Dry Season Effect on Live Weight and some Body Dimensions of Working Donkeys in the Sudano-sahel Region of Cameroon

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Summary

Live weight (LW), heart girth (HG), trunk length (TL), body length (BL) and height-at-withers (HW) of 135 working donkeys, aged between two and 15 years, were monitored during the dry season of 1996 and 1997. This was to determine period(s) of the dry season when feed supplementation and/or health care should be reinforced in preparation of high work demands during the rainy season. Variations in LW, HG, TL, BL, HW, HG:HW and TL:HW from start of the dry season to the start of the rainy season were highly significant (P< 0.001). Correlations between live weight and the other measures were positive and highly significant (P< 0.0001). Males showed weight gains between start of the cold-dry-season (CDS) and start of the hot-dry-season (HDS). Weight gains in castrates were between start of the CDS and end of the HDS (April). Female donkeys maintained weight gains through out the dry season. Consequently, supplementation of castrates and males at the beginning (January) and end (April) of the HDS as to reinforce and maintain significant weight gains for maximize draught energy potential for rainy season work demands, is necessary. Where the female donkey express weight gain but poor bodied there will be need for supplementation in order to booster and enhance endurance. Also, estimates of HG, TL, BL, HW, HG:HW and TL:HW may be useful indicators for the selection of working donkeys as to optimize draft capacity and endurance for rainy season work demands.

Résumé

Effet de la saison sèche sur le poids et quelques dimensions du corps des ânes de traits de la région soudano-sahélienne du Cameroun

Le poids vif (PV), le périmètre thoracique (PT), la longueur du tronc (LT), la longueur du corps (LC) et la hauteur au garrot (HG) pour 135 ânes de traits, âgés de deux à 13 ans, ont été mesurés durant la saison sèche de 1997 et de 1998. L'objectif était de déterminer la (les) période(s) de saison sèche où la supplémentation alimentaire pourrait être intensifiée en vue de la préparation des animaux aux travaux intensifs de saison des pluies. Les variations de PV, PT, LT, LC, HG, PT:HG et LT:HG du début de la saison sèche au début de la saison des pluies étaient fortement significatives (P< 0,001). Les corrélations entre le PV et les autres mesures étaient positives et fortement significatives (P< 0,0001). Les mâles entiers ont montré un gain de poids entre le début de la saison-sèche-froide (SSF) et le début de la saison-sèche-chaude (SSC). Les castrés ont montré des gains de poids entre le début de la SSF et la fin de la SSC (avril). Les ânesses ont maintenu des gains de poids jusqu'au début de la saison pluvieuse. Il a été observé que la supplémentation des mâles entiers et/ou castrés doit commencer au début de la SSC (janvier) et/ou à la fin de la SSC afin de renforcer et maintenir le gain du poids pour optimiser le potentiel d'énergie des ânes de traits en saison des pluies. Pour augmenter la capacité de trait et la résistance, la supplémentation est nécessaire pour les ânesses en mauvais état corporel. En outre, l'estimation de PT, LT, LC, HG, PT:HG et LT:HG peut être un indicateur utile pour la sélection des ânes de traits afin d'optimiser leur capacité du travail en saison pluvieuse.

Introduction

Farmers in Northern Cameroon have since 1970 been historically attached to draft animals. Of recent, donkeys are used increasingly, especially within the cotton producing zones of Guider in the North Province, and Kaele and Maroua South of the Far North Province of Cameroon. Between 1978 and 1983, the donkey population estimates rose from 700 to 3.000 head (6) and today they are estimated at about 25.000 head, representing 30% of working animals (9). These donkeys are characteristics of the *Equus asinus nubicus* (1, 9) though they are small bodied (live weight averages 130 kg as against 200

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kg and height-at-withers 100 cm as against 125 cm) compared to typical Nubian types. However, they possess a high ability to tolerate the long stressful dry season (October to June) and can survive on relatively high forage diets that may not be readily accepted by other classes of livestock. They are less affected by external parasites and can survive in tsetse infested areas (3). However, due to the long stressful dry season of the northern region of Cameroon, the body conditions of the donkeys fluctuate, especially, during the dry season as feed supply fluctuates. Vall *et al*. (9) reported that the majority (70%) of working male donkeys in North Cameroon are good bodied the greater part of the dry season. The female donkeys, however, are generally poor bodied as reflected by low body condition score (BCS). Tembo (8) and Vall (10) suggested that draft capacity is directly proportionate to body size. However, the optimum draft force will depend on the live weight and also on the body condition of the animal. The live weight will directly affect draft capacity given that optimum draft force has been estimated between 10 and 16% of the animal's live weight (10). Endurance is an essential component of the draft capacity of the donkey. This will depend on the physical form of the donkey which depends directly on the nutritional and health status of the animal. Consequently, the visual appreciation (BCS) of the donkey though subjective, is a good indicator of endurance. Therefore in order to optimize draft energy potential of the working donkey, it will be necessary to improve on the live weight and also on the body condition. Consequently, an assessment of the changes in live weight and body dimensions in conjunction with body conditions and health status of working donkey will be useful for reliable assessment of working donkeys in the dry season.

The objective of the present study is, therefore, to study the changes in live weight and body dimensions of the working donkeys during the long stressful dry season. This will be useful, in conjunction with information by Vall *et al*. (9) and Ebangi and Vall (Unpublished) for the determination of period(s) most appropriate for the development of nutritionally sound recommendations on the improvement of the feeding of working donkeys. This strategy will help reinforce maintenance and steady growth as to maximize draught energy potential for the rainy season work demands.

Materials and methods

Experimental animals

A sample of 135 working donkeys (59 males, 16 castrates and 60 females), belonging to smallholder farmers of five villages (Tchonchi, Ouro El Hadji, Mayel Naode, Zamay, Amitie) within two cotton producing areas: Guider (Lat. 09° 53' N and Long. 13° 17' E) and Maroua South (Lat. 10° 35' N and Long. 14° 20' E) were selected. Female donkeys with visible signs of pregnancy were excluded from the experiment. The donkeys aged two to 15 years were grouped into five age groups (two to three years; four to six years; seven to nine years; 10 to 12 years and above 12 years) and identified with ear tags. They were allowed to fend for themselves on open natural pastures, with little or no health care. Details on climate, management environment, body conditions (BCS) and phenotype have been documented by Vall *et al*. (9) and Ebangi and Vall (1).

Period of experimentation

Measurements on the experimental donkeys were carried at four distinct periods: beginning of the dry-cold-season (DCS) of 1996 (October); beginning of the Hot-dry-season (HDS) of 1997 (January); end of the HDS of 1997 (April) and at the start of the 1997 rainy season (June). The period between April and May was considered as a transitional period during which rainfall is very inconsistent and quite insignificant.

Weights and body dimensions

The traits studied included:

Live weight (LW), measured with a portable mobile electronic weighing (Marechalle pesage with a precision of 0.001 kg) scale attached to a mobile weighing cage; Heart girth (HG), the circumference from the caudal edge of the withers behind the elbow; Body length (BL), the distance from the forehead to the tuber ischii and Trunk length (TL), the distance from the elbow to the tuber ischii measured with a graduated plastic tape and Height-at-withers (HW), the distance from the level ground to the highest point of the withers measured using a measuring stick. Ages of the donkeys were determined from the incisors as described by Jones (2).

Statistical analysis

Data summarized in table 1 were analyzed with the SAS computer program (7) that adjusted for significant effects.

Least Squares Means (LSM) and Standard Errors (SE) for the various live weight and body dimensions were computed using a Linear Model. This model also determined the impact of village, sex, seasonal variation (period), age group and coat color on the response variables that included live weight (LW), heart girth (HG), trunk length (TL), body length (BL), height-at-withers (HW), proportion of heart girth to height-at-withers (HG:HW) and proportion of trunk length to height-at-withers (TL:HW).

All the effects were considered fixed but for the error that was random and assumed to be identically, independently and normally distributed with zero means and variance Ó² (iind 0, ó²).

The Linear Model was presented as

$y_{ijklmn} = \mu + V_i + S_j + A_k + C_l + P_m + e_{ijklmn}$ where,

μ= Overall mean of the response variable;

Table 1
Live weights (kg) and body dimensions (cm) of working donkeys in northern Cameroon

Trait	N°	Mean	SD	CV	Minimum	Maximum
Live weight (kg)	540	123.45	15.98	12.17	84	172
Heart girth (cm)	540	107.53	4.11	3.76	97	125
Trunk length (cm)	540	110.19	5.74	5.07	91	126
Height-at-withers (cm)	540	98.05	3.57	3.34	90	110
Body length (cm)	539	137.26	9.16	5.56	115	173
HG:HW	540	1.10	0.03	2.92	0.97	1.21
TL:HW	540	1.20	0.05	4.26	0.88	1.29

SD= standard deviation; CV= coefficient of variation; HG:HW= proportion of heart girth to height-at-withers; TL:HW= proportion trunk length to height-at-withers; N°= number of measurements.

V_i= Effect of village (i= Tchonchi, Ouro El Hadji, Mayel Naode, Zamay, Amitie);

S_j= Effect of sex (j= non castrate, female, castrate);

A_k= Effect of age group (k= 2 to 3 yrs, 4 to 6 yrs, 7 to 9 yrs, 10 to 12 yrs, above 12 yrs);

C_l= Effect of coat color (l= light grey, dark grey, brownish grey, black, cream);

P_m= Effect of period of measurement (m= Oct. 1996, Jan. 1997, April 1997 and June 1997) and

$e_{ijklmn=}$ Random effect of error attributable to the n^{th} working donkey of the i^{th} sex belonging to the j^{th} age group and of the l^{th} coat color for measurements obtained in the m^{th} period.

Results and discussions

The impact of the independent variables on the dependent variables are presented in table 2.

With the exception of period (period of the dry season) that did not affect heart girth, trunk length and proportion of trunk length to height-at-withers (TL:HW), all other variables significantly ($P< 0.05$ or $P< 0.01$) affected the dependent variables. The significant sex and age effects reported corroborate reports by Ebangi and Vall (1). However, the sexual dimorphism reported in this study did not agree with reports by Nengomasha *et al*. (4). With the exception of TL:HW, the significant coat color effect ($P< 0.05$ or $P< 0.01$) obtained in the present study contradicts reports by Ebangi and Vall (1), suggesting the possibility of adaptive significance of this trait on live weight and body dimensions during the dry season.

Table 3 shows changes in the response variables from the start of the cold-dry-season (October) to the beginning of the rainy season (June). There was generally an increase from the start of the CDS to the

Table 2
Variance analysis of impact of fixed effects on live weight and body dimensions of working donkeys of northern Cameroon in the dry season

Dependent variable	Independent variable	Degree of freedom	F value	P
Live weight	Age group	4	19.75	0.0001
	Village	4	9.32	0.0001
	Sex	2	8.94	0.0002
	Period	3	4.92	0.0022
	Coat color	4	4.58	0.0012
Heart girth	Age group	4	13.84	0.0001
	Village	4	2.04	0.0877
	Sex	2	4.75	0.0090
	Period	3	1.37	0.2516
	Coat color	4	3.74	0.0052
Height-at-withers	Age group	4	4.66	0.0011
	Village	4	6.00	0.0001
	Sex	2	8.14	0.0003
	Period	3	3.23	0.0222
	Coat color	4	10.30	0.0001
Trunk length	Age group	4	22.35	0.0001
	Village	4	3.34	0.0103
	Sex	2	9.12	0.0001
	Period	3	2.29	0.0778
	Coat color	4	4.00	0.0033
Body length	Age group	4	11.95	0.0001
	Village	4	14.84	0.0001
	Sex	2	52.23	0.0001
	Period	3	3.40	0.0176
	Coat color	4	5.73	0.0002
Heart girth: Height-at-withers	Age group	4	3.77	0.0001
	Village	4	6.17	0.0001
	Sex	2	13.17	0.0001
	Period	3	2.56	0.053
	Coat color	4	3.51	0.007
Trunk length: Height-at-withers	Age group	4	6.73	0.0001
	Village	4	12.91	0.0001
	Sex	2	13.53	0.0001
	Period	3	1.49	0.217
	Coat color	4	0.96	0.427

Table 3
Least squares means and standard errors (SE) for live weights and body dimensions of working donkeys according to sex by period of the dry season

Trait/ Sex*Per.	LW (kg)	HG (cm)	TL (cm)	HW (cm)	BL (cm)
Oct. 96					
Male	118.05 (2.08)	106.68 (0.57)	108.34 (0.76)	97.87 (0.59)	133.31 (1.12)
Female	119.96 (2.19)	107.67 (0.59)	109.76 (0.80)	97.98 (0.51)	137.18 (1.17)
Castrate	121.05 (8.62)	107.71 (2.36)	111.80 (3.16)	101.50 (2.02)	132.56 (4.62)
Jan. 97					
Male	121.44 (2.08)	107.13 (0.57)	109.63 (0.76)	97.95 (0.59)	133.90 (1.12)
Female	127.56 (2.19)	108.08 (0.60)	111.23 (0.80)	98.50 (0.51)	142.04 (1.17)
Castrate	124.37 (8.62)	108.20 (2.36)	111.89 (3.16)	102.36 (2.02)	132.73 (4.63)
April 97					
Male	120.76 (2.08)	106.93 (0.57)	109.31 (0.76)	98.93 (0.59)	133.04 (1.12)
Female	128.97 (2.19)	108.44 (0.60)	112.09 (0.80)	99.39 (0.51)	142.39 (1.18)
Castrate	127.48 (8.62)	108.58 (2.36)	108.72 (3.16)	103.05 (2.02)	134.49 (4.63)
June 97					
Male	118.12 (2.08)	107.16 (0.57)	108.70 (0.76)	98.76 (0.49)	131.75 (1.12)
Female	129.25 (2.19)	109.13 (0.60)	111.80 (0.80)	98.74 (0.51)	144.04 (1.17)
Castrate	125.83 (8.62)	109.22 (2.36)	111.06 (3.16)	102.10 (2.02)	132.06 (4.63)

LW= live weight, HG= heart girth, TL= trunk length, HW= height-at-withers, BL= body length, PER= period of dry season.

end of the HDS. The sexual dimorphism characteristic of the working donkeys in the area is clearly shown in table 3 and figure 1.

There was an increase in the mean LW of female donkeys from the start of the CDS to the start of the rainy season. The mean LW of female donkeys was higher than that of the male donkeys. Castrated donkeys however, had a higher mean live weight than the males. The castrates gained weight as from the beginning of the CDS up to the end of the HDS and thereafter, they experienced weight loss. However, results obtained by Vall *et al*. (9) on the same animals indicated that the female donkeys registered lower BCS and lower percentage of Packed Cell Volume (PCV) during the dry season, compared to the males. Surprisingly, the same female donkeys, as indicated in the present study, maintained weight gain through out the dry season. It is possible that live weight measurements obtained on the females could have been inflated as a result of unidentified cases of pregnancy.

Otherwise this fact may be indicative that live weight alone might not be the best barometer for the evaluation of the draft capacity of the animal. While live weight might be indicative of the draft

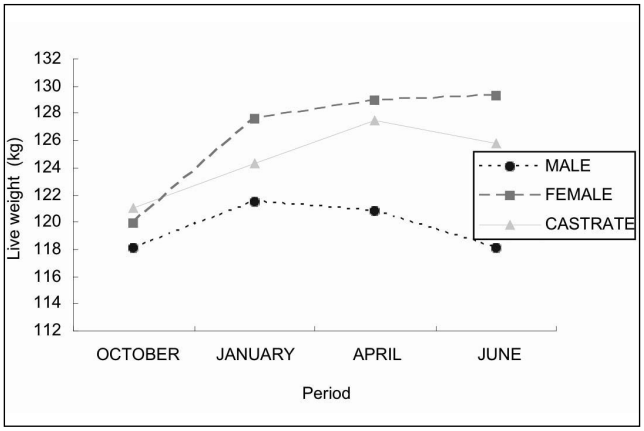

Figure 1: Effect of sex by period on live weight of working donkeys during the dry season.

capacity, body condition on the other hand might be indicative of the animal's nutritional and health status. Consequently, to improve on the draft capacity and endurance of the working donkey will necessitate concurrent improvement in the live weight, body conditions and health status of the donkey. Though the female donkeys showed weight gain from start of the dry season to the beginning of the rainy season,

they presented poor body conditions the greater part of the dry season as indicated by reports by Vall *et al*. (9). This implies the need for various levels of supplementation of the female donkeys as to booster and enhance endurance. Also, the male donkeys presented better body conditions the greater part of the dry season (9) but registered some weight loss before the start of the rainy season. It will also be necessary to supplement these males as soon as weight loss is apparent as to booster and enhance draft capacity for the rainy season work demands. Unpublished results by Ebangi and Vall have shown that supplementation of draft donkeys in the dry season using cotton-seed-cake brings about significant improvement in the live weight and body condition score.

Correlation estimations between live weight and other response variables indicated positive and highly significant ($P< 0.001$) values of 0.81, 0.74, 0.52, 0.81, 0.39 and 0.42 between LW and HG; LW and TL; LW and HW; LW and BL; LW and HG: HW and LW and TL:HW, respectively. Pearson and Quassat (5) have also reported the strong relationship between live weight and body dimensions of working donkeys. The correlationship between height-at-withers and live weight (0.52) was lowest compared to 0.80 between LW and HG; 0.71 between LW and TL and 0.81 between LW and BL. This might be an indication of the fact that the inherent size of the working donkey is more influenced by HW than would be HG, TL and BL that might be more influenced by environmental conditions. Thus, using the proportions of 1.10 for HG:HW and 1.20 for TL:HW, it can be deduced that the working donkeys in the northern region of Cameroon are shorter than they are long. Consequently, proportions of HG:HW and TL:HW lower than one might be indicative of small body size of the working donkey. Also, the positive and highly significant correlation estimates might be indicative of the indirect influence of the live weight on the said response variables. As a result, an increase in any of these response variables will have a positive impact on the draft capacity of the animal.

From these observations suitability of different supplements as complements to forage and grazing for the castrates would be most profitable if applied as from the end of the HDS (April). This will help to maintain weight again in preparation for the rainy season work that begins in June. For the males, it would be profitable to begin different supplementations at the end (January) of the CDS. Though the trends observed in female donkeys indicate weight gain from start of the dry season to the start of the rainy season, there is need to introduce different supplements, especially to female donkeys that show signs of poor body conditions (low BCS) and signs of anemia (low PCV) as recommended by Vall *et al*. (9).

Conclusion

The live weight (LW), heart girth (HG), trunk length (TL), body length (BL) and height-at-withers (HW) of working donkeys are affected by the variability and length of the dry season. The male donkeys show weight gain from start of the CDS to the end of HDS and thereafter express weight loss up to the start of the rainy season. Consequently, there is need to supplement males as from the beginning of the HDS (January) and castrates as from the month of April in order to reinforce thereafter, and maintain significant weight increases in anticipation of the high draft power demands of the following rainy season. Female donkeys maintain weight gain through out the dry season, but generally are poor bodied. There is therefore need for supplementation of poor bodied females as to booster and enhance endurance. Phenotypic correlations between LW and body dimensions are positive and highly significant. As a result, estimates of HG, TL, BL, HW, HG:HW and TL: HW could useful indicators for the selection of working donkeys as to optimize draft capacity and endurance for rainy season work demands.

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