Comparison of different modes of food particle size reduction in extant amniotes and implications for competition between ornithopods and sauropods

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Introduction
Between herbivorous dinosaur taxa, profound differences in the degree and way (teeth or gastric mill) of food particle size reduction are discussed.
→ On the one hand, there seems to be some consensus that an important reason for the radiation of ornithopods was their effective dental masticatory apparatus, the “dental batteries”.
→ On the other hand, many authors have assumed that sauropods compensated the lack of a masticatory apparatus with a gastrolith-containing gastric mill - similar to extant herbivorous birds.

However, if the dental batteries of ornithopods were to represent an adaptive advantage, then the evident implication is that a gastric mill is less efficient than teeth at comminuting forage material. This assumption has not only never been clearly stated, but also never been tested so far.

Aim
To quantify the effects of different modes of food particle size reduction:
- practically no particle size reduction (reptiles)
- gastric mill (birds)
- mastication (non-ruminant mammals)

Results
Faecal particle size in reptiles is considerably larger than that of equally sized homoiotherm animals.
No difference is obvious between birds (gastric mill) and mammals (masticating teeth).

Conclusions
If, with respect to sauropods, the argument is followed that there is not enough evidence to assume a functional gastric mill, then an important physiological difference between sauropods and ornithopods is hypothesized – the particle size at which food is digested - which significantly influences evolutionary scenarios based on ecophysiological niche competition.

Assuming no particle size reduction in ankylosaurs, stegosaurs and sauropods, body allometry allows the giant sauropods to compensate for a lack of particle size reduction by increased ingesta retention without compromising metabolic rates. For the smaller ankylosaurs and stegosaurs, such increased retention would only appear feasible at reduced food intake and hence metabolism.

Methods
Representative for ingesta the mean faecal particle sizes of captive reptiles (n=37; 14 species), birds (n=79; 12 species) and non-ruminant mammals (n=452; 115 species) were evaluated. Only adult healthy individuals were sampled. Analysis was performed by wet sieving (Retsch® AS 200 digit, Haan, Germany) using nine sieves with 0.063, 0.125, 0.25, 0.5, 1, 2, 4, 8 and 16 mm mesh size (quadrate openings). Sieving time was ten minutes and water throughput 2l/min. The geometric mean was obtained by curve fitting (TableCurve® 2Dv5.01, Systat Software UK Ltd., UK).

This work was supported by DFG grant CL 182/3-1 and is a contribution of the DFG Research Unit 533 “The Biology of Sauropod Dinosaurs”