Old teeth, new methods: microtexture and morphometry analysis provide insight in gradual evolution and dietary change in the extinct bovid *Myotragus*

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Energetic constraints are a substantial challenge for mammals living in an insular environment. The immediate interface between forage and the mammal are teeth. These can either be specialised or generalist in function, in order to meet demands of forage and environment. The extinct artiodactyl *Myotragus* is endemic to Mallorca and Minorca, with at least six succeeding species. With its peculiar cranial and post-cranial adaptations, it evolved to meet the specific demands of its insular habitat. Three dimensional (3D) methods of dental morphometry and microtexture analysis were applied to four *Myotragus* species to test the following hypotheses.

1. Along with 'large-scale' adaptations of dentition, 'small-scale' adaptations in single molar tooth morphology occur and can be used as a dietary proxy.
2. Within the *Myotragus* lineage, a dietary shift took place.
3. Dietary differences existed between geographically separated populations of *M. balearicus*.

An optical topometric digitisation system (smartSCAN3D, Breuckmann, Meersburg, Germany) generated 3D occlusal surface models (Nieberg *et al*., 2009). Further, a high-resolution surface measuring system (μsurf Custom, NanoFocus AG, Oberhausen, Germany) generated microtexture scans of dental facets. Microtexture analysis was performed according to industrial areal surface texture standards (ISO/DIS 25178-2) (Schulz *et al*., 2010).

The older species, *Myotragus pepgonellae*, *M. kopperi* and *M. batei*, have significantly higher enamel/dentine ratios than the younger *M. balearicus*, whose teeth are composed of more dentine, suggesting a gradual evolutionary decrease of the dentine/enamel ratio. Also, the length and surface of inner enamel ridges decreases within the *Myotragus* lineage, an indication for a dietary shift from grazing to browsing. The ISO/DIS *Sz*-(maximum height of the scale limited surface) and *Vm*-parameters (material volume) decrease within the succession of species, which implies that tooth-to-tooth contact was prevalent in *M. balearicus*, producing more flattened textures with large dales. This signature indicates a dominance of soft and tough food items (browse), while brittle and hard forage (graze) maintains a more elevated profile. However, within two tested populations of *M. balearicus*, there is no difference in tooth morphology or microtexture. Both 3D dental morphometry and microtexture analyses place *M. balearicus* among

extant browsers which have a source of abrasives in their diet, while its ancestors show characteristics similar to extant grazers. These results reveal that either a dietary shift took place in this lineage or *Myotragus* successively adapted to increased intraspecific competition, expanding its dietary range to adapt to energetic restrictions.

References

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