

# Camel herd health and productivity in Eastern Ethiopia selected semi-nomadic households

M. Zeleke<sup>1</sup> T. Bekele<sup>1</sup>

## Key words

*Camelus dromedarius* - Dromedary - Animal health - Productivity - Seasonal variation - Ethiopia.

## Summary

This study was conducted on camels kept under pastoral management conditions from October 1997 to September 1998. Trypanosomosis was one of the most important diseases identified with a maximum prevalence of 20.6% and minimum of 5.4% for the sampled period. The prevalence rate of sarcoptic mange mites varied from 21.7 to 4.7% during rainy and dry months, respectively. The highest prevalence rate of strongyle eggs was 85.7% during rainy months and the lowest was 61.5% during dry months. The highest eggs per gram count was  $1036.1 \pm 0.6$ , the lowest  $358.8 \pm 0.6$ . Milk offtake was significantly higher ( $p < 0.01$ ) during the wet season (3.1 l) than during the dry season (1.5 l). A significantly higher ( $p < 0.01$ ) milk offtake was also recorded in camels of parities 1-4 (3 l) than in camels of parities 5 and above (1.6 l). Female immature camels (1-4 years old) showed a significantly higher ( $p < 0.01$ ) daily weight gain (59.4 g) than males of the same age (33.2 g). Furthermore, a significantly higher ( $p < 0.01$ ) daily weight gain (63.1 g) was recorded in camels 1-2 years old compared to camels 3-4 years old (29.5 g). Likewise, a significantly higher ( $p < 0.05$ ) daily weight gain (50.7 g) was observed during the wet season than during the dry season (41.9 g). Mating and calving mainly occurred during the rainy months. The annual calving percentage of the herd was 42.7%. The annual commercial animal offtake and herd growth rates were 4.74 and 8.9%, respectively. The mortality rate of calves below one-year of age was higher than that of immature and adult camels.

## INTRODUCTION

In Ethiopia, about half of the total area has an arid and semi-arid climate with marginal lands (9). This part of the country is assumed to be a habitat for about 6-10% of Ethiopian human population (5). The camel (*Camelus dromedarius*), due to its unique anatomical, physiological and behavioral features, is well adapted and known to provide basic necessities to pastoralists living in these regions. It is almost everything to pastoralists, source of food and power, cash and prestige, and means of storing wealth. However, despite its significant contribution to the livelihood of the pastoral society who do not have any alternative mode of production system, the camel is one of the most neglected

domestic livestock in Ethiopia. Thus, very little has been studied about productivity and health of camels to date. Scientific information on productivity, reproductivity, prevalence rates and seasonal dynamics of major health problems is lacking. An in-depth study on productivity, reproductivity and health aspects is crucial to generate baseline information that would boost productivity of camels under pastoral management conditions.

The objectives of this study were:

1. To identify major health constraints (trypanosomosis, mange mites and helminth parasites), and to study their prevalence rates
2. To study productivity taking into account milk and animal offtake, growth (weight gain) and mortality rates
3. To assess reproductive parameters that include calving percentage, services per conception, interval between birth and conception, stillbirths and abortions

1. Animal Sciences Department, Alemaya University of Agriculture, PO Box 138, Dire Dawa, Ethiopia

## ■ MATERIALS AND METHODS

### Study area

The study was conducted at Errer valley (Errer Guda), Eastern Hararghe region, Eastern Ethiopia. The valley is at an altitude of 1300 to 1600 m above sea level. It lies in a transitional zone between the intensively cropped areas of the northern highlands and the Jijiga plain. The vegetation type is diversified according to geological and edaphic conditions. The predominant vegetation types in the valley are acacia and cacti.

### Data collection

Blood, skin lesions and fecal samples were collected from camels to study prevalence rate and seasonal dynamics of trypanosomosis, mange mite infestation and strongylosis.

Blood samples were taken from ear vein at two-month intervals for a year to prepare thick and thin blood smears. The thin smear was fixed with 70% methanol for 2 min. The fixed thin smear and thick smears were stained in Giemsa (1.5 ml of Giemsa in 15 ml of distilled water buffered to pH 7.2) for 30 min. The trypanosome species were identified based on their body structure and morphological characteristics (14).

Skin scrapings were also collected from camels exhibiting dermatological problems (skin lesions). The scraped material (all keratinous and epidermal) was examined for mange mite using standard diagnostic methods of Kaufmann (15).

Furthermore, fecal samples were collected every other month from rectum of camels using disposable plastic glove. Egg counts were undertaken by the McMaster technique (15).

Ticks were collected once every other month and kept in pre-labeled bottles containing 70% ethanol until identification was carried out according to Hoogstraal (1956).

In addition, any disease events observed in the herd were recorded during the monitoring period.

### Productivity

Milk extraction from 19 lactating camels was measured every week for a year using a graduated cylinder. To determine weight gain of camels, 29 immature camels (1-4 years of age) were subjected to linear body measurements. Measurements were taken once a month using a height pole and measuring tape. Body weight was estimated from body measurements (20). Furthermore, all camels slaughtered or that died or were sold and/or given to others were recorded every day throughout the year by a full time enumerator. Camels that entered the herd either by birth or purchase/gift were also recorded. In addition, mating, repeat breeders, abortions and births were recorded regularly.

### Data analysis

Data were analyzed using Minitab (Minitab statistical software company, UK, 1993). General linear model was used to run analysis of variance (ANOVA) for variables affecting milk offtake and weight gain. Strongyle egg count data were transformed into logarithmic scale before ANOVA was performed. Means of parameters that showed significant differences were separated using Duncan's Multiple Range Test (12).

## ■ RESULTS

Trypanosomosis, mange mite lesions, strongyle parasites and ticks were prevalent throughout the year. However, their prevalence rates were higher during rainy months than dry months in the study period. The trypanosome species identified was *Trypanosoma evansi*. Its minimum and maximum prevalence rates were 5.41 and 20.59%, respectively (table I). Similarly, prevalence rates of mange mite infection (table II) varied from 4.67% (dry months) to 21.70% (rainy months).

The highest strongyle eggs per gram of feces ( $1036.05 \pm 0.65$ ) and highest prevalence rate (85.71%) were observed in October (rainy month), whereas the least eggs per gram of feces ( $358.83 \pm 0.62$ ) and least prevalence rate (61.54%) were recorded in April (dry month) (table III).

A total of 15,284 ticks were examined and 11 species of ticks were identified. Among these, *Rhipicephalus pulchellus* (87.4%), *Amblyomma gamma* (4.1%) and *Hyalomma dromedarii* (3.9%) were dominant (table IV).

Table I

Trypanosomosis prevalence rates (PR)

	Num. positive cases	PR (%)
December 1997	7 (34*)	20.59
February 1997	2 (37)	5.41
April 1998	3 (39)	7.69
June 1998	5 (36)	13.89
August 1998	6 (33)	18.18

\* Number of camels sampled

Table II

Mange mite prevalence rates (PR) in camel herd

	Num. positive cases	PR (%)
October	23 (106*)	21.70
November	21 (109)	19.27
December	19 (108)	17.59
January	6 (107)	5.61
February	5 (107)	4.67
March	7 (106)	6.60
April	9 (106)	8.49
May	14 (106)	13.21
June	10 (106)	9.43
July	11 (107)	10.28
August	15 (106)	14.15
September	20 (110)	18.18

\* Total number of camels in the herd at time of sampling

Table III

Mean strongyle egg count and prevalence rates (PR)

	N	Mean EPG $\pm$ SE	PR (%)
October	41	1036.05 $\pm$ 0.65 <sup>a*</sup>	85.37
December	41	749.56 $\pm$ 0.54 <sup>b</sup>	80.49
February	41	920.37 $\pm$ 0.65 <sup>ab</sup>	75.61
April	41	358.33 $\pm$ 0.62 <sup>c</sup>	61.00
June	41	655.27 $\pm$ 0.61 <sup>b</sup>	82.93
August	41	806.55 $\pm$ 0.62 <sup>ab</sup>	82.93

\* The differences are significant when the letters (a, b, c, ab) are different

Table IV

Tick species identified and percentages

Tick species	% total
<i>Rhipicephalus pulchellus</i>	87.36
<i>Rhipicephalus e. evertsi</i>	0.65
<i>Rhipicephalus muthamae</i>	0.04
<i>Amblyomma gamma</i>	4.10
<i>Amblyomma variegatum</i>	3.21
<i>Amblyomma lepidum</i>	0.08
<i>Hyalomma dromedarii</i>	3.87
<i>Hyalomma marginatum</i>	0.48
<i>Hyalomma excavatum</i>	0.07
<i>Hyalomma impeltatum</i>	0.01
<i>Boophilus decoloratus</i>	0.12

In addition to the aforementioned parasitic diseases, an outbreak of camel pox and a new respiratory disease were encountered during the monitoring period.

Milk offtake was significantly higher ( $p < 0.1$ ) during the wet season (3.12 l) than during the dry season (1.49 l). A significantly higher ( $p < 0.01$ ) milk offtake was also recorded in camels of parities 1-4 (3.03 l) than in camels of parities 5 and above (1.58 l). Likewise, a significantly higher ( $p < 0.05$ ) daily weight gain (50.68 g) was observed during the wet season than during the dry season. Female immature camels gained significantly ( $p < 0.01$ ) more weight (59.4  $\pm$  0.61 g) than male immature camels (33.2  $\pm$  40.5 g). Camels 1-2 years of age gained significantly ( $p < 0.01$ ) more weight (63.12  $\pm$  0.45 g) than camels 3-4 years of age (29.52  $\pm$  0.54 g).

Twelve camels were sold and seven were purchased leading to a 4.74% net commercial offtake. All camels purchased were immature females (2-4 years of age). More than 67% of the camels sold were males and old females. During the monitoring period, a total of 8 camels (7.58%) died (table V). Out of these, 5 were

below 1 year of age, and the remaining 3 were over 12-years old. The monitored herd showed an 8.9% growth rate, the result of purchases and births during the study period.

A total of 22 calvings were observed during the monitoring period (annual calving rate = 42.7%). The average number of services per conception for the monitored herd was 1.36  $\pm$  1 (n = 33). The average number of days open was 162.8  $\pm$  7.9 (n = 33) (table VI). Four abortions were encountered during the monitoring period (annual abortion rate = 12.12%).

## DISCUSSION

Trypanosomosis, mange lesions and strongylosis were prevalent in the monitored herd throughout the monitoring period. However, their prevalence rates were found to be higher during rainy months than dry months. The highest prevalence rate of *Trypanosoma evansi* immediately after and during rainy months may be due to favorable weather conditions (moisture and temperature) for breeding and activity of biting flies, which serve as mechanical vectors for transmission.

Similarly, the reason for the highest prevalence rates of sarcoptic mange lesions during wet months may be due to the favorable weather conditions for transmission of the parasite to healthy camels. The parasite may be more easily transmitted from wet skin (rainy months) than from dry skin (dry months). In addition, the crowding of animals around encampments during salt feeding and milking in wet months might facilitate disease transmission since mange mite is known to be highly contagious (11).

Table V

Mortality of camels

Age class	Mortality	
	% of each age class	% of total mortality
Calves	20.42 (5*)	62.50
Immature	-	-
Adults	5.09 (3)	37.50
Crude death rate	7.58 (8)	

\* Total number of camels

Table VI

Some reproductive parameters of camels

Calving percentage (per year)	42.72 (22*)
Services per conception (mean $\pm$ SE)	1.36 $\pm$ 0.10
Days open	162.76 $\pm$ 7.95
Abortions (%)	12.12 (4)
Stillbirths (%)	-

\* Total number of camels

Likewise, the highest eggs per gram and prevalence rates observed during rainy months agree with previous reports by Birhanu (7) and Abebe (3). They may be due to favorable weather conditions (moisture and temperature) for survival and development of infective larvae on pasture and soil (19).

*Rhipicephalus pulchellus* (87.4%), *Amblyomma gemma* (4.1%) and *Hyalomma dromedarii* (3.9%) were the dominant tick species identified in this study. These results match those of Bekele (6) who reported the same decreasing hierarchy of ticks in Eastern Ethiopia. Inversely, Richard (16) and Gupta and Kumar (13) found that the most abundant tick species in camels was *Hyalomma dromedarii* (90%). The discrepancy between the current finding and these latter reports may be due to the difference in the ecology of the study site.

An outbreak of camel pox was observed twice during the monitoring period. The disease only affected young animals from 6 months to 2 years of age. Only one calf died of the disease. Another important disease observed during the study was a new camel respiratory disease that affected almost 85.8% of the animals under monitoring. A decline of the daily weight gain of affected camels was noticed.

The higher milk offtake observed during the wet season compared to the dry season agrees with the findings of Ayele (5). This may be due to the availability of feed and water that are relatively scarce during the dry months. In addition, direct solar radiation and ambient temperature may create discomfort in camels in the dry season. The lower milk offtake from later parities may be due to old age. Since camels reach puberty at a very late age, the age of the camels by the time they have given five or more offspring will be relatively old. Due to this reason, as with any other livestock, camels may decrease the efficiency of feed conversion into a product when they advance in age.

Similarly, the significantly ( $p < 0.05$ ) higher body weight gain per day recorded during the wet season ( $50.68 \pm 0.54$  g) compared to that of the dry season ( $41.96 \pm 0.54$  g) may have nutritional causes and/or result from the direct effect of ambient temperatures (low night temperatures and very high day time temperatures). Immature female camels had significantly higher daily weight gains than males, which is in agreement with the finding of Simpkin (18) for Kenyan camels. This could be due to the intrinsic factor that females mature earlier than males and reach puberty at an earlier age. Furthermore, the mean daily weight gain of 1-2 year old camels was significantly higher than that of 3-4 year old ones, results similar to those reported by Simpkin (18) in Kenya. It is a natural phenomenon that young animals 1-2 years old grow faster than 3-4 years old ones of the same breed under the same management condition.

Camels were found to be an important source of cash for pastoralists of the study area especially during the dry season. The higher proportion of sales (58.33%) during the dry season indicates that pastoralists sold their camels to generate money for purchase of grains since milk offtake during that period was not sufficient for home consumption let alone for sale. The selective offtake of camels by pastoralists was also noticed. About 67% of the camels sold were males and old females, which revealed that the pastoralists were reluctant to sell camels valuable for future use. The net commercial offtake of the monitored camel herd was 4.74% which is in line with the finding of Schwartz and Dioli (17) for East Africa in general; higher offtake rates were reported by Dahl and Hjort (10) for camels of Somalia. The discrepancy may be due to the difference in production goals.

In this study, age specific mortality was clearly observed. The highest mortality rate was recorded for younger calves. High mortality of very young camel calves is in agreement with the previous report of Chowdhary (8). Though specific causes for camel calf mortality requires further study, the main symptom observed prior to death in almost all of the calves was difficulty in breathing. Therefore, the major probable cause for calf mortality at an early age may be pneumonia.

In the monitored herd, 84.85% of the matings and 86.36% of the calvings were recorded during the wet season demonstrating the seasonality of reproduction in camels. This finding is in conformity with the previous report of Schwartz and Dioli (17), i.e. the breeding season of camels (both males and females) is very short and coincides with the rainy season. The main reason for the seasonality of breeding in camels may be nutritional. In addition, the number of services per conception and days open were  $1.36 \pm 0.10$  and  $162.76 \pm 7.95$  days ( $n = 33$ ), respectively (table VI). Though literature on services per conception for Ethiopian camels is lacking, figures of  $2.0 \pm 0.2$ , 2.0 and  $1.63 \pm 0.16$  have been reported for Saudi Arabian camels (references 1, 2, 4, respectively), which is in line with the present findings.

The area coverage and duration of the study were insufficient to generate adequate information especially for productivity and reproductive parameters as they are influenced by many factors. However, the findings present some information on productivity, reproductivity and some health constraints of camel. In general, in spite of higher prevalence rates of trypanosomosis, sarcoptic mange, strongylosis and external parasites, higher milk offtake and growth rate, percentage of conception and calving were noticed during the rainy season.

Due emphasis to reduce health constraints during the rainy season and to increase availability of feed and water during the dry season should be objectives of any improvement program for camels of this region.

## REFERENCES

1. ABDEL RAHIM S.E.A., ABDEL RAHIM K., NAZIER A.E., 1994. Production and reproduction of one-humped camels in the Al-Quasim region, Saudi Arabia. *J. Arid Environ.*, **26**: 53-59.
2. ABDEL RAHIM S.E.A., NAZIER A.E., 1993. Factors affecting camel reproduction performance in the tropics. In: Proc. Workshop "Is it possible to improve the reproductive performance of the camel?", Paris, France, 10-12 September 1990. Maisons-Alfort, France, Cirad-Iemvt, p. 131-147. (Etudes et synthèses n° 41)
3. ABEBE W., 1991. Traditional husbandry practices and major health problems of camels in the Ogaden. In: Anders H.O. Ed., Nomadic Peoples. Uppsala, Sweden, Scandinavian Institute of African Studies, p. 21-30. (No. 29)
4. ABOUL ELA M.B., 1994. Reproductive performance of the one-humped camel under traditional management in the United Arab Emirates. *J. Arid Environ.*, **26**: 7-51.
5. AYELE G., 1989. The future of camel rearing for food production in Ethiopia. In: Tegegne T. Ed., Camel pastoralism as food system in Ethiopia. Addis Ababa, Ethiopia, Institute of Development Research (IDR)/Uppsala, Sweden, Scandinavian Institute of African Studies (SIAS), p. 1-8.
6. BEKELE T., 1996. Survey on the distribution of ticks of domestic animals in the Eastern zone of Ethiopia. *Trop. Anim. Health Prod.*, **28**: 145-146.

7. BIRHANU A., 1986. Survey of camel helminthiasis in Hararghe region. DVM Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Ethiopia.
8. CHOWDHARY B., 1986. Some important biological and production characteristics of the Bikaneri camel. *Indian J. Anim. Prod. Manage.*, 2: 145-151.
9. COPPOCK D.L., 1993. The Boran Plateau of the Southern Ethiopia: Synthesis of pastoral research development and change, 1980-1991. Addis Ababa, Ethiopia, ILRI.
10. DHAL G., HJORT A., 1976. Having herds, pastoral herd growth and household economy. Stockholm, Sweden.
11. DIOLI M., STIMMELMAYR R., 1992. Important camel diseases. In: Schwartz M., Dioli M. Eds., The one-humped camel (*Camelus dromedarius*) in Eastern Africa: A pictorial guide to disease, health care and management. Berlin, Germany, Verlag Joseph Margraf, p. 155-224.
12. GOMEZ A.A., GOMEZ K.A., 1984. Statistical procedures for agricultural research. New York, NY, USA, Wiley-Interscience.
13. GUPTA S.K., KUMAR R., 1994. Ixodidae ticks of camel in India and their control measures. *Intern. J. Anim. Sci.*, 9: 55-56.
14. ITARD J., 1989. African animal trypanosomiasis. In: Fischer S., Say R.R. Eds., Manual of tropical veterinary parasitology. Wallingford, UK, CTA, p. 177-290.
15. KAUFMANN J., 1996. Parasitic infections of domestic animals. A diagnostic manual. Berlin, Germany, Birkhauser Verlag, p. 5-15.
16. RICHARD D., 1979. Study of the pathology of dromedary in Borena Awraja, Ethiopia. Maisons-Alfort, France, Gerdat-lemvt, 232 p.
17. SCHWARTZ H.J., DIOLI M., 1992. The one-humped camel (*Camelus dromedarius*) in Eastern Africa. A pictorial guide to disease health care and management. Berlin, Germany, Verlag Josef Margraf.
18. SIMPKIN S.P., 1985. The importance of camels to subsistence pastoralists in Kenya. Camel disease and productivity in arid lands of Northern Kenya. Germany, IPAL, p. 163-192. (Technical report E7)
19. TRONCY P.M., 1989. Helminths of livestock and poultry in tropical Africa. In: Fischer S., Say R.R., Eds., Manual of tropical veterinary parasitology. Wallingford, UK, CTA, p. 33-54.
20. YAGIL R., 1994. The camel in today's world. A hand book on camel management. Bonn, Germany, Deutsche Welthungerhilfe, Germ. Agro. Action. (Research Report No. 1)

## Résumé

**Zelege M., Bekele T.** Santé et productivité d'un troupeau de dromadaires élevés dans des conditions semi-nomadiques en Ethiopie de l'Est

Cette étude a été réalisée sur des dromadaires élevés en conditions pastorales d'octobre 1997 à septembre 1998. La trypanosomose a été une des maladies les plus importantes identifiées avec une prévalence maximale de 20,6 p. 100 et minimale de 5,4 p. 100 sur la période d'échantillonnage. Le taux de prévalence de la gale sarcoptique a varié de 21,7 p. 100 pendant la saison pluvieuse à 4,7 p. 100 pendant la saison sèche. Le taux de prévalence d'œufs de strongles le plus élevé a été de 85,7 p. 100 pendant la saison pluvieuse et le plus faible de 61,5 p. 100 en saison sèche. Le plus grand nombre d'œufs par gramme enregistré a été  $1\ 036,1 \pm 0,6$  et le plus faible  $358,8 \pm 0,6$ . La production de lait a été significativement ( $p < 0,01$ ) plus élevée pendant la saison des pluies (3,1 l) que pendant la saison sèche (1,5 l). La production de lait a également été significativement ( $p < 0,01$ ) plus élevée chez les chamelles ayant mis bas 1-4 fois (3 l) que chez les femelles ayant mis bas 5 fois ou plus (1,6 l). Les femelles immatures (1-4 ans) ont eu un gain de poids quotidien significativement ( $p < 0,01$ ) plus élevé (59,4 g) que les mâles au même âge (33,2 g). Par ailleurs, le gain de poids quotidien des dromadaires de 1-2 ans (63,1 g) a été significativement ( $p < 0,01$ ) plus élevé que celui des 3-4 ans (29,5 g). De même le gain de poids quotidien a été significativement ( $p < 0,05$ ) plus élevé pendant la saison des pluies (50,7 g) que pendant la saison sèche (41,9 g). La plupart des montes et des mises bas ont eu lieu pendant la saison des pluies. Le taux annuel de mises bas du troupeau a été de 42,7 p. 100. Les taux de commercialisation annuels et de croissance ont été respectivement de 4,74 et 8,9 p. 100. Le taux de mortalité des chamelons de moins d'un an a été plus élevé que celui des animaux immatures et adultes.

**Mots-clés :** *Camelus dromedarius* - Dromadaire - Santé animale - Productivité - Variation saisonnière - Ethiopie.

## Resumen

**Zelege M., Bekele T.** Productividad y salud del hato de camellos en Etiopía del este seleccionó hogares semi-nómadas

El presente estudio fue conducido en camellos mantenidos bajo condiciones de manejo de pastoreo, entre octubre 1997 y septiembre 1998. La tripanosomosis fue una de las enfermedades identificadas más importante, con una prevalencia puntual máxima de 20,6% y una mínima de 5,4% para el período de toma de muestras. La tasa de prevalencia puntual de la sarna sarcoptica varió de 21,7% a 4,7% durante el mes lluvioso y seco respectivamente. La tasa de prevalencia más elevada para los huevos de estróngilos fue de 85,7% en los meses lluviosos y la prevalencia más baja fue de 61,5% en el mes seco. La EPG registrada más elevada fue de  $1036,1 \pm 0,6$  y la más baja fue de  $358,8 \pm 0,6$ . La producción láctea fue significativamente ( $p < 0,01$ ) más alta durante la estación húmeda (3,1 l) que durante la estación seca (1,5 l). También se registró una producción significativamente ( $p < 0,01$ ) más elevada en camellas entre 1-4 partos (3 l) que aquellas de 5 y más partos (1,6 l). Las camellas inmaduras (entre 1-4 años de edad) mostraron una ganancia de peso diaria (59,4 g) significativamente ( $p < 0,01$ ) más elevada que los machos de la misma edad (33,2 g). Aún más, se registró una ganancia de peso diaria (63,1 g) significativamente ( $p < 0,01$ ) más elevada en los camellos de 1-2 años de edad que en aquellos de 3-4 años (29,5 g). De igual manera, ganancias de peso diarias (50,7 g) significativamente ( $p < 0,05$ ) mayores se observaron durante la estación lluviosa, que durante la estación seca (41,9 g). La mayoría de los apareamientos y de los partos de los camellos fueron durante los meses lluviosos del año. El porcentaje de parto del hato fue de 42,7%. La producción comercial anual de animales y la tasa de crecimiento de hato de los camellos bajo muestra fue de 4,74% y de 8,9% respectivamente. La tasa de mortalidad de los jóvenes de menos de un año fue mayor que aquella de los inmaduros y de los adultos.

**Palabras clave:** *Camelus dromedarius* - Dromedario - Sanidad animal - Productividad - Variación estacional - Etiopía.