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Efficiency of yak as pack animal for snowbound highlander

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Yak (*Poephagus grunniens*) which is popularly known as 'boat of the plateau' is the most remarkable and multipurpose domestic animal living at high altitudes of 3,000 to 6,000 m above mean sea level (msl). They are well adapted to reduced oxygen in the air, high solar radiation, survive on scanty local feed resources and are the only large mammals able to graze at 6000 m above sea level, even at –50°C. The yak has strong limbs, small, solid and cup-shaped hooves with hard edges and a narrow hoof fork, which attributed them to walk in dangerous places and climb over steep mountains. They are used for draught and pack purposes at the high altitudes, in semi-agricultural areas they are also used for ploughing, thrashing and other cultivation. It can carry loads over long distances for two or three days without water or feed (Joshi 1982). Though yak is considered as the backbone of the highlanders, very less work has been done on validation of work efficiency of yak as pack animal. Hence the present study was carried out to evaluate the load carrying capacity or packability of yak during different seasons and the impacts of environmental temperature and topography of hilly terrain.

The experiment was conducted at Nyukmadung yak farm of ICAR-National Research Centre on Yak and its adjacent areas of Tom hill with altitude ranging from 2750 to 3000 msl, of West Kameng district, Arunachal Pradesh. The weather was generally cloudy with very few bright sunny days with the environmental temperature ranging between –2 to 24°C with a relative humidity of 75–94% throughout the experimental period. Ten adult healthy yaks of 2.5 to 4 years of age with a body weight of 270–390 kg were trained for a week by putting a locally available wooden saddle and walked a distance of 14 km (7 km up the valley and 7 km down the valley) per day with the speed of 5–6 km/h to habituate them. Thereafter the experiment was started with a load of 10% (27–39 kg) of their live body weight (LBW) and gradually increased (i.e. 10, 15, 20 and 25%) to 25% (67.5 – 97.5 kg) during the summer season. In winter, the same animals were used to carry with an initial load of 27% (72.9–105.3 kg) of their LBW and gradually increased (27, 30, 32, 34 and 35%) to 35% (94.5 – 136.5kg). The quantifiable physiological parameters (body temperature, pulse rate and respiration rate) were recorded 4 times (before journey, 7 km up the valley, 7 km down the valley and 1 h after rest). The qualitative parameters for fatigue (frothing, non-coordination of legs, excitement, inhibition of progressive movement of legs and tongue protrusion) were also recorded to study their fitness as pack animal. In both the seasons animals were make to walked with different percentage of load for 80 days each. The data were subjected to two way ANOVA with repeated measure to assess the effect of work with different loads during up and down valley walks and during rest for recovery.

The findings (Table 1) revealed that the yaks could carry a load of 25% of their live body weight during summer season without any adverse impacts on their normal health and the result were in agreement with the findings of Liu Qigui (1981) and Ramesha *et al.* (2008). The quantifiable parameters were significantly ($P<0.05$) increased due to up and down movement of the valley with different loads. The highest body temperature, respiration and pulse rate was observed when the yaks carried 20% of its live body weight (LBW) after climbing 7 km up the valley. Increased in quantifiable parameters while carrying 20% when compared with 25% might be due to increased environmental temperature (during the period when the animals carried 20%, the recorded environmental temperature was maximum (22° to 25°C)).

During winter season (Table 2), a yak can carry a load up to 35% of its LBW. The present finding was in agreement with the report of Joshi (1982) and Kataktalware *et al*. (2009). The highest body temperature was recorded when the yaks carried 34%, after climbing 7 km up the valley. However, highest pulse and respiration rate was observed when the animal carried 35% of its LBW and the findings were in agreement of Zhang Rongchang (1989). In both the seasons, quantifiable parameters didn't return to the pre-work level even after 1 h of rest. The findings were supported by Cai *et al.* (1975), who reported that in yak, the body temperature, respiration and pulse rate was always significantly higher in the evening than the morning even if the animals are off from the day work.

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Table 1. Variations (mean ±SEM) of quantifiable parameters (per min) subjected to different loads (10 to 25% LBW) during summer

Load as % of LBW	Parameter	Before work	During work		After 1 h rest
			7 km up	7 km down	
10	Body temp	100.33± 0.10^{bA}	101.98± 0.06^{aC}	102.18± 0.07^{aC}	101.42± 0.09^{aB}
	Respiration	18.20± 0.45^{cA}	62.89± 1.57^{bC}	64.80± 0.87^{bC}	33.69± 0.68^{bB}
	Pulse	61.29± 0.47^{bA}	64.69± 0.57^{aB}	65.07± 0.42^{aB}	61.36± 0.47^{aA}
15	Body temp	100.33± 0.10^{bA}	102.29± 0.08^{bC}	102.29± 0.08 ^{aC}	101.24± 0.11 ^{aB}
	Respiration	15.24± 0.61^{bA}	54.53± 1.76^{aC}	51.87± 1.39^{aC}	27.84± 0.85^{aB}
	Pulse	60.80± 0.67^{bA}	64.56± 0.79^{aB}	65.82± 0.79^{aB}	61± 0.70^{aA}
20	Body temp	100.33± 0.10^{bA}	102.51± 0.01^{cC}	102.31± 0.09^{aC}	101.27± 0.10^{aB}
	Respiration	15.56± 0.60^{bA}	77.44± 2.19^{cC}	73.69± 2.26^{cC}	30.44± 1.14^{aB}
	Pulse	61.78± 0.61^{bA}	69.58± 0.86^{bC}	68.78± 0.51^{cC}	66.93± 0.54^{bB}
25	Body temp	99.78± 0.08^{aA}	102.18± 0.07^{abC}	102.44± 0.08^{aD}	101.42± 0.10^{aB}
	Respiration	12.93± 0.39^{aA}	63.08± 1.80^{bC}	68.20± 2.38^{bD}	29.82± 1.00^{aB}
	Pulse	56.76± 0.66^{aA}	66.16± 0.55^{aC}	067.24± 062^{bC}	61.18± 0.53^{aB}

Different superscript (A,B,C,D) differs significantly (P<0.05) in same row. Different superscript (a,b,c,) differs significantly (P<0.05) in same column.

Table 2. Variations (mean±SEM) of quantifiable parameters (per min) subjected to different loads (27 to 35% LBW) during winter

Load as % of LBW	Parameter	Before work	During work		After 1 h rest
			7 km up	7 km down	
27	Body temp	99.96± 0.12^{aA}	101.96± 0.09^{aC}	102.5± 0.15^{aD}	101.29± 0.12^{cB}
	Respiration	14.00± 0.63^{aA}	73.04± 3.65^{bC}	79.08± 4.47^{aC}	30.83± 1.39^{abB}
	Pulse	59± 0.76^{aA}	65.08± 1.29^{aB}	69.54± 1.22^{abC}	66.04± 0.75^{bB}
30	Body temp	99.92± 0.10^{aA}	101.79± 0.17^{aC}	102.38± 0.13^{aD}	100.13± 0.15^{bcB}
	Respiration	14.50± 0.38^{abA}	95.92± 2.66^{cdC}	98.83± 2.57^{bC}	33.58± 2.18^{bB}
	Pulse	59.33± 0.91^{aA}	68.29± 1.15^{abB}	71.04± 1.23^{bB}	61.46± 0.80^{aA}
32	Body temp	100± 0.13^{aA}	102.13± 0.06^{abC}	102.29± 0.14^{aC}	100.96± 0.09^{bcB}
	Respiration	13.75± 0.47^{aA}	92.58± 1.77^{cC}	94.33± 3.50^{bC}	30.33± 1.3^{abB}
	Pulse	62.25± 1.90^{aA}	69.83± 1.24^{bB}	71± 1.55^{bB}	61.79± 0.57^{aA}
34	Body temp	99.96± 0.21^{aA}	102.67± 0.14^{aD}	102.17± 0.11^{aC}	100.79± 0.10^{bB}
	Respiration	16.00± 0.63b^{cA}	100.08± 4.00^{cdC}	100.00± 3.43^{bC}	46.50± 12.86^{bB}
	Pulse	60.58± 0.85^{aA}	74.04± 1.78^{cB}	71.33± 1.22^{bB}	60.67± 0.67^{aA}
35	Body temp	99.92± 0.11^{aA}	102.33± 0.09^{aC}	102.5± 0.12^{aC}	100.96± 0.12^{bcB}
	Respiration	16.71± 0.60^{cA}	103.83± 3.46^{bC}	112.21± 3.55^{cD}	35.50± 2.15^{bB}
	Pulse	59.25± 1.51^{aA}	78.46± 1.78^{dB}	76.46± 1.40^{cB}	59.92± 0.93^{aA}

Different superscript (A,B,C) differs significantly (P<0.05) in same row. Different superscript (a,b,c,) differs significantly (P<0.05) in same column.

The performance of present findings was better than as reported by Das *et al.* (2001). Yaks are the better choice of animals for highlander when compared with other pack animals or beast of the burden such as horse mule, ass and Llamas in term of carrying the load and adaptability to high altitude. The pack assess can carry 50 to 60 kg, donkey 20% of LBW (Cole and Ronning 1974), llamas 25 to 50 kg (Link 1946, Fernandez-Baca 1978), which is less than or equivalent to packability of yak during summer season. In horse when carrying 15 to 20% of their live body weight, it showed relatively little indication of stress and when they carried 25%, the physical sings changed markedly and this become much accentuated under 30% loads (Liz Osborn, HorseScienceNews.com/horsebac). However, in yak when carrying 25% loads during summer season and up to 35% during winter season, no signs of stressed was indicated except walking speed was slightly reduced when loaded with 35% of its LBW. The recorded qualitative parameters revealed that yaks performed very well even carrying 35% LBW as no noticeable fatigue condition was observed. It is noticed that ambient temperature as well as the percentage of load has a direct impact on working efficiency or packability of yak. The experiment also revealed that younger yaks (2.5 to 3.5 years) performed better when compared with the older animal (4 years), as the later one was sluggish in speed when compared with younger animals. Combining all the parameters we can conclude that yak can carry a load of 25% of its LBW during the summer season and 35% during winter season without any adverse effect on their normal health. However, the yak should be well trained.

SUMMARY

The experiment was conducted in 10 adult yaks at Nyukmadung farm under ICAR, NRC on Yak, to evaluate the load carrying capacity or packability in different seasons and to access the impacts of environmental temperature in different altitude. The yaks were trained for a week, thereafter, they were made to carry a different % of load starting with 10% to 35% of LBW. It was observed that yaks could carry 25% of LBW during summer season and 35% LBW, without any adverse effect on their normal health and no fatigue symptoms were observed. It is further

observed that younger yaks performed better when compared with the older animal, as the later one was sluggish in speed. Combining all the parameters we conclude that yaks are the better choice of animals for highlander when compared with other pack animals or beast of the burden.

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