

Clinical, hematological and serum biochemical reference values of working donkeys (*Equus asinus*) owned by transport operators in Addis Ababa, Ethiopia

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Abstract

A study was conducted to establish reference values of clinical, hematological and serum biochemical parameters in 85 working donkeys. Clinical parameters such as temperature, respiratory and heart rates were routinely collected. Blood samples were collected with EDTA-coated vacutainer to determine red and white blood cell counts, Hg, PCV, MCV, MCH, and MCHC. Blood was also collected in plain vacutainer and the serum was analyzed to determine total protein, urea, glucose, creatinine, serum enzymes and electrolytes. The effects of age, body condition, and workload on the different physiological parameters were assessed.

The study showed that clinical, hematological and serum biochemical parameters of working donkeys were significantly affected ($P < 0.05$) by age. Both clinical and hematological parameters were not affected by the level of work performance. Conversely, all serum biochemical values, except total protein, were significantly affected ($p < 0.05$) by workload, and K^+ concentration by body condition. While most of the current findings are closely similar to previous reports for Ethiopia and elsewhere, the effect of workload and body condition on serum biochemical parameters shows the lack of proportional adjustment of management for animals engaged in heavy work and requires a due consideration during the use of these serum values as a clinical diagnostic aid.

Key words: body condition, ethiopia, physiological parameters, workload, working donkeys

Introduction

Determination of physiological parameters can provide valuable information as it relates to the age, sex, nutritional, and physiological status of the animal (Osman and Al-Busadah 2003). The fact that most donkeys in Ethiopia are often used for work at early age, suffer from malnourishment and heavy work, makes the use of physiological reference values that were established elsewhere illogical. The normal reference clinical, hematological and serum biochemical values have been previously studied in donkeys that are seasonally engaged in work under the traditional management system (Simenew 2007). However, physiological parameters may greatly vary based on age, breed, climate, nutrition, physical exertion, ambient temperatures, diurnal and sexual cycles (Minka and Ayo 2007, Osman and Al-Busadah 2003, Zinkl et al 1990).

Donkeys, sturdy working animals, are considered better than other draught animals because of their inherent tolerance

for dehydration, low sweating rate and good thermo ability (Singh et al 2005). The average work performance of donkeys in Ethiopia has been estimated to be 500 KmKg/Day, though a low utilization and a presence of spare capacity has been suggested in the traditional sector (Jahnke 1982). Conversely, in Addis Ababa alone, more than 3000 donkeys owned by transport operators are reported to be involved in transport activities carrying loads up to 700 tones per day (equivalent to 100 mini-trucks). The average daily transaction attributed to this activity has been indicated to be 40,000 Birr (~3500 Euros) (Sisay and Tilahun 1997).

Most donkey owners in Ethiopia are poor and resource limited, primarily depending on donkeys for their livelihood. Because of this, there is unprecedented disparity between their usage and level of management leading donkeys to suffer from malnutrition, diseases, harsh working condition, many work-related health problems and poor management (Yilma et al 1991). In this regard, many of the physiological parameters will be negatively affected and results of clinical examination and laboratory findings should reflect this variation. Whereas, clinical diagnosis of animals is largely dependant on technical information on reference physiological values, very little has been done in donkeys particularly engaged in heavy work. The present study was initiated with the objectives of determining reference values of clinical, hematological, and serum biochemical values of working donkeys owned by transport operators, and to assess the influence of age, body condition and level of work on the reference values.

Materials and methods

This study was carried out in central Ethiopia at Addis Ababa located at 9° 2' 0N, 38° 42' E at an altitude of 2400 meters above sea level. The average minimum and maximum temperatures are 10.7 and 23.6°C, respectively while the annual rainfall and mean relative humidity are 1,800 mm and 62%, respectively. The climate is characterized by bimodal rainfall. A short rainy season occurring from March to May is preceded by a long dry season between October and February. The long rainy season occurs from June to September (NMSA 2005).

The study animals were 85 Abyssinian donkeys engaged in daily work with in Addis Ababa city. All animals belonged to transport operators who exclusively depend on their donkeys to generate their income. The feeding basically constitutes wheat or barley straw and mill byproducts supplemented with wheat bran. The health management was taken care of by the mobile clinic of the Donkey Health and Welfare Project (Donkey Sanctuary, Ethiopia). All the study donkeys were periodically dewormed using oral anthelmintic (Ivermectine, 1ml per 50 kg). Age was determined from dentition (Crane 1997), body weight was estimated using nomogram (Svendsen 1997), and body condition was scored on 1-5 scale. Work performance was calculated as a product of [Km*Kg] per day (Jahnke 1982). The average work-starting age for Abyssinian donkeys (3 - 4years) was considered to arbitrarily categorize the age of the study animals as young (<4 years), adult (4-10 years) and old (>10 years). Similarly, body condition was categorized based on the average body condition score (BCS) frequently reported for the central highlands of Ethiopia (BCS=2.5) thus, <2.5 was considered as poor, 2.5 - 3 as moderate and >3 as good. Previous estimate of work performance (500 KgKm/Day) by Jahnke, (1982) was taken to categorize the work performance level as light work = £500 KgKm/Day, medium work = 501 - 1000 KgKm/Day and heavy work > 1000 KgKm/Day.

All measurements and sampling were performed during the morning time before work. Clinical parameters such as rectal temperature [°C], respiratory rate [breath/minute] and heart rate [beat/minute] were measured in accordance with routine clinical procedures. A total of 20ml of blood was collected following measurement of the clinical

parameters through jugular venipuncture in a plain and EDTA-coated vacutainer. Haematological values were immediately determined from the blood with the anticoagulant using a standard Haematology Analyser (Sysmex POCH-100iv Diff, Sysmex Corporation, Japan). The blood in the plain vacutainer was allowed to form serum at room temperature and centrifuged at 1500rpm for 3-5 minutes after which the serum was harvested and stored at -20°C until analysis. The serum sample was subjected to a standard biochemical analysis procedure using Photometer (Photometer 5010, Robert Reile GmbH and Co Kg, Germany) to determine aspartate aminotransferase (AST), alkaline phosphatase (ALP), urea, creatinine, glucose, and total protein. Serum concentrations of sodium (Na^+), potassium (K^+), and Chloride (Cl) were determined using Electrolyte Analyser (AVL 9180, Roche Diagnostics Ltd, USA).

Statistical analysis

All computations were performed using computer software STATISTICA 6 for Windows and SPSS for Windows Version 11.0. Descriptive statistics was used to describe all physiological parameters. ANOVA was employed to compare differences among variables. Product-moment correlation (r) was used to show relationships among variables. P-value was set at 0.05 to determine the level of significance.

Results

Results of the overall clinical and hematological values are presented in Table 1, Table 2 and Table 3.

Table 1. Clinical parameters and working performance of the study donkeys (N=85)

Parameter	Mean	SD	Min	Max
Age, years	5.93	3.83	1.5	18
BCS	2.47	0.53	1	3
Body Weight, Kg	138	7.10	120	145
Temperature, $^{\circ}\text{C}$	37.4	0.49	36	38.3
Heart rate, Bt/min	42.5	2.37	38	48
Respiration, Br/min	21.6	2.34	14	26
Work Performance, KgKm/day	1067	963	229	4800

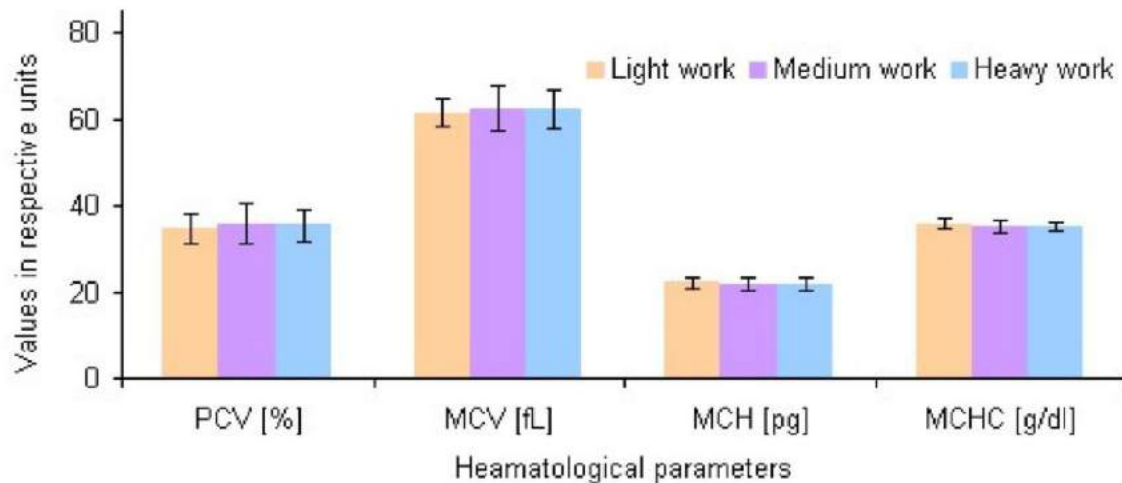
Table 2. Hematological parameters of the study donkeys (N=85)

Parameter	Mean	SD	Min	Max
PCV, %	35.4	3.99	24	49
Hg, mmol/l]	20.6	2.37	14.8	29.9
WBC, Million/ml	12.2	2.72	6.7	18.6
RBC, Million/ml	5.68	0.68	4.12	7.5
MCV, fL	62.2	4.35	53.1	72.9
MCH, pg	21.9	1.37	19	24.8
MCHC, g/dl	35.2	1.24	32.3	37.3

Table 3. Summary of clinical parameters of working donkeys based on age category

Parameter	Age category	N	Mean	SD
Temperature, °C	Young	27	37.4	0.6
	Adult	46	37.5	0.4
	Old	12	37.4	0.5
Heart rate, Bt/min	Young	27	42.6	2.4
	Adult	46	42.4	2.3
	Old	12	43.2	2.6
Respiration [Br/min]	Young	27	21.8	2.8
	Adult	46	21.7	2.2
	Old	12	20.5	1.5

Hematological values for donkeys engaged in different level of workload are also summarized in Figure 1 and Figure 2.

**Figure 1.** Hematological values of working donkeys under different levels of work load

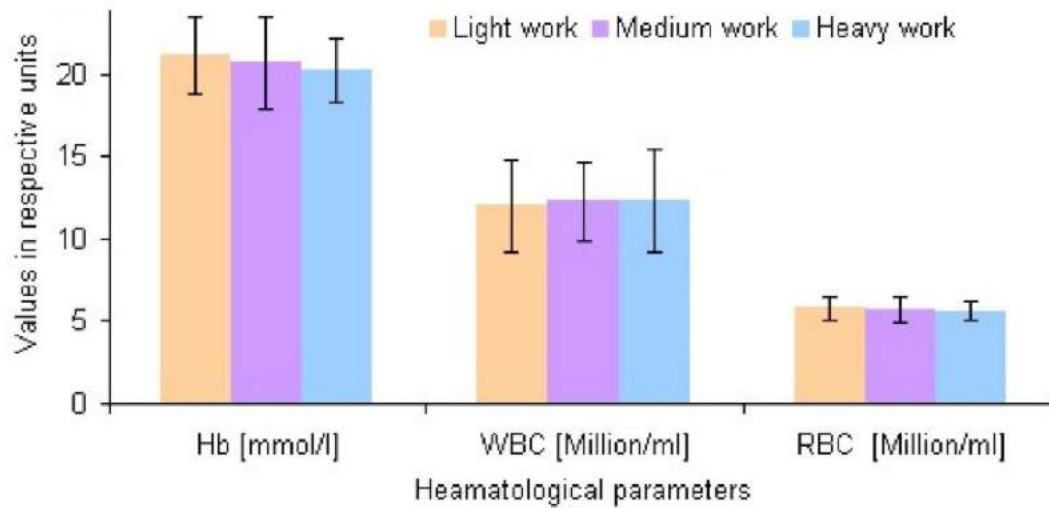


Figure 2. Distribution of haematological parameters (Hb, RBC, WBC) among the different work performance level

Similar descriptive statistics has been summarized for serum biochemical values based on the level of workload (Table 4).

Table 4. Distribution of serum biochemical values based on workload

Parameter	Light work (N=22)		Medium work (N=31)		Heavy work (N=32)	
	Mean	SD	Mean	SD	Mean	SD
AST, IU/L	288	90.6	239	65.2	243	59.5
ALP, IU/L	405	97.4	334	115	294	107
Urea, mmol/L	7.7	1.93	6.52	1.63	6.57	1.54
Creatinine, mmol/L	0.24	0.05	0.22	0.03	0.21	0.02
Glucose, mmol/L	3.0	1.81	5.25	2.84	5.04	2.44
Total protein, mmol/L	128	16.3	125	14.3	128	13.5
Na ⁺ , mmol/L	138	3.14	130	4.25	128	4.40
K ⁺ , mmol/L	4.9	0.8	4.52	0.63	4.25	0.66
Cl, mmol/L	102	3.42	97.8	3.50	97.9	4.01

The overall mean (\pm SD) serum concentrations of AST, ALP, Urea, Creatinine, Glucose, Total protein, Na⁺, K⁺ and Cl were in the order of 253 ± 72.51 IU/L, 336 ± 116 IU/L, 6.83 ± 1.74 mmol/L, 0.22 ± 0.04 mmol/L, 4.63 ± 2.63 mmol/L, 127 ± 14.5 mmol/L, 131 ± 5.76 mmol/L, 4.45 ± 0.73 mmol/L, and 99 ± 4.10 mmol/L, respectively. There was a significant difference ($P < 0.05$) in the clinical and hematological values among the age groups.

Serum concentration of Na⁺ was significantly correlated ($P < 0.05$) with AST ($r = 0.38$), ALP ($r = 0.52$), Urea ($r = 0.42$), Creatinine ($r = 0.45$), and Cl ($r = 0.64$). Serum glucose level was negatively correlated with concentrations of ALP ($r = -0.27$), Urea ($r = -0.27$), Na ($r = -0.28$) and Cl ($r = -0.35$). Serum concentration of urea was positively correlated ($P < 0.05$) with ALP ($r = 0.35$), Na⁺ ($r = 0.43$), K⁺ ($r = 0.40$), and Cl ($r = 0.37$). The observed values for clinical parameters: temperature, heart rate and respiratory rates were not statistically different for animals under different categories of BCS. No significant difference was also observed in these values for different levels of

workload. Except total protein, serum concentrations of AST, ALP, Urea, Creatinine, Na^+ , K^+ and Cl were significantly different ($P < 0.001$) among the different workload groups. All values were highest in animals with relatively lighter workload. Concentrations of ALP, Creatinine, Na^+ , K^+ were lowest in animals with the heavy workload. Body condition was significantly correlated ($P < 0.05$) with serum concentration of Na^+ ($r = 0.24$). Donkeys with poor body condition had a significantly higher ($P < 0.05$) serum Na^+ concentration. Though not strong, bodyweight was also positively correlated with both RBC and Hb levels ($r = 0.26$ and $r = 0.22$), respectively. Donkeys with heavy workload had the highest serum K^+ concentration.

Discussion

Clinical parameter values including temperature, respiration, pulse rate, and heart rate of working donkeys were found to be within the ranges of previous reports both in Ethiopia (Simenew 2007) and elsewhere (French and Patrick 1995, Pal et al 2002). An age difference in most of the clinical parameters has been previously explained by different authors (Zinkl et al 1990). Minor differences observed in values of some of the clinical parameters may be explained by difference in geographical conditions, season or climate and physiological conditions of sampled donkeys. Most of the hematological values found in this study were in agreement with previous values (de Aluja et al 2006, Mushi et al 2000). Though values for PCV, RBC, WBC and total protein were higher than report from Mexico (de Aluja et al 2006), they were generally within the recommended reference ranges. The trend in hematological values with respect to age showed that adult had higher RBC, Hb, MCV, MCHC, PCV, MCH than young animals. These findings are in agreement with reports for tropical donkeys (Canacoo et al 1991) except for the value of MCHC, which were reported to be higher in young. The difference in hemoglobin level, which was generally lower in this study, may be due to breed variation not elucidated in the current study.

AST value obtained in this study is within the reference ranges of previous report (de Aluja et al 2006, Zinkl et al 1990) but slightly higher than a report for domestic donkeys elsewhere (French and Patrick 1995). Values for Na^+ , K^+ and Cl are generally within the ranges of reports by other authors (de Aluja et al 2006, French and Patrick 1995). Variations observed in concentrations of most serum biochemical among the different workload and body condition categories could be explained by differences in the metabolic and electrolyte regulatory mechanisms that regulates their concentration in plasma and extra cellular fluid both in animals engaged in heavy work and those with relatively poor body condition (Burtis and Aswood 1994). Age differences in the concentrations of urea, potassium, glucose and total protein have not been observed in this study as were in donkeys irregularly used for work and originating from different localities within the central highlands of Ethiopia (Simenew 2007).

Conclusion

- The present study provides a comprehensive description of the clinical parameters and biochemical analysis of the major constituents of blood and serum in donkeys that are intensively engaged in work.
- Except minor differences, both clinical and hematological values determined in this study were within the range of previous reports for donkeys in the central highlands of Ethiopia.