

Can nitrogen isotopic fractionation estimate urinary nitrogen excretion in small ruminants?

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Urinary nitrogen (N) excretion (UN) is an important part of N partitioning, with major effects on the profitability and sustainability of farms. However, it is difficult to quantify in production settings. Recent studies with cattle (Cheng et al., 2014; Cabrita et al., 2014; Cantalapiedra-Hijar et al., 2018) showed potential to develop N isotopic fractionation ($^{15}\text{N}_{\text{animal-diet}}$) to estimate UN, but limited work has been done with small ruminants. Therefore, in this preliminary study we explore the potential to use $^{15}\text{N}_{\text{animal-diet}}$ as an indicator of UN in small ruminants.

Linear and REML analyses were used to explore the relationship between $^{15}\text{N}_{\text{animal-diet}}$ and both UN and UN/N intake (NI) in small ruminants. Treatment means from four studies reporting UN (g/day), UN/NI (g/g), and $^{15}\text{N}_{\text{animal-diet}}$ (‰) from 62 dry sheep offered one of 17 treatments were analyzed using GenStat software. All four studies were carried out indoors using metabolic crates. In the first study, six sheep were used in three periods each lasting three weeks, while the second study was conducted with eight goats and two periods each lasting three weeks. The third study was conducted with 24 growing lambs in two different periods each lasting six days, whilst in the fourth study, 24 rams were used in one period of 47 days.

Linear regression analysis showed that the UN/NI had a positive correlation ($r^2 = 0.86$, $P < 0.001$) with $^{15}\text{N}_{\text{animal-diet}}$ (Figure 1a). A weaker, but positive ($r^2 = 0.43$; $P = 0.005$) relationship between $^{15}\text{N}_{\text{animal-diet}}$ and UN was also observed (Figure 1b). In addition, REML estimates of the parameters in linear mixed-effects models illustrated that there were significant relationships between both UN/NI and UN with $^{15}\text{N}_{\text{animal-diet}}$ ($P = 0.004$ and $P < 0.001$; respectively).

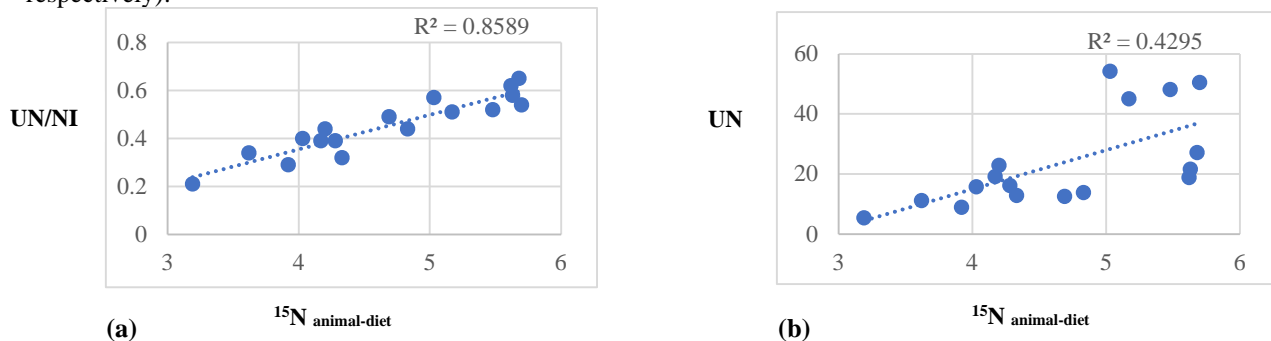


Figure 1. Correlation between (a) urinary nitrogen to nitrogen intake (UN/NI) ratio and nitrogen isotopic fractionation ($^{15}\text{N}_{\text{animal-diet}}$) (b) urinary nitrogen (UN) and nitrogen isotopic fractionation ($^{15}\text{N}_{\text{animal-diet}}$)

The preliminary results confirmed our hypothesis that $^{15}\text{N}_{\text{animal-diet}}$ can be used as an indicator for UN and UN/NI in small ruminants.

References

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