Chameleon digestive system

Comprehensive question: Why do some chameleons eat plants? Related questions: Are all/some chameleons omnivorous? What exactly makes an animal omnivorous? Should I feed my chameleon vegetables? Do some chameleons need plant material in their diet? Are chameleons able to digest/extract nutrients from plant material; do they have the right kind of digestive system? Do some chameleons use plants as an additional source of water? Why do some chameleons, particularly veiled, eat plants in their cages? Wild veiled do the same? Why did I start this recording with such a cluster of questions? Well, for starters, because it often happens that two or more people end up arguing about a comprehensive question because they firmly believe in answering one related to them. And as far as I can tell, some of them are different issues. For example, an animal can be considered omnivorous if a certain percentage (e.g. 25%) its plant-based diet, a certain percentage of meat, etc. Chameleon may not meet this requirement, and yet still require some plant material in his diet. Two parties can argue with each other if one claims that chameleons are not omnivores and the other claims that they need plant material in their diet. In other words, there is no factual disagreement between them, as both of them may be right. In the same vein, some may argue that chameleons cannot digest plant material, while another argues that plant material is necessary for proper digestion. Again, both sides could be right here. It may turn out that chameleons cannot digest plant material, but it is for this reason that they need it to properly digest other foods, although not self-absorbed, a plant matter is required to move digestible contents through the intestines. Again, the parties involved do not take in-line positions. While even the solution-no less answering-all of the above questions goes beyond this blog post, I would like to discuss some, and I want it to be as clear as possible, what I say, what I think the evidence is attest to, and where I think the evidence is inconclusive. ---------- This is the point of Nekas... more to follow. ---------- data point: Some captive chameleons have been seen consuming plants in cages. While the captive Chamaeleo calyptratus (multiple calyptratii?) is the most famous example, such behavior has also been noted in the captive samples of C. chamaeleon (Ibrahim, 2013), (Herrel, 2007). Moreover, such behaviour does not appear to be confined to captivity. Wild examples of calyprate calyprate calypratic caliptrateus (Necas, 1999/2004), C. calyptratus calcarifer (Necas, 1999/2004), C. chamaeleon (Karen-Rotem, Bouskila, s 2006) (Herrel, 2007) (Ibrahim, 2013), C. namaquensis (Burrage, 1973) and Furcifer oustaleti (Takahashi, 2008) were either seen by plant material, or significant plant material was found in their samples. Burraji Burrages Takahashi Ibrahim noted not only vegetation, but also fruits in the faeces of their species. With that in mind, it's wise to change our original data point: Some chameleons eat plant material, including fruit. Several theories have been proposed to explain this (Measey, Raselimanana, and Herrel, 2014). Among them: A) casual meal (Cooper and Witt, 2002); B) as a dietary tool for moving soft prey (e.g. caterpillars) through the digestive tract (Necas, 2018a); C) as a means of supplementation of hydration in dry habitats (Burrage, 1973), and D) in addition to some nutrient missing in the diet. Theory a) may explain some cases. Hornworms, for example, are famous for their acumen. The gentle leaf can give way before the worm is gripped, in which case both the worm and the fragment of the sheet are caught. In fact, I watched this very situation, but the chameleon actually spit out a leaf. Similarly, I can imagine some species of Brookesia or Rhampholeon ingesting the occasional dropped leaf while hunting tiny bugs on the forest floor; however, such cases seemed implausible here as a comprehensive explanation. First, the species in question, namely C. calyptratus, calcalifer, chameleon, namaquensis and Furcifer oustaleti - are all great chameleons. And with the exception of namaquensis, whose hunting grounds are often not covered with sheet litter-all wood feeder, so the Brookesia/Rhampholeon example does not apply. More importantly, chameleons are accurate hunters, highly adapted for accurately hitting their prey. This strains the credulity of thinking they are accidentally ingesting enough plant material to account for the data. Fortiori, it has been noted that in at least some examples of herbivores, the chameleon uses non-slingual feeding behavior (Takahashi, 2008) (and almost everyone who watched their chameleon eat a hibiscus flower) that seems incompatible with casual eating. Theory B) was proposed by Peter Nekas (2018a), (2019) from his first experience with C. calyptratus in both Yemen and its decades of storage, reproduction and research of this and many other species. The idea here is this: Kaliptrate has a relatively short intestinal tract (small intestine and colon), which has no curves and bends characteristic of other animals (Necas, 2018a). Consequently, the loose or liquid contents of the intestine are difficult to pass through. At certain times of the year, the most prolific prey items for C. calyptratus are soft-bodied caterpillars and nymphs of various orthopedists (Necas, 2019). Such prey items are low in chitin, and relatively soft bodily are the very kinds of predatory objects that one might think would create a kind of free homogeneous intestinal content in question. In the absence of prickly, hard parts of the body to help the intestines gain grip on these weaker contents, the caliptrate will ingests the plant material, fill that role. Basically, the vegetable substance replaces chitin as dietary fiber. I must confess that I had intuitive draw to this position. First, it puts a new and creative explanation of the data. Secondly, it combines facts about chameleon biology, ecology and morphology in a convincing and intuitive way. Nekas further explains that the consumption of plant material as a means of hydration is incompatible with data: most of the herbivorous activity occurs during the rainy season (Necas, 2019). It is a mockery of our observations of captive caliptrates that consume plants even if they are well hydrated. Again, I am sympathetic to this story, but there are some drawbacks. First, the theory seems to light on peer-reviewed support, and my admittedly brief examination of relevant literature suggests the same. While nothing I read directly addresses the Necas hypothesis, I also found no other researcher actively pursuing this line. That being said, Galileo didn't enjoy much public support in his day either. Secondly, the theory and its concomitant statement (part about hydration) do not take into account other data about F. oustaleti, C. chamaeleon and C. namaquensis. It is not entirely clear that any of these latest species experience a season in which insect prey consists mainly of soft-bodied insects that requires the consumption of plants as fiber. Ibrahim (2013) noted an equal amount of plant matter in C. chamaeleon faeces throughout the year. Similarly, linking the data (Ibrahim, 2013) (Pleguezuelos, Poveda, Monterrubio, and Ontiveros, 1999) (Burrage, 1973) (Karen-Rotem, Bouskila, s Geffen, 2006), we see a rather interesting correlation between the arid environment and the level of plant material in the faeces of C chaele. Plant matter was found in faeces samples from the relatively arid climate of North Sinai (Egypt), Israel and Libia, but were clearly absent from samples taken from spain's much less arid regions (Measey, Raselimanana, and Herrel, 2014, p. 108). To be clear, there seems to be a correlation between the intake of plant matter C. chamaeleon and the aridity of its habitat. Intuitively, this seems to partially undermine the Nekas hypothesis, and its discounting of the view of hydration (theory c), above). Finally, the Necas score not only suggests a special look at the digestive capacity of C. calyptratus- what stands as opposed to the scant digestion treatment gets into being dedicated to the biology of the chameleon (see (Tolley and Herrel, 2014)), but will also require that we generalize all of the aforementioned species. That being said, the evidence is not conclusive in any way. As I mentioned in the previous section, there is some empirical support c) - the theory that taking plant matter chameleons is an adaptation in addition to hydration. Chameleons of the same species have levels of plant material in their faeces, which appear to vary depending on the aridity of their environment (see above). these figures are equally disputed by the findings of Takahashi (2008) and Nekas (2019). We will discuss Takahashi's data below, but he has observed (and newly created) cases of Furcifer oustaleti, seemingly looking for fruit, regardless of hydration. And anecdotal, though following evidence, we have all witnessed well-hydrated chameleons consuming plant matter. Therefore, while it is not surprising that, for example, C. namaquensis regularly consumes meaty plant material (Burrage, 1973), dehydration seems to be the unlikely direct cause of all herbivores. Although herbivores may turn out to be a well-established rudimentary genetic adaptation - still present, but no longer needed... More on that later. The theory (d) - the notion that chameleons supplement nutrient intake by taking plants is perhaps the most controversial and demanding of the four. To be clear, this account is not just claiming that plant material is essential for digestion, but that the body is actually able to extract certain nutrients from plant-based nutrients that make up an important or necessary part of the diet. This is controversial and demanding for the following reasons. First, there's so much community pushback against it (and I sympathize with that intuition, but admit that it's just an inductive leap that allows for a lot of conflicting explanations). Secondly, the opinion either includes a number of controversial assumptions about the digestion of the chameleon, or requires a large-scale research project at the same. There are a lot of problems. From what I can tell, given the cursory digestion treatment in several sources, such as (Anderson and Hyam, 2014), we just don't know enough about digestion in chameleons to know whether nutrient extraction from plant material is at all possible. Indeed, the small intestine and colon are given a whopping two paragraphs in the entire volume about chameleon biology see (Anderson and Higham, 2014, p. 52)-the most cited source in it from more than forty years ago (Parson and Cameron, 1977)! This in itself demonstrates the state of our knowledge. There are probably some compounds that any digestive system can sequester out a plant matter (even celery adds something), but the question is anything important/necessary plant-based. To this I am not optimistic about what is coming in the near future. However, thoroughly unqualified, although I certainly have, I can (at least) bring a conceptual analysis to bear here... From other vertebrates, we can get something about herbivores and omnivores. Obligate herbivores, as well as often herbivores, tend to have a longer, more complex digestive system. These systems use a variety of agents to break down the plant matter. With a few stomachs, chewing chews, having The small intestine and colon are capable of fermentation, excessive, sometimes daytime nutrition, and symbiotic relationships with certain microorganisms all adapting to the destruction of plant material. Material. Accordingly, herbivorous reptiles, such as iguanas, often demonstrate teeth capable of effectively chewing/crushing leaves, a long intestinal tract and/or special intestinal valves that slow down the movement of food through the intestines, as well as various digestive agents, including enzymes and symbiosis of microorganisms (Cooper and Vitt, 2002); (Baer, Oftedal, Rumpler, and Ulry, 1997) (Iverson, 1988) (McBey and McBey, 1988). While these adaptations are present in herbivores (and some omnivorous reptiles), reptiles that consume only a small amount of plant matter tend to lack these more complex adaptations, and therefore consume more easily digestible plant parts such as fruits, nectar, flowers and pollen (Cooper and Witt, 2002). So how does this information help us? Well, for a start, it is generally believed that chameleons have short digestive tracts (Necas, 2018a) (Necas, 2019) (Anderson and Higham, 2014). Photos are available online in Chameleons! Online e-zing-courtesy Bill Strand and Tom Greek DVM-bear it: the oesophagus and stomach seem to be as long as the entire gastrointestinal tract. Similarly, there is no textual support for chameleons capable of gastrointestinal fermentation that occurs in herbivorous reptiles such as iguanas, or even omnivores such as the bearded dragon. The chameleon of dentures and chewing also seem incompatible with the ability to break down a plant matter in a way that promotes digestion (Anderson and Higham, 2014) - something for which their herbivorous reptile relatives are well adapted (Cooper and Witt, 2002). This being said, photo evidence from Strand and Greek comes from dismembered Trioceros deremensis, and Calumma parsonii- none of the species is generally considered to be herbivorous tendencies. It may well be that veiled chameleons are anatomically different, showing specific devices for digestion of plants. However, I can't find any literature that supports this point of view (nor anyone who speaks against it). For the most part, literature seems to suggest digestive anatomical homogeneity through Chamaeleonidae. However, one would expect that if something new had been found in the digestive tract of C. calyptratus, the journals would have done so. ----------, why doesn't the chameleon poop stink? I am indebted to Kninga for pointing it out. In her personal correspondence, she repeatedly asked me if veiled chameleons, in particular, have short digestive tracts. Its point is particularly relevant here, as it is really veiled that we want to know. Unfortunately, I don't have an answer here. Literature seems to lump all chameleons into one digestive tract of phenotype. ---------- tying together the previous two paragraphs seems to have some prima facie reason to doubt (d) - The view that chameleons are able to extract certain nutrients from plant-based nutrients that form an important or necessary part of the Diet. Again, this is hardly definitive. In fact, he conflates the distinction cut by Cooper and Witt (2002)above; namely, that different parts of plants are more or less easily digested. Folio reptiles tend to have special devices for processing relatively difficult to digest foliage plants (Cooper and Witt, 2002). However, reptiles that are not so endowed tend to feed on more easily digestible plant parts such as fruit, nectar and pollen. Thus, even if the theory (d) seems dubious in light of the two previous paragraphs, it does not suggest the possibility that chameleons are capable of extracting nutrients from, for example, fruit. In a highly relevant work, Takahashi (2008) examines the fruity eating habits of Furzifer oustaleti. Observing a wild specimen fed to the fruits of Grangeria porosa, Takahashi developed a study in which 24 wild F. oustaleti caught were presented with a horse in one case, and the fruits of Chassalia princei in another. Takahashi discovered that a tongue projection was used in the case of horsefly, but the jaw prehension was used for fruit. According to Takahashi (2008) and Measey, Raselimanana and Herbel (2014, p. 108), this suggests that the subjects differed between the two foods and used suitable feeding methods for mining. More clearly, it looks like the chameleons were able to distinguish the fruit as such, and yet proceeded to ingest it. Takahashi is not alone in his conclusions. Burrage (1973) also observed C. namaquensis using various feeding techniques for fruit. In addition, Takahashi observations and subsequent experiments were conducted over several years between November and April (rainy season) - the consequence is that hydration is not a factor. This makes the theory (d) less questionable, at least for fruit. If chameleons purposefully consume fruit, the mechanisms of evolution seem to support them to do so for a reason. If this cause is not hydration, then it may be food. Prima facie, scant evidence seems to support the view that (some/most?) chameleons do not have the equipment to extract nutrients from hard-boiled foliage plants. On the other hand, some chameleons seem to be able to distinguish between more easily digestible fruits as other types of food suitable for obtaining different types of feeding behavior. And equally scant evidence here may support the view that these chameleons do so for food reasons. ---------- stress that the last moment is weak at best. In fact, all I've done is piece together some superficial anatomical facts about herbivores, compare them to some equally far-fetched data about chameleon anatomy in a cursory kind of pathway, and add a half-formed hypothesis that is supported by as much intuition as it is empirical evidence. But just doesn't exist. ---------- While we obviously need to change the theory d) to reflect the fruit/foliage differences, there is more to eat Concern: What often prompts us to ask why chameleons sometimes eat plants is the observation that our captive veiled chameleons are often seen devouring plants in their cages. And plants in cages are rarely covered with fruits or flowers - the easier it is to digest the details. So even if wild specimens of F. oustaleti sometimes purposefully consume fruit, it doesn't help us understand why captive veiled chameleons eat leaves. Earlier, while discussing theory c), I said I would go back to the point of evolution. The fact is that herbivores in chameleons can be an evolutionary adaptation that is infused by some members of the species with little survival advantage, thereby allowing them to transfer any gene responsible for behavior. Just spit ball some ideas here: Perhaps sometime in their evolutionary history, chameleons from arid climatic really consume leaves in addition to their hydration needs. Similarly, hunger may have prompted some people to consume a plant substance. And, ineffectively, although the chameleon's digestive system is to extract nutrients from plants, a small energy boost may have tipped the balance in favor of survival for those fearless few. As I said, even celery probably has some vigorous benefits given the specific metabolic rate. Perhaps at certain times of the year, the winds carry a small amount of calcium carbonate and deposit it on the foliage, making herbivores casual to an additional source of calcium. In addition, it may be all of the above, or some other evolutionary quirks. The fact is that the herbivores in the evolutionary history of some chameleons may well have imbued certain individuals with a slight survival advantage over their conspecifics, and this was enough to ensure the transmission of any gene/s were responsible for the behavior. ---------- I attribute the genesis of this idea to Kynong, which observed a more common herbivore in female veiled. Perhaps sometime in their evolutionary history, gravid women continued to produce large and healthy paws if they ate leaves dusted in calcium-rich sediments. ---------- What exactly does this mean for us? First, if a herbivore turns out to be some kind of adaptation that helped chameleons survive during drought or famine, or was random to increase calcium absorption, then this does not appear to apply to captive samples. In other words, this does not seem to be a requirement for prisoners, as we do not usually expose them to these extreme conditions. Thus, according to this line, the adapted behavior of herbivores is a rudimentary relic of the past. If this is correct, then the answer he gives to our question is this: Chameleons eat plants, because once in their evolutionary history such behavior helped eek-out life in difficult times. Both the behavior and the gene responsible for it were encoded in the genetic genetic To some species; and forty years of captivity is not enough to undo tens of thousands of evolution. In short, it is believed that chameleons do not require plants in their diet, but continue to consume plant material because no longer required genetic adaptation. Is this a satisfying account of every instance of herbivores in chameleons? I certainly find it a believable account for many occasions. In fact, it actually links several theories that we've reviewed: Chameleons used herbivores in addition to their hydration requirements to get enough vigorous benefit to go through hunger, even in addition to their calcium requirements. Indeed, nothing about this latest theory/hypothesis (guess?) discounts Necas' dietary fiber vision (see above). Necas said that in the absence of something to help move soft objects through the intestines, veiled chameleons observed vomiting (Necas, 2018a). Herbivores, in this context, may have helped them preserve the precious contents of their gut rather than losing these potential nutrients by vomiting. So I think we need to change our list of theories to include this fifth, evolutionary account. Fortunately, the next letter is on our list of theory e). Accidentally. To be clear, this is not a new account. Necas (2018a), Tolly and Herrel (2014), Reilly et al (2007) and many others expressed this view. However, it is interesting how the evolutionary account is compatible with many theories, suggested to explain the phenomenon of chameleon herbivores. Indeed, theory (e) serves as a partial justification for those who assume that chameleons consume plants for hydration, for nutrition, for fiber, etc. Chameleons probably used plants for all these reasons. For those who are still convinced that we should offer fruits and vegetables to our modern pets in captivity, feel free to stop reading now: Some species have adapted to be able to consume a small amount of these items, and it probably doesn't hurt. For everyone else, this may be appropriate, given that while herbivore may be genetically entrenched behavior, the purpose it used to serve (at least according to this line of thought) is no longer applicable, since our captive charges do not face survival problems that, combined with natural mechanisms, led the selection to transfer their ancestral genes responsible for herbivorous behavior. ---------- note that I'm not conflating on/phylogenetic differences. Ontogenetic behavioral oddities that fill a person with the advantage of survival often eventually become a phylogenetic adaptation. ---------- Of course, much of this germ theory depends on some pretty long logical leaps, quite a bit of speculation, and not a small number of simple old guesses. the most egregious of these flaws is the following conclusion: chameleons appear to have short digestive pathways. Herbivores some heavily herbivorous omnivores don't. It seems chameleons don't have the right sort of thing to handle hard to digest a plant matter. As a kidnapping conclusion, I would give it 4/10; even worse if you factor in how little we know about the chameleon digestive system. Indeed, the pattern of reasoning closely reflects the following: bumblebees have small wings compared to their body size. The vast majority of good flyers don't. Looks like bumblebees don't have the right sort of thing to fly. I say this, not to disappoint those who held on to the final answer here, we fell off the bridge a few thousand words ago, but just keep my promise to be as transparent as possible about what I think the evidence shows. In this case, the evidence doesn't show all that much. However, we have to start somewhere; and, all things being equal, I prefer a hypothesis that can accommodate other related hypotheses rather than discounting them. While far from definitive, the evidence has so far pulled my intuition towards it does not need to feed our chameleons of plant matter, and the fact that they sometimes consume a vegetable substance is the result of thousands of years of evolution in which it has been beneficial. If it's no longer profitable (but obviously not harmful), then I'm happy to put my time and effort into a proper gut load, supplements and husbands, and don't worry about why my veiled ones don't eat their collars. What about our list of questions? Well, I've been thinking about going through them one by one, and finding out where the possible answer is going in this long ramble. But I just broke 4,000 words, and it's New Year's Eve. I'll leave the little things to any patient enough to read this... Works cited by Anderson, K.V., Higham, T. E. (2014). The chameleon's anatomy. In C. Tolley, A. Hurrell, the biology of chameleons (p. 7-55). Berkeley/Los Angeles, California, USA: University of California Press. Baer, D. J., Oftedal, O. T., Rumpler, W. V., and Ullrey, D. E. (1997). Dietary fiber affects the use of nutrients, the growth and consumption of dry matter green iguanas. 127(8), 1501-1507. Berraj, B.R. (1973). Comparative ecology Chamaeleo pumilis pumilis and C. namaquensis. Annals of the South African Museum, 61, 1-158. Cooper, W. E., and Witt, L. J. (2002). The distribution, scale and evolution of lizard plant consumption. Zoological journal, 257, 487-517. Herrel, A. (2007). Herbivores and feeding regimen for lizards. 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chameleons.Berkeley/Los Angeles, California, USA: University of California Press. Reaction: Kylarben92, Christel, Brodybreaux25 and 4 others chameleon digestive system diagram