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Comparison of commercial gecko food on growth of *Rhacodactylus* geckos

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Abstract

Available food sources can provide a different effect on the growth rates of *Rhacodactylus auriculatus*. In this study three food sources were compared, Repashy MRP, Pangea super foods, and GeckoPro New Caledonian blend. These are composed of similar nutrients but tend to have some points where they vary. Thirty-six gargoyle geckos were put through a trial over a 14 week period to determine which commercially available food source provides the best nutrients for growth, as measured by weight gain. Three groups of twelve were chosen based on a variety of ages and sizes to be given three different foods for an extended period of time to test food stimulus on growth. While all three foods provided nutrients for growth, Geckos fed Pangea and Repashy had the most significant weight increase, while those fed GeckoPro grew the slowest. A cost analysis compared both individual user usage (small quantities) and bulk usage (for larger facilities). For the individual gecko keeper, GeckoPro provides the most cost effective food source, while for bulk usage Pangea provided the best growth rate for the lowest food cost.

Introduction

All animals rely on some form of food source in order to thrive in any type of habitat, but some sources of food prove to be better for survival and growth than others. In captivity there is a smaller abundance of commercially available foods that provide the necessary nutrients for living. This may not be true for all animals, but in terms of the gargoyle gecko, or *Rhacodactylus auriculatus*, it is.

Rhacodactylus auriculatus is species of gecko found on the island of New Caledonia. Their scientific name *auriculatus* (meaning eared) referring to the pointed bone projections above their ear openings (Vosjoli et al. 2013). While their common name stems from the word “gargouille” which is a French word that described “throated” spouts that were often in the shapes of carved heads or figures, which resembled the gargoyle gecko’s unique head. They are considered to be medium to large members of the *Rhacodactylus* genus. In the wild these species are endemic to New Caledonia with a very limited range of habitat through the southern parts of the area (Whitaker et al. 2010). Although their range is very small, these species are considered least concern in terms of extinction.

In the wild these species seem to be doing well, and in captivity they have become popular in the reptile market. Gargoyle geckos were the first member of their genus to become commercially available to the reptile community (Henkel, 2003). They were first bred in Europe, reaching the United States in the mid-80’s only to be slighted by hobbyists, who were more interested in the more bright-colored species that had just entered the market. After time passed it was realized that they were calm, handle-able animals, which came in a wide-variety of colors and rested exposed on branches during the day (Hamper, 2005). All these traits made them become popular to hobbyists and zoological institutions, increasing their need to be bred and sold throughout the markets.

The Bowling Green State University herpetology lab is an example of one of the institutions that took in *Rhacodactylus auriculatus*, along with a few other *Rhacodactylus* species, and continue to breed them to obtain different morphologies and circulate them back into the market. There are six breeding pairs within the lab producing two eggs per clutch per month. These animals are being housed in a variety of different enclosures, all following what the literature about them says. The geckos are initially raised singly in large plastic terrariums then moved to screened enclosures as they become adults; 20-gallon enclosure for up to three adults (Vosjoli et al. 2013);

temperatures being kept between 72 and 82 degrees F. The animals are offered climbing opportunities in the forms of logs and fake fauna. They are also regularly misted with RO water (reverse osmosis water contains less harmful pollutants that may be in the tap water) and fed a standard diet three times a week.

In the wild *Rhacodactylus auriculatus* eat fruit, insects, nectar, small invertebrates and small mammals (Gargoyle Gecko Care, 2004), but in captivity it is not always possible to offer all these items, especially with a large number of animals. This is why alternative meal sources are provided. Commercially, there are only a few food sources that are readily available to facilities, such as the BGSU herpetology lab. During the earlier years of the lab fruit flavored baby food and a fruit mix was made for the animals; these methods were used until different dry mixes became available on the market for purchase. Repashy, Pangea and Gecko Pro food products are three that are currently available.

Materials and Methods

Materials consisted of thirty-six gargoyle geckos and thirty six small plastic critter containers set up to accommodate individual geckos. Three different types of food were used; Repashy Super Foods Crested Gecko Meal Replacement Powder, Pangea Fruit Mix™ Watermelon Mango Complete Gecko Diet and New Caledonia Flavored Gecko Pro Diet. A Mettler balance was used to weigh the geckos and units were transcribed to the nearest hundredth decimal place.

The study used three different groups of geckos varying in weights and ages. Each group was provided one of the three types of food for a particular span of time. These geckos were weighed before the experiment began and once weekly for a month, after the month had passed the frequency was reduced to twice monthly.

A plastic enclosure was set up for each individual gecko. They were provided a paper towel substrate that was replaced every other day, a shallow water dish that was always filled, and some small foliage to provide cover or climbing surfaces for enrichment. They were provided with fresh caps of food every Monday, Wednesday, and Friday along with clean enclosures and fresh water. Handling was kept at a minimum in order to reduce any stress or unwanted variables affecting growth. Each gecko was housed individually due to the aggressive nature of the juvenile geckos when housed together. The geckos were treated the same and placed in the same area of the lab in order to prevent outside factors affecting the growth. Each gecko was given the amount of food that best fits their size; no gecko was over or underfed. Health of the geckos was key and if any noticeable drop in weight had occurred, the food would have been switched back to the food last provided, in this case Pangea, and they would have been monitored more extensively. This proved to be unnecessary.

Results

The geckos consumed at least a small portion of the food they were provided, no gecko left their food consistently empty. This means that the growth of the geckos was not the result of them not eating.

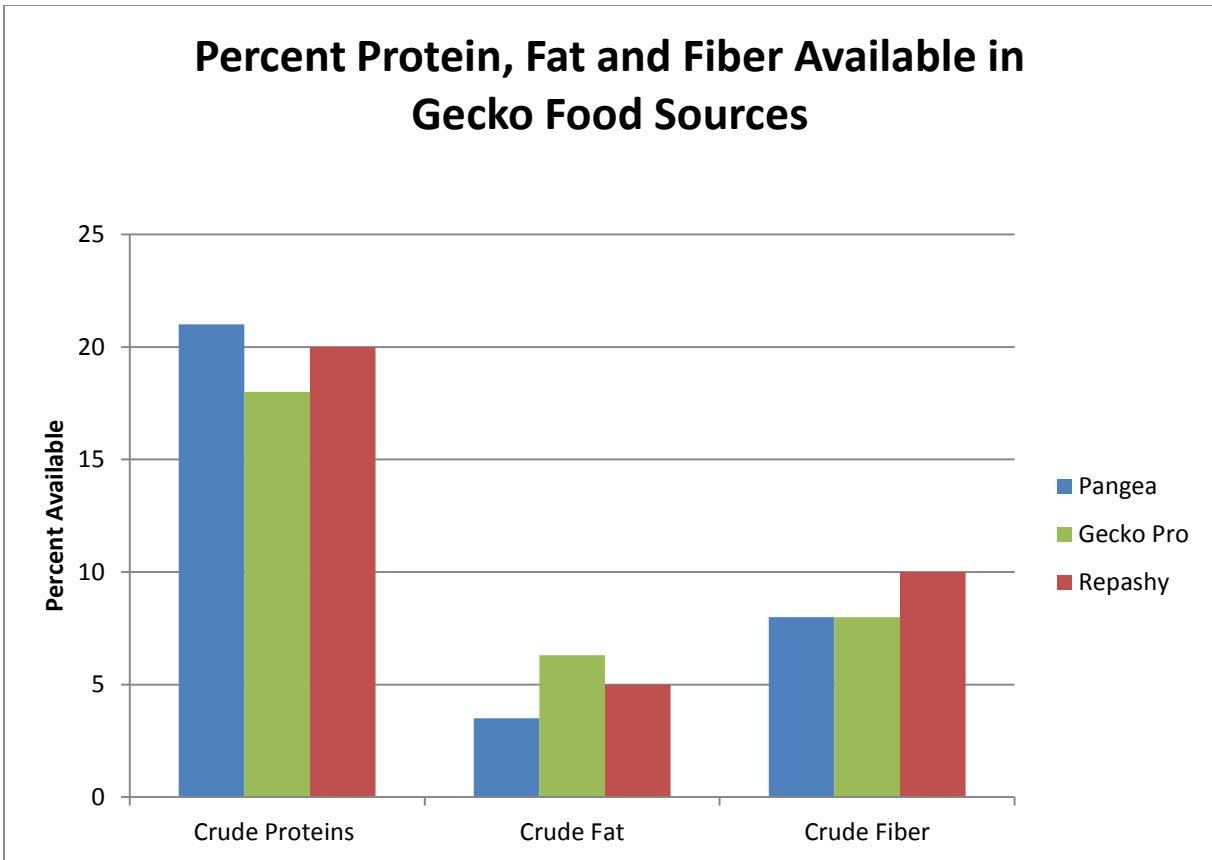


Figure 1. The three commercially available gecko foods crude percent of protein, fiber and fat were compared. The percent crude protein was provided on each label.

Pangea contains a minimum of twenty-one percent crude proteins, Repashy contains twenty percent and Gecko Pro has a minimum of eighteen percent. The first protein listed on each label is a whey protein label isolate. Crude fat contained in Repashy was 5, Pangea contained 3.5 and Gecko Pro had 6.3; the final bar group represented crude fiber containing 8 percent for Pangea and Gecko Pro and 10 for Repashy.

As seen in figure 2 geckos from each feeding group had an increase in weight over the 14-week study period ($p < 0.001$). This being said, the type of food that was consumed gave alternate results with each food type ($p < 0.001$). In the first week of the study, geckos fed Pangea and GeckoPro gained more weight than those feed Repashy ($p < 0.05$ for both). During weeks 4-8, 8-10, and 10-12, as well as overall, geckos fed Repashy and Pangea gained more weight than those fed GeckoPro ($P < 0.05$ for all time points). With the exception of the first week of the study, there were no significant differences in growth between Repashy and Pangea.

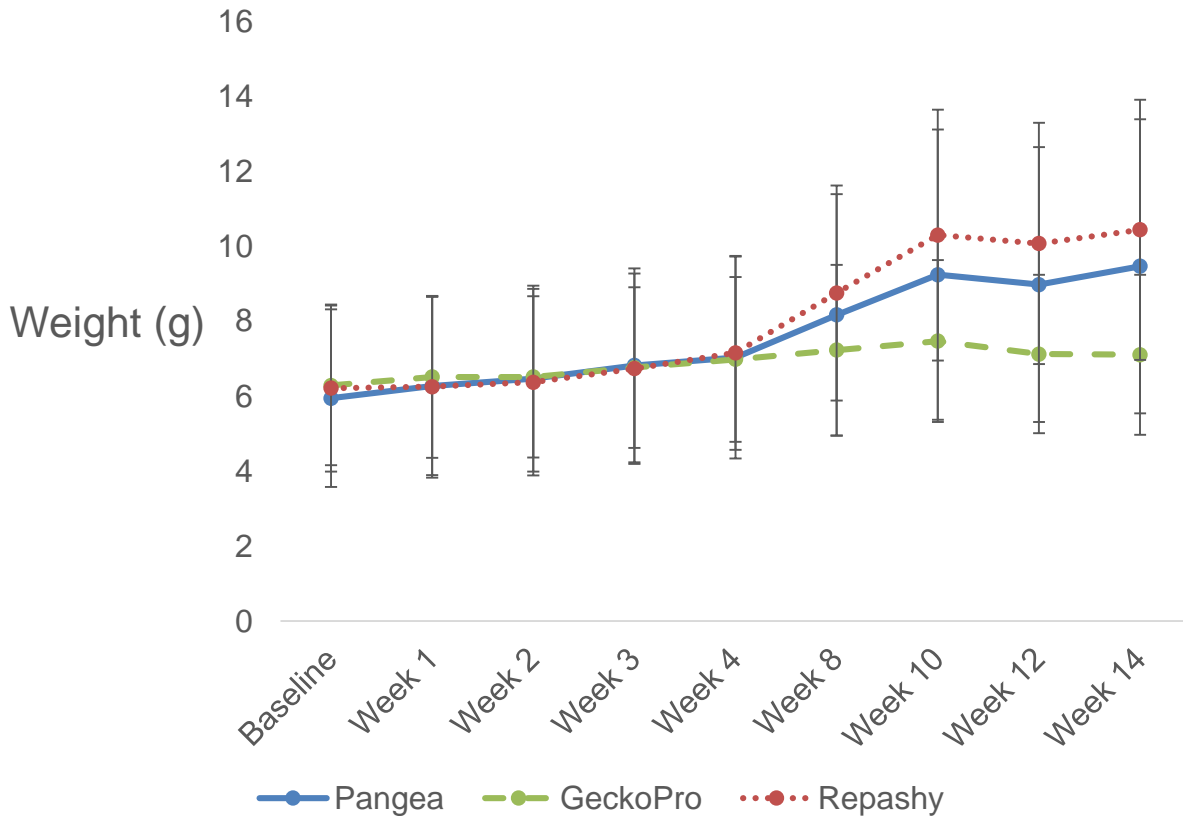


Figure 2. This is based on how much the average weight of each group of 12 geckos increased collectively over the course of the 14 week period. The y-axis is based on the weight of the twelve geckos and the x-axis is the 14 week time span the data was collected over. Each line represents the average increase in between the weeks.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics Version 23 for Windows (IBM Corp; Armonk, NY). Significance was defined as $p < 0.05$. The LSD test was applied for multiple comparisons. One-way repeated measures analysis of variance (ANOVA) was conducted to determine effects of feed type (Pangea vs. GeckoPro vs. Repashy), time, and their interactions on weight change. When a significant effect was revealed, additional one-way ANOVAs were performed to assess weight change at each time point (Table 1).

Table 1. This table shows the P values that are found over the 14 week time span that the experiment occurred. Starting with the baseline values and ending with overall results.

P-value Statistical Analysis of Gecko Growth	
Baseline to week 1	Week 8 to Week 10
Repashy < Pangea (p=0.002)	GeckoPro < Pangea (p=0.006)
Repashy < GeckoPro (p=0.029)	GeckoPro < Repashy (p<0.001)
Week 4 to Week 8	Week 12 to Week 14
GeckoPro < Pangea (p=0.002)	GeckoPro < Pangea (p=0.016)
GeckoPro < Repashy (p<0.001)	Overall
	GeckoPro < Pangea (p=0.001)
	GeckoPro < Repashy (p<0.001)

Table 2. Cost/benefit analysis of three food groups comparing cost per pound of food and cost per ounce.

	Gecko Pro	Repashy	Pangea
Cost/Ounce	2.49	3.33	3.99
Cost/Pound	30	21.82	20.7

Discussion

It is assumed that during the first week, geckos being offered Repashy were adjusting to the new food because it was unlike the original food being offered (Pangea) in texture, consistency and aroma. This would produce the results of Pangea and GeckoPro having a higher weight gain than those of Repashy (GeckoPro has similar consistencies to that of Pangea reducing the likely hood of them not eating it).

Repashy is a “meal replacement powder” that consists of dried banana, whey protein isolate, dried date, dried fig, etc. (Repashy, 2004). Pangea similarly is made with 60% real fruit and whey isolate (Gargoyle Gecko Care, 2004); while Gecko Pro varies with its main components being dried organic fruits (Gecko Pro, 2015). These three food sources are composed of similar nutrients but tend to have some points where they vary. As seen in figure 1, Pangea has one percent higher protein content than that of Repashy and three percent higher than that of Gecko Pro. The fat and fiber percentages differed in the three food sources as well. Gecko Pro contains the highest percent of fat and Repashy the highest percent of fiber; both fiber and fat tend to make the stomach feel full so these nutrients may have caused the geckos eating them to feel fuller before they consumed enough food to maximize growth.

Gecko Pro is a newer gecko diet that is based in Columbus, Ohio, while Repashy and Pangea have been on the market for multiple years and are wide spread. Pangea was utilized in the lab with the variety of gecko species. In past studies done at Bowling Green State University it was

found that some gargoyle geckos did not gain weight from eating mealworms or Repashy super foods, because the geckos did not eat them (Beverick et al. 2012). Four out of twenty geckos did not end up surviving the trial, but the remaining geckos who did consume the food ended up growing better than those fed baby food. Further studies were required to determine if Repashy's updated formula would improve gecko growth or any of the new foods on the market would provide a better food source.

Through this study, Pangea was found to be one of the best food sources to care for and maintain healthy gargoyle geckos. Repashy supplied similar nutrients to Pangea, with one key difference being an insect protein that was provided within. Gargoyle geckos in the lab are notorious for not eating crickets or other insects which can provide extra protein to the animal which can aid in growth (Beverick et al. 2012). This being said the Repashy did not have the fruity aroma that GeckoPro and Pangea produced, which was assumed could cause a problem with the geckos actually consuming the brown Repashy. After the 14 week experiment ended the data indicated that, minus the first week of the experiment (this was the adjustment period), Repashy and Pangea provided similar results in terms of gecko growth. They both had an increase in growth. While GeckoPro did not yield the same rate of growth, gecko weight did increase.

When picking which food should be used in the lab some other factors should be included. Each food powder requires two parts water and one part food in order to mix to desired consistency. GeckoPro caused slower growth rates and convenience of purchase, this food also molded very quickly (in comparison to the other two) and tended to have too liquid consistency. Repashy had good results that as long as the gecko is started on the food source early should produce similar growth rates to Pangea. The only downside to this food is that it also molds quicker than Pangea and because it is a brown coloration the geckos tracked it through the cage and made them appear messier much quicker than the other two food sources. With this in mind Pangea produced good growth rate, tended to mold the least fast, and had a good consistency that was not easily tracked through the cage; making Pangea the best choice of the three in terms of growth and long-term maintenance of the animals.

Lastly cost is an important factor that controls what foods can be purchased in a large scale lab setting. In bulk packaging (which is typically cheaper) Pangea costs \$206.99 for 10 pounds (Pangea), Repashy costs \$95.99 for 4.4 lbs. (Repashy), and GeckoPro sells 2 lbs. for \$59.95 (GeckoPro). These are the largest sizes available online. For one pound of food, it costs \$20.70 from Pangea, \$21.82 from Repashy and about \$30.00 from GeckoPro (table 2); meaning per pound Pangea is the cheapest. For one gecko a pound of food is a lot of food but for a whole lab it gets used fairly quickly. This being stated, Pangea is the only food source that provides how long the food will stay good in multiple environments. Pangea states that their mix is good for 6 months at room temperature and 1 year refrigerated, while unopened its shelf life is about 2 years (Pangea). This information provides needed background to determine how much should be bought at one time, giving Pangea another reason it is the best choice for the lab.

If individuals are searching for food sources for just a few pet geckos a smaller size is preferred. For one ounce of food; Pangea costs \$3.99, Repashy \$3.33, and Gecko Pro \$2.49 (table 2). This amount of food would suffice for one gecko for a few months. Although, it is cheaper to buy in the larger sized bags; with Pangea buying an 8 oz. bag costs \$2.24 per oz. of food and \$2.18 for Gecko Pro. A 6 oz. jar costs \$2.67 per oz. with Repashy. Gecko Pro may be packaged this way because it is providing less for the large facilities and more for the individual to buy. If the same feeding plan is followed as in the lab, geckos should be fed every other day (Monday,

Wednesday, and Friday) a water bottle cap full of food. Size of the gecko determines the size of the cap used. The food does tend to dry up quickly so no real measure of how much food was consumed by each individual gecko could be determined. Realistically a smaller amount of food purchased is acceptable if the owner is not breeding geckos or does not have a large quantity of them. Although, food quality should still be considered when purchasing; Gecko Pro is the cheapest per ounce of food but produced the slowest growth rates, possible because of the lower protein content. Pangea and Repashy, even though their cost is increased slightly, had better results with gecko growth and likeability.

Individuals may also be aware that, under conditions used in the lab, Repashy and GeckoPro tended to mold within 24 hours of being left in the enclosures. Pangea tended to have close to a 48 hour span before the food would mold. These times were estimated and may vary with different environments. If the food is replaced daily then these issues should not arise, but the lab replaced every other day which caused problems when the mold developed at a faster rate with the Repashy and GeckoPro diets.

There are very few studies that have been done comparing these food sources and the effects they have on these specific species. A literature research was conducted using a wide variety of databases, including PubMed, summons, BioMed, Agricola and Biosis. No similar studies were found in any of these databases. This is considered to be a strength of this study because not many things like it have been done on a large scale level for extended lengths of time. There were statistically acceptable results and through clear analysis of different factors an end product was selected to be beneficial on many levels. This is an experiment that can be easily replicated and done in an even larger scale if need be. This being said there are some limitations that need to be noted.

Because this study may be one of the first conducted, the results have not been verified by others. The number of test subjects was also slightly lacking, mainly because they were all different age groups from different breeding pairs. Ideally, they should be about the same size and there should have been more of them; all being started on the food right as the animal hatches to ensure no room for error. The length of the experiment was also shorter than preferred. Results could be analyzed to determine if there were any significant differences between Repashy and Pangea in a longer study. The only true publications on any related information was from Alan Repashy, which can provide bias.

Through this experiment beneficial information can be taken and used by the Bowling Green State University Herpetarium and other large scale herpetology labs/ breeding facilities. Cost effective ways of increasing weight for gargoyle geckos and other species that consume the fruit mixes can be utilized. To expand this process in the future, the next step would be to find more foods and test them for longer periods of time to see if additional significant results would come from a longer study period. For now, as the results have demonstrated, Pangea is the food source that should be used based on cost and benefits in growth for the animal.

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