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Change of Soil Microbial Biomass C, N between Longtime Free Grazing and Exclosure Pasture in Semiarid Grassland Ecosystem in Tongliao and Chifeng of Inner Mongolia

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1. To evaluate soil microbial biomass C (C_{mic}) and N (N_{mic}) under the longtime free-grazing and exclusion of livestock in the neutral and alkaline grassland soil;

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Grazing signi cantly decreased soil moisture both in two study sites ($P<0.05$) (Table 2). Soil showed alkaline (8.83-9.62) in NGST, and it was highest in EG of 0-5 cm in NGST in combination with highest moisture and EC. In 0-5 cm, Soil pH in GG was signi cantly decreased in 0-5 cm in NGST ($P<0.05$), but increased in HSLM. Soil EC, organic C and TN in GG were all signi cantly lower than in EG both in the two sites ($P<0.05$). Soil silt and clay content decreased in GG compared with in EG, while soil sand increased both in the two study sites and it was signi cant in NGST. Available P in GG was higher than EG in NGST, but it was lower than EG in HSLM.

C N

In NGST, C_{mic} varied from 79.2 to 881.1 mg C kg^{-1} soil and N_{mic} varied from 6.1 to 64.8 mg C kg^{-1} soil during the experimental period (Figures 1a and 1b). In GG, C_{mic} and N_{mic} decreased 81.39, 69.51% and 75.48, 67.12% in 0-5 and 5-15 cm layers, respectively, compared to EG. In HSLM, C_{mic} varied from 452.7 to 1218.1 mg C kg^{-1} soil and N_{mic} varied from 48.4 to 152.6 mg C kg^{-1} soil (Figures 2a and 2b). In GG, C_{mic} and N

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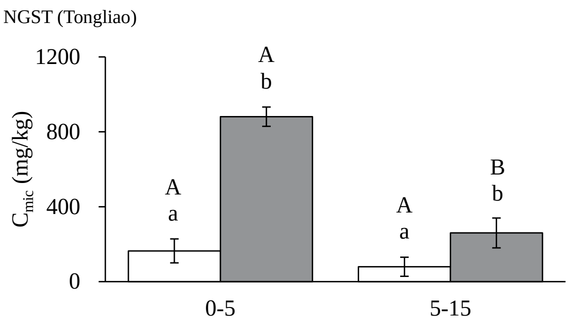

C_{mic}:N_{mic}, C_{mic}:C_{org} and N_{mic}:TN ratios in NGST uctuated from 10.2 to 14.6, from 0.2 to 0.4 and from 0.1 to 0.3, respectively (Figures 1c, 1d and 1e). In HSLM, C_{mic}:N_{mic}, C_{mic}:C_{org} and N_{mic}:TN ratios uctuated from 7.4 to 9.5, from 3.1 to 4.6 and from 0.3 to 0.5, respectively (Figures 2c, 2d and 2e). C_{mic}:N_{mic} ratio in 0-5 cm was lower than 5-15 cm and in 0-5 cm C_{mic}:N_{mic} ratio in EG was higher than in GG while in 5-15 cm the one in GG was higher than in EG in both NGST and HSLM (Figures 1 and 2c), and the di erence was not signi cant (P>0.05). In NGST, C_{mic}:C_{org} and N_{mic}:TN ratios in GG was higher than in EG in both two layers, but in contrast, in HSLM, the ones in EG were higher than GG except for N_{mic}:TN ratio in 5-15 cm. e di erence between the GG and EG as well as between the two layers were not signi cant (P>0.05).

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Our results show higher sand content and signi cantly lower moisture, C_{org}, EC, TN and silt content in NGST and HSLM with GG compared to EG (Table 2). Fencing increased soil moisture compared to grazing (Table 2); consistent with the previous studies [46-51] which shows that soil water content signi cantly increased a er long-term fencing. And in this study, fencing also increased the above-ground biomass and coverage (Table 2), which could decrease evaporat e ave-razing (To iTw 9 0 0TG1MC /3done e197 (i)3 (s)5 (t)10009 Tw

HSLM. The C_{mic}:N_{mic} ratio is affected by soil properties such as moisture content, texture, pH, C_{mic}:C_{org} and N_{mic}:N_{tot} ratios (i.e., the substrate availability), N incorporation in fungi and the ratio of active to dormant microorganisms [76,77]. In this study, the soil moisture, C_{org} and silt and clay content were all higher in NGST than in HSLM in EG which can explain the C_{mic}:N_{mic} ratios was significantly higher in NGST than in HSLM. Results indicated that the difference soil physical-chemical properties between the two experimental sites had a particular impact on this ratio rather than the effect of livestock grazing.

C_{mic}:C_{org} ratio has been proposed that the biomass C is more sensitive to changes in soil quality than the total organic C and therefore the ratio of C_{mic} to C_{org} may provide an early warning system for changes in organic matter dynamics, e.g., forest soil degradation in terms of soil organic matter loss. It is an index of the mineralization rate of soil microbes on organic matter, the higher value represents higher mineralization rate and could induce higher soil nutrient utilization rate. Furthermore, the higher ratio represents that the maintenance of the same amount of microorganisms required relatively less energy, suggesting higher soil quality for the growth of soil microorganisms. The ratio of N_{mic}:NT has the same significant as the ratio of C_{mic}:C_{org}. As shown in Figure 2, the C_{mic}:C_{org} ratio in EG was significantly higher than in grazing in HSLM in 0-5 cm but in 5-15 cm the difference was not significant. The N_{mic}:TN ratio was higher in EG in 0-5 cm in HSLM but in 5-15 the result was opposite and the difference was not significant. It indicated that in 0-5 cm there was more accumulation of degradable organic compounds. But the opposite results showed in NGST site, the C_{mic}:N_{mic} was higher than in GG than EG. Furthermore, the C_{mic}:N_{mic} in HSLM was significantly higher than in NGST in bsh0023 T6 (h)40.07 Tw 9 0 0 9 42.5197 467.2993 shwin cpe results g0023 gwested hat the oatin GST

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