in weight and size but had differences in age and gender. It is difficult to distinguish gecko sexes before sexual maturity, however, a longer study interval, lasting until maturity, would allow for sex determination. It would also clarify if there were other nutritive components in the commercial diet missing in the insect diet that may ultimately manifest into deficiencies. Repeating this study with a longer treatment interval and a comparison of sex differences is an important future direction. Geckos do experience sexual dimorphism while males are generally smaller although there is temperature and environmental plasticity can influence final body size [15].

The Crested Geckos in this study grew in length throughout the study, although minor differences may be seen between the feeding group lengths, these were not significant. Consequently, our reported differences in body weight between the feeding groups cannot be explained by body length changes alone. Geckos do not grow uniformly, tails and toe pads for example may grow at different rates from the body [16,17]. Body composition and body girth measurement are needed to explain whether differences in weight between treatment groups represent animal hydration levels, lean mass, constipation, or another factor in these groups.

References

1. Seipp R, Klemmer K. Wiederentdeckung von Rhacodactylus ciliatus Guichenot 1866 im Süden Neukaledoniens (Reptilia: Sauria: Gekkonidae). Senckenbergiana Biologica. 1994;24:199-204. Available from: https://inpn.mnhn.fr/docs-web/docs/download/410852

Citation: Brundage CM, Atamian S, Vasquez J. Juvenile Crested Gecko (*Correlophus ciliates*) Growth Rate on a Calcium-dusted Dubia Roach and Papaya Diet Versus a Commercial Diet. Int J Vet Sci Res. 2024;10(3):029-033. Available from: https://dx.doi.org/10.17352/ijvsr.000147

2. Valdez JW. Using Google Trends to determine current, past, and future trends in the reptile pet Trade. Animals. 2021;11(3):676. Available from: https://doi.org/10.3390/ani11030676

3. Digirolamo R. Google trends and online Q&A site reveal surging demand for endemic pet reptiles in Japan. bioRxiv. 2024;2024-04. Available from: https://doi.org/10.1101/2024.04.28.591490. https://www.biorxiv.org/content/10.1101/2024.04.28.591490v1

4. Aparicio Ramirez A, Perez K, Telemeco RS. Thermoregulation and thermal performance of crested geckos (Correlophus ciliatus) suggest an extended optimality hypothesis for the evolution of thermoregulatory set-points. J Exp Zool. 2021;335(1):86-95. Available from: https://onlinelibrary.wiley.com/doi/10.1002/jez.2388

5. Donoghue S, McKeown S. Nutrition of captive reptiles. Vet Clin North Am Exot Anim Pract. 1999;2:69-81. Available from: https://www.sciencedirect.com/science/article/abs/pii/S1094919417301408?via%3Dihub

6. Bauer AM, Sadlier RA. Diet of the new Caledonian gecko Rhacodactylus auriculatus (Squamata, Gekkonidae). Russ J Herpetol. 1994;1:108-113. Available from: https://www.artfulauriculatus.com/uploads/1/1/8/0/118053559/1994_bauer_diet_of_r._auriculatus_the_gargoyle_gecko.pdf

7. Cooper WE. Correspondence between diet and food chemical discriminations by omnivorous geckos (Rhacodactylus). J Chem Ecol. 2000;26:755-763. Available from: https://link.springer.com/article/10.1023/A:1005488507840

8. Di Giuseppe M, Martines Silvestre A, Luparello M, Faraci L. Post-ovulatory dystocia in two small lizards: Leopard gecko (Eublepharis macularius) and crested gecko (Correlophus ciliatus). Russ J Herpetol. 2017;24(2):128-132. Available from: https://www.researchgate.net/profile/Albert-Martinez-Silvestre/publication/317597881_POST-OVULATORY_DYSTOCIA_IN_TWO_SMALL_LIZARDS_LEOPARD_GECKO_Eublepharis_macularius_AND_CRESTED_GECKO_Correlophus_ciliatus/links/59425b0c0f7e9b1d45329d07/POST-OVULATORY-DYSTOCIA-IN-TWO-SMALL-LIZARDS-LEOPARD-GECKO-Eublepharis-macularius-AND-CRESTED-GECKO-Correlophus-ciliatus.pdf

9. Klaphake E. A fresh look at metabolic bone diseases in reptiles and amphibians. Vet Clin North Am Exot Anim Pract. 2010 Sep;13(3):375-92. doi: 10.1016/j.cvex.2010.05.007. Available from: https://ia902906.us.archive.org/9/items/endoscopyandendosurgery/AFRESH~1.pdf

10. Oonincx DGAB, Van De Wal MD, Bosch G, Stumpel JBG, Heijboer AC, Van Leeuwen JPTM, et al. Blood vitamin D3 metabolite concentrations of adult female Bearded Dragons (Pogona Vitticeps) remain stable after ceasing UVb exposure. Comp Biochem Physiol B Biochem Mol Biol. 2013;165:196-200. Available from: https://www.sciencedirect.com/science/article/abs/pii/S1096495913000754?via%3Dihub

11. Richard K L. Comparison of commercial gecko food on growth on rhacodactylus geckos. Honors Projects 2016;311. Available from: https://scholarworks.bgsu.edu/cgi/viewcontent.cgi?article=1258&context=honorsprojects

12. Hoby S, Clauss M, Aebischer A, Wenker C, Robert N, Liesegang, A. Dry matter and calcium digestibility in captive veiled chameleons (*Chamaeleo calyptratus*).J of Anim Physiol and Anim Nutr 2011;96:778-782. Available from: https://onlinelibrary.wiley.com/doi/10.1111/j.1439-0396.2011.01170.x

13. Heldman ML, Paisley AM, Saadeh HN, Swihart MP, Underwood EM. Food preferences of Crested Geckos *Correlophus ciliates*. Ohio J of Sci 2018; 118(1): A30-A30. Available from: https://www.proquest.com/docview/2137839696?fromopenview=true&pq-origsite=gscholar&sourcetype=Scholarly%20Journals

14. Pasmans F, Bogaerts S, Braeckman J, Cunningham A, Hellebuyck T, Griffiths R, et al. Future of keeping pet reptiles and amphibians: Towards integrating animal welfare, human health and environmental sustainability. Veterinary Rec 2017;181:450. Available from: https://europepmc.org/article/MED/29051315

15. Starostov ÁZ, Kubička L, and Kratochvíl L. Macroevolutionary pattern of sexual size dimorphism in geckos corresponds to intraspecific temperature-induced variation. J of Evol Biol 2010;23(4):670–677. Available from: https://academic.oup.com/jeb/article-abstract/23/4/670/7324391?redirectedFrom=fulltext

16. Griffing AH, Daza JD, Nielsen SV, Werneck FP, Viana PF, Gamble T. Toe pad morphology and adhesion in the miniaturized gecko, *Chatogekko amazonicus* (Gekkota: Sphaerodactylidae)." The Anatomical Rec. 2024;1-11. Available from: https://anatomypubs.onlinelibrary.wiley.com/doi/10.1002/ar.25511

17. Griffing AH, Gamble T, Behere A, Higham TE, Keller GM, Resener J, Sanger TJ. Developmental patterns underlying variation in form and function exhibited by house gecko toe pads. Integr Comp Biol. 2024;icae008. Available from: https://academic.oup.com/icb/advance-article-abstract/doi/10.1093/icb/icae008/7635665

Citation: Brundage CM, Atamian S, Vasquez J. Juvenile Crested Gecko (*Correlophus ciliates*) Growth Rate on a Calcium-dusted Dubia Roach and Papaya Diet Versus a Commercial Diet. Int J Vet Sci Res. 2024;10(3):029-033. Available from: https://dx.doi.org/10.17352/ijvsr.000147