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Forestomach pH in hunted roe deer (*Capreolus capreolus*) in relation to forestomach region, time of measurement and supplemental feeding and comparison among wild ruminant species

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Abstract: There is a debate whether supplemental feeding of deer bears the risk of inducing health problems, in particular acidosis. Here, the pH values of forestomach contents of free-ranging roe deer (*Capreolus capreolus*) shot in areas with and without supplemental winter feeding were compared. pH was similar in the dorsal and ventral rumen, but lower at these sites than in the Atrium ruminis, where it was again lower than in the reticulum; this pattern corresponds to expectations based on differences in the presence of saliva at the different sites of the forestomach. pH was lower with increasing time that elapsed between death of the animal and measuring pH in unsupplemented animals and was lower in unsupplemented animals in May/June than later in the year. Animals with supplemental winter feeding had significantly lower rumen pH (5.5) than animals without food supplementation (5.7). These data suggest that supplemental feeding of roe deer has the potential to lower forestomach pH. Although pH values measured in supplemented animals in this study would be considered indicative of rumen acidosis in domestic cattle, they are within the range previously measured in various free-ranging Odocoilid species, including roe deer; were of a similar magnitude as the May/June values of unsupplemented roe deer in this study; and must be considered with respect to potentially rapid declines in pH between death of the animal and pH measurement. Given methodological problems, analyses of literature data from free-ranging wild ruminants provide little evidence for a systematic variation of rumen pH with feeding type and body mass, but lead to the hypothesis that some New World cervids, including the roe deer, might either naturally have lower pH values than other ruminants or rumen contents whose pH drops rapidly after death.

DOI: <https://doi.org/10.1007/s10344-013-0698-7>

Posted at the Zurich Open Repository and Archive, University of Zurich

ZORA URL: <https://doi.org/10.5167/uzh-79408>

Journal Article

Supplemental Material

Originally published at:

Ritz, J; Hofer, K; Hofer, E; Hackländer, K; Immekus, D; Codron, Daryl; Clauss, Marcus (2013). Forestomach pH in hunted roe deer (*Capreolus capreolus*) in relation to forestomach region, time of measurement and supplemental feeding and comparison among wild ruminant species. *European Journal of Wildlife Research*, 59(4):505-517.

DOI: <https://doi.org/10.1007/s10344-013-0698-7>

Supplementary Figures

Figure S1. Influence of supplemental feeding on environmental and biological effects on pH in the dorsal rumen of roe deer. Symbols in a) and b) are means, vertical bars are ± 1 s.e.m. In months with sufficient sample, 95% confidence intervals of females and males overlapped (a; note that the sample did not include any males that received the supplemental feeding). Interaction effects were not significant in all cases (b - e; $p = 0.201$ to 0.442); however, the temperature effect (e) had a significantly more positive slope amongst animals that had access to supplemental feeds when only females were included in the analysis ($p = 0.035$), and when only females sampled during November and December were included ($p = 0.043$).

Figure S2. Influence of supplemental feeding on environmental and biological effects on pH in the atrium ruminis of roe deer. Symbols in a) and b) are means, vertical bars are ± 1 s.e.m. In months with sufficient sample, 95% confidence intervals of females and males overlapped (a; note that the sample did not include any males that received the supplemental feeding).

Interaction effects were not significant in all cases (b - e; $p = 0.186$ to 0.747); however, the body mass (c) had a significantly more positive slope amongst animals that had access to supplemental feeds when only females sampled during November and December were included in the analysis ($p < 0.050$).

Figure S3. Influence of supplemental feeding on environmental and biological effects on pH in the reticulum of roe deer. Symbols in a) and b) are means, vertical bars are ± 1 s.e.m. In months with sufficient sample, 95% confidence intervals of females and males overlapped (a; note that the sample did not include any males that received the supplemental feeding). Interaction effects were not significant in all cases (b - d; $p = 0.230$ to 0.449) except for the more positive slope of the temperature effect amongst animals that had access to supplemental feeds ($p = 0.029$). The latter effect remained significant when only females were included in the analysis ($p = 0.016$), and when only females sampled during November and December were included ($p < 0.022$).