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"Development on the margin"

## Carbohydrates – A Trait to Indicate Sustainable Grazing Practice in Semi-arid Grasslands?

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## Abstract

Adequate carbohydrate reserves in underground organs of perennial grasses are crucial for winter survival, drought tolerance, spring growth initiation, and regrowth after herbage removal and therefore an important trait of ecosystem resilience. Most natural grasslands are used for livestock keeping, but our understanding of how belowground carbohydrate dynamics respond to different grazing intensities is still limited, although this parameter might have the potential to function as a proxy for sustainable land management and ecosystem health.

In the Northern Chinese semi-arid grasslands we analysed soluble carbohydrates and the different sugar components of two dominant grass species, representing the functional plant types of rhizome grasses (*Leymus chinensis*) and bunch grasses (*Stipa grandis*) at three sites representing different management practices: a long-term grazing exclosure (UG), a moderately winter grazed site (WG) and a heavy grazed site (HG).

The results showed that total soluble carbohydrate (TSC) in the underground organs of L. chinesis and S. grandis increased and then declined with increasing grazing intensity. The rhizomes of Leymus had highest TSC at site WG. Generally Leymus stored a higher amount of soluble sugar in the belowground organs than Stipa, indicating that plant functional types (bunch and rhizome grass) responded differently to grazing. Fructan, sucrose, glucose and fructose were important soluble sugar components for both species. Fructan and fructose accounted for more than 80% of TSC. For Leymus, TSC and the four sugar components in the roots were lower than that in the rhizome, demonstrating that rhizomes served as the main underground sugar-storage organ. Our results indicate that moderate winter grazing effectively contributes to the accumulation of soluble carbohydrates, and TSC can be used as potential indicator of sustainable land use.

**Keywords:** Grazing intensity, Mongolia grassland, *Leymus chinesis, Stipa grandis*, soluble carbohydrates

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