Activity, physiology and milk production of yaks and two different yak crossbreds grazing Himalayan pasture sites at 4700 m and 3000 m

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Introduction

Yaks (*Bos grunniens*) and crossbreds of yaks with different local cattle breeds are important for the livelihood of local herders in the Himalayas. They are often kept in a system of transhumance comprising the use of different pasture sites for grazing along an altitudinal gradient throughout the year. The animals are moved upwards to the high altitude pastures in spring/early summer and gradually moved downwards in late summer/autumn. Yaks are suitable for very high altitudes as they are especially adapted to low oxygen partial pressure, forage scarcity and cold and harsh environment (Wiener *et al.* 2003). However, yak-cattle crossbreds have an advantage in terms of milk yield due to heterosis and can utilize the lower winter pasture sites better than yaks.

In the Taplejung District of Nepal, in the Kanchenjunga Conservation Area (KCA), two different yak crossbreds are most common. In the lower mountains of KCA, Nepalese common hill cattle (a *Bos indicus* genotype) are available and are crossed with yak bulls. In the higher mountain regions, closer to the Tibetan border, crosses of female yaks (called naks) with so-called Bhelang bulls of *B. taurus* genotype are produced. The aim of the study was to compare these crossbreds of yaks and cattle and relate them to yaks in terms of locomotive activity pattern, physiological responses and performance when grazing at two different altitudes along a transhumant route in the Himalayan Mountains.

Methods

Two pasture sites, one at 4700 m, the other at 3000 m, that are traditionally used by local herders during transhumance within the KCA were selected in the Taplejung district of Nepal. Six lactating multiparous animals per genotype were used as experimental animals. Genotypes were yaks (Y), cattle-yak crossbreds (*B. taurus* × *B. grunniens* (T×Y)) and yak-cattle crossbreds (*B. grunniens* × *B. indicus* (Y×I)). Following the herder's traditional practice, the yaks were accompanied by their calves, but not the crossbreds. Calving times were at the beginning of April (Y×I), middle of April (T×Y), and at the end of April (Y), respectively. The measurements were undertaken when the animals reached the respective pasture site, which was in August at 4700 m and in October at 3000 m. Upon arrival to the respective pasture sites, blood hemoglobin, glucose and lactate were analyzed using point-of-care devices for the blood samples taken from the ear. After 6 and 8 days of adaptation, respectively, further measurements were taken during 6 consecutive days of the normal grazing schedule. The measurements included locomotive behavior (separately for daytime and night-time) using pedometer devices (Ice Tag, Ice Robotics Ltd., Scotland), heart rate (Polar Equine CS600X, Polar Electro Oy, Finland) and respiration rate (stethoscope), the latter twice per day and animal rectal temperature (twice daily using a clinical thermometer), and milk yield and composition (twice daily in the crossbreds and only in the morning for the yaks; Lactoscan SA-L, Milkotronic Limited, Bulgaria).

The weigh-suckle-weigh method was applied to the yaks in order to estimate the daily milk yield; calves were weighed before and after suckling and the differences in body weight were added to the quantity of milk hand milked. Body weight was assessed with a portable electronic balance before and after the 6 day period of data collection at each site. After the 6 day period of data collection at each altitude, blood parameters were re-assessed. The data were analyzed with the Mixed procedure of SAS (SAS Institute Inc., Cary, USA, 2009 version 9.3).

Results

The factors genotype and altitude significantly affected standing and lying activities at nighttime and of lying across 24 h. At 4700 m, Y spent more (P<0.05) time lying during 24 h than Y×I but not T×Y (P>0.05). In contrast, Y×I spent more time standing than Y (P<0.05). No significant differences were found between the genotypes at 3000 m. In general all three genotypes spent more time (P<0.05) standing and less time (P<0.05) lying at 4700 m as compared to the pasture site at 3000 m at night. Genotype had no significant effect on the activities measured during the daytime. The initial hemoglobin levels at 4700 m were highest (P<0.05) for Y, significantly lower for T×Y and lowest (P<0.05) for Y×I. Blood hemoglobin level increased when measured again after 12 days at 4700 m, although the genotype

pattern was maintained in a similar way *i.e.* highest in Y, intermediate in T×Y and lowest in Y×I. In contrast, the blood lactate levels measured at 4700 m were lowest (P<0.05) for Y and highest for Y×I, showing a significant decreasing trend for all three genotypes when measured again after 12 days at 4700 m.

Overall, heart rate, respiration rate and rectal temperature were higher (P<0.05) at 4700 m compared to 3000 m. Yaks had a lower (P<0.05) initial body weight than the two crossbreds at both altitudes (244 and 229 kg at 4700 m and 3000 m, respectively). T×Y had a similar body weight as the Y×I at 4700 m (259 and 256 kg, P>0.05), but only Y×I lost weight when measured at 3000 m (258 and 251 kg in T×Y and Y×I, respectively, P<0.05).

In accordance with the progressing stage of lactation, recorded milk yield was higher at 4700 m than at 3000 m. The T×Y had a higher (P<0.05) milk yield than Y×I at 4700 m (2.5 and 2.1 kg/day, respectively) and also at 3000 m (1.2, and 0.8 kg/day, respectively). The milk fat content was highest (P<0.05) for Y at both altitudes, being highest at 3000 m. Y×I had the lowest milk fat content at both altitudes, being lower at 4700 m. The highest daily milk fat yield was recorded for T×Y at 4700 m.

Conclusion

The *B. taurus* × *B. grunniens* crossbreds seemed to have an advantage over the crosses of *B. grunniens* × *B. indicus* as shown by the better performance (higher daily milk and milk fat yield, no decrease in body weight from 4700 to 3000 m). High levels of blood hemoglobin and low levels of blood lactate revealed the better adaptation of the yaks at high altitude over the crossbreds. The *B. grunniens* × *B. indicus* cross seemed to be less tolerant to high altitude as shown by the altered resting behavior at 4700 m and the lowest level of blood hemoglobin and the highest level of lactate among the three genotypes at 4700 m.

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References

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