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Original Research

A Comparison Between Working and Nonworking Donkeys Welfare Issues in Nyala City, South Darfur, Sudan

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ABSTRACT

In impoverished nations, donkeys help people make a living. The welfare of donkeys in Sudan is neglected compared with developed countries. However, there is no information available about donkey welfare in Nyala. This study aimed to assess the welfare of donkeys in Nyala. Donkeys were divided into two groups ($n = 50$), working and nonworking. The donkeys' physical, emotional, and clinical parameters and an owner's interview were assessed. There were significant differences in body condition scores: 37% and 47% of working and nonworking donkeys, respectively, had ideal body condition scores, while 13% of working donkeys were emaciated. Of the working and nonworking 33% and 19% had hoof problems, respectively. Fifteen percent of working donkeys had ocular discharge, and 25% had wounds. In working donkeys, 7% and 5% depressive and aggressive behavioral responses, respectively, were observed. Furthermore, there were significant differences in tools used for hitting donkeys, with 33% and 17% of owners using a stick and whip, respectively, for hitting working donkeys. Eighty-two percent of owners feed their donkeys one to three times daily (50% working and 32% nonworking donkeys), and free access feeding was only observed in 18% of nonworking donkeys. There were no significant differences ($P > .06$) in emotional parameters. We conclude that working donkeys suffer from multiple welfare problems more than nonworking donkeys in Nyala. More awareness, veterinary services, and research are needed to improve donkey care in Nyala.

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Animal welfare/ethical statement: Hereby, I /Abdelkareem A. Ahmed/ consciously assure that for the manuscript / **A comparison Between Working and Nonworking Donkeys, Welfare Issues in Nyala City, South Darfur, Sudan** / the following is fulfilled: (1) This material is the authors' own original work, which has not been previously published elsewhere. (2) The paper is not currently being considered for publication elsewhere. (3) The paper reflects the authors' own research and analysis in a truthful and complete manner. (4) The paper properly credits the meaningful contributions of co-authors and co-researchers. (5) The results are appropriately placed in the context of prior and existing research. (6) All sources used are properly disclosed (correct citation). Literally copying of text must be indicated as such by using quotation marks and giving proper reference. (7) All authors have been personally and actively involved in substantial work leading to the paper and will take public responsibility for its content. The violation of the Ethical Statement rules may result in severe consequences. I agree with the above statements and declare that this submission follows the policies Guide for Authors and in the Ethical Statement.

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1. Introduction

There are approximately 43 million donkeys in the world [1]. Most of them contribute to developing countries' livelihoods, both directly and indirectly [2]. Donkeys supply draught power (for plowing and hauling) and serve as a transportation resource for passengers and agricultural products, making a significant contribution to food security, mobility, and income generation [3,4]. The population of donkeys in Africa is estimated to be 13 million [5]. Despite motorized transportation worldwide, donkeys play an essential role in many developing countries' farming systems and poor people's lives [6]. Donkeys represent an essential part of the smallholder agricultural system, especially in rural communities. Where bad- quality roads exist, they transport people, goods, and

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Fig. 1. The map shows Nyala city in western Sudan (bottom left), in which study was conducted. Downloaded from the Wikipedia.

farm inputs and outputs to and from farms [7]. Donkeys are valued for their characteristics: inexpensive, hardy, adaptable to many terrains such as dry areas and hills, disease resistant, and simple to manage and train [8].

Despite the contribution of donkeys to human livelihoods, some welfare issues have been reported in working donkeys. In Africa, harsh environmental conditions, overuse, improper tools, limited veterinary awareness and little or poor-quality supplementary feed during dry periods can lead to advanced welfare problems [3,9]. Donkeys suffer from the poor body condition, sores and wounds, lameness, ticks and gastrointestinal parasites, dehydration, and aggressive or apathetic behavior, all typically linked to human job demands and the environment [3,10,11]. Previous research has found that chronic joint pain is common in working donkeys and that lameness is linked to pain responses in the hoof and lower joints, resulting in depressed demeanor and decreased production [3,12,13]. As a result, it's critical to address the health and welfare issues that come with working donkeys, not just for the animals' benefit but also for those who own them [14].

The lack of management and husbandry of donkeys in African countries, especially in Sudan, means they are subjected to various diseases. There is limited information regarding donkey welfare issues and health problems in Sudan, particularly in Nyala city, because Nyala veterinary hospitals and clinics lack information. No study regarding donkey welfare and health problems has been reported in the study area. Consequently, this study was done to compare welfare issues of working and nonworking donkeys in Nyala city, South Darfur, Sudan.

2. Material and Methods

2.1. Study Area

The research was carried out in Nyala, the capital of South Darfur state in Sudan's western region. Nyala lies in the Darfur historical region at 2,208 feet (673 meters) (Fig. 1).

2.2. Sampling Procedure

The present study occurred over two months, from August to October 2019. A total of 100 donkeys were included in this study and divided into two groups: Group 1 had 50 working donkeys with their individual owner or user, which had worked throughout their lifetime in cart transportation, water-tanker pulling and plowing during the autumn season, while Group 2 had 50 non-working donkeys with their individual owner, who had not worked

yet in their lifetime but were sometimes used for leisure, breeding and special visitation. Donkeys sampled in various places include the markets (Mawashy, Algniana Station, Alshabey, Central market and Aljabal), big streets and water well stations situated in and around Nyala city.

2.3. Data Collection

Permission was taken from the donkeys' owners to evaluate the welfare issues. The Assessment took approximately 20 to 40 minutes per donkey. Data collected included the donkey's emotional and physical condition measures and owner interviews.

Emotional parameters were evaluated and recorded via an equine sentiment analysis diagram and modified to befit this study [15]. Data were collected on the head position (Normal position, turn to left, turn to the right, down or uprise ahead), eyes (Normal or abnormal depending on corneal appearance and degree of eyelid openness), tail state (movement or still), ear position (normal position, back or straight ahead turn), kicking the researcher (yes or no) and biting the researcher (yes or no). The parameters also identified the donkeys' responses to the researcher, including engagement (ears straight ahead, interaction via sniffing, and interest in, the movement towards the researcher), avoidance (ears back, head rise and movement away from the researcher) and argumentative (ears back, kicking, biting, and abnormal eyes position).

Physical assessments were based on existing equine welfare assessment methodologies, modified and added to befit this study [3,10,15–17]. The parameters included sex, age, body conformation (symmetry or asymmetry), body condition (ideal, obese or emaciation), gait (impeded movement, lameness and hoof problems present), external parasites (Present or absent), hair position (erected or non-erected), coat appearance (bright or not), presence/absence of external orifice discharge (from nostrils, mouth and eyes), lesion presence (scars, inflammation and wound) and behavior of the donkey (bright, depressed and alert).

Age categories of the donkeys were classified into two groups (less than 10 years, 10 years or more) estimated based on observation of the front teeth. Body conformation was examined by a researcher standing in front of and behind the donkeys. The observing without touching scored either as symmetry if all parts of the donkeys' conformation appeared normal or if there was misplacement or loss of some parts of the donkey's body. Body condition score was done according to the criteria described previously [18,19], and donkeys were observed from all sides without touching. Body condition was scored from 0 to 5 (0 = very thin, 1 = thin, 2 = ideal, 3 = good, 4 = fat and 5 = very fat). Categories 0 and 1 were grouped as (emaciation), categories 2 and 3 were ideal, and categories 4 and 5 were obese. Hoof problems were examined at the surface level, and hoof cracks, heel cracks and hoof overgrowth were recorded. The lameness was evaluated by watching the donkey walk forward for 10 steps, with the researcher observing from behind based on previous reports [13,17]. The impeded movement was observed as favoring a certain limb or shortened stride. A normal stride was considered if all four limbs took equal steps, followed in the footsteps of one another, and appeared comfortable during motion [20]. Behavior was assessed via an attempt by the researcher to touch the donkeys with one hand and recorded as bright, meaning normal donkey behavior; depressant, meaning body parts were reduce the vital activities, and no movement occurred; and alert responses for the hand touch. The presence of lesions and external parasites was observed through close visual examination of the donkey. External orifices were recorded for any discharge, and coat condition was examined visually for hair coat position and coat appearance.

Other manual welfare parameters included hydration, whether hydrated or dehydrated by press the thumb of the researcher on

Table 1
Distribution of physiological parameters in donkeys ($n = 100$), the P value ($P < .05$) significantly different between groups of donkeys.

Variables	Working (%)	Nonworking (%)	Total (%)	(χ^2)	P value
Sex					
Male	50 (50)	45 (54)	95 (95)	5.26	.056
Female	0 (0)	5 (5)	5 (5)		
Age				1.714	.275
Less than 10	32 (32)	38 (38)	70 (70)		
More than 11	18 (18)	12 (12)	30 (30)		
Body confirmation					
Symmetry	49 (49)	50 (50)	99 (99)	1.010	1.000
Asymmetry	1 (1)	0 (0)	1 (1)		
Body condition					
Sound	37 (37)	47 (47)	84 (84)	7.440	.012
Emaciated	13 (13)	3 (3)	16 (16)		
Obese	0 (0)	0 (0)	0 (0)		
Gait					
Impeded movement	2 (2)	0 (0)	2 (2)	21.525	.000
Lameness	5 (5)	0 (0)	5 (5)		
Hoof problem	33 (33)	19 (19)	52 (52)		
Not	10 (10)	31 (31)	41 (41)		
External parasite	3 (3)	0 (0)	3 (3)	3.093	.242
Present	47 (47)	50 (50)	97 (97)		
Absent					
Hair position					
Erected	7 (7)	1 (1)	8 (8)	4.891	.059
Not erected	43 (43)	49 (49)	92 (92)		
Coat appearance					
Bright	14 (14)	40 (40)	54 (54)	27.214	.000
Not bright	36 (36)	10 (10)	46 (46)		
Orifices discharge					
Nasal	7 (7)	0 (0)	7 (7)	15.015	.001
Oral	1 (1)	1 (1)	2 (2)		
Ocular	13 (13)	5 (5)	18 (18)		
Not	29 (29)	45 (45)	74 (74)		
Lesion					
Scars	16 (16)	10 (10)	26 (26)	36.489	.000
Inflammation	1(1)	1 (1)	2 (2)		
Wounds	25 (25)	3 (3)	28 (28)		
Not	8 (8)	36 (36)	44 (44)		
Behaviors					
Normal	38 (38)	50(50)	88 (88)	13.636	.000
Depressed	7 (7)	0 (0)	7 (7)		
Aggressive	5 (5)	0 (0)	5 (5)		

upper gum of the donkey for two second and pull the thumb, waiting for blood to return to the pressure part is in second. From faster per second, medium in two second and late in three second, the last one considered dehydrated. Mucous membrane color was examined as normal/rosy red, pale, yellow, red or cyanosed. The respiration rate, pulse rate and temperature of the donkey were also recorded. Owners were interviewed about which tool was most often used to encourage donkeys to move, feeding type and feeding times per day.

2.4. Data Analysis

The Data was analyzed using SPSS Version 21.0 (IBM Corporation, NY). A cumulative score was given to each variable, which was the total score for each questionnaire item. Percentage and frequency distribution were calculated. The Chi-square test (χ^2) was used to assess the differences between scores for working and nonworking donkeys. P values of $\leq .05$ were considered statistically significant.

3. Results

3.1. Physiological Parameters

In the present study, working and nonworking donkeys differed significantly ($P < .05$) between sex, body condition score, gait and lameness, and hoof problems (Table 1). In hair position, abnor-

mal ocular orifice discharge, and abnormal nasal discharge had significant differences between groups of donkeys (Table 1). Moreover, the prevalence of scars and wounds were observed in working more than nonworking (Fig. 2A and 2B), and working donkeys were more aggressive compared to nonworking donkeys significantly (Table 1). However, there were no significant differences between working and nonworking donkeys in age, body conformation and external parasites (Table 1).

3.2. Emotional Parameters

There were no significant differences in kicking, biting, head position, eyes position, ears position, and tail state in the present study between working and nonworking donkeys (Table 2).

3.3. Clinical Parameters

This study showed a significant difference in hydration, polypnea respiration and increased of pulse rate in working donkeys more than nonworking donkeys in study area. However, there was no significant difference in mucus membrane color between the two groups (Table 3).

3.4. Owner Interviews

The result showed significant differences in owners' hitting tools, showing that 24% of owners used a whip (17% working, 7%



Fig. 2. Showing the severity of the wound on the ribs region of the working donkey, due to improper equipment (A), and the severity of the wound on the dorsal region of the working donkey, due to improper equipment (B). This photo has been taken by Dr. Saber Yagoub Adam, during data collection, September 13, 2019.

Table 2
Refer to emotional parameters of working and nonworking donkeys ($n = 100$), the P value ($P < .05$) significantly different between groups of donkeys.

Variables	Working (%)	Nonworking (%)	Total (%)	(χ^2)	P value
Kicking					
Yes	10 (10)	7 (7)	17 (17)	0.638	.298
No	40 (40)	43 (43)	83 (83)		
Biting	5 (5)	6 (6)	11 (11)	0.102	1.000
Yes	45 (45)	44 (44)	89 (89)		
Not	42 (42)	45 (45)	87 (87)	0.796	.277
Tail status	8 (8)	5 (5)	13 (13)		
Movement	42 (42)	36 (36)	78 (78)	4.573	.277
Still	1 (1)	3 (3)	4 (4)		
Head position	0 (0)	1 (1)	1 (1)		
Normal	2 (2)	6 (6)	8 (8)		
Left	5 (5)	4 (4)	9 (9)		
Right	42 (42)	46 (46)	88 (88)	1.515	.357
Rise	8 (8)	4 (4)	12 (12)		
Down	29 (29)	28 (28)	57 (57)	4.248	.120
Eyes position	0 (0)	4 (4)	4 (4)		
Normal	21 (21)	18 (18)	39 (39)		
Up to normal					
Ears position					
Normal					
Straight forward					
Behind					

Table 3
Explicates manual parameters of working and nonworking donkeys ($n = 100$), the P value ($P < .05$) significantly different between groups of donkeys.

Variables	Working (%)	Nonworking (%)	Total (%)	(χ^2)	P value
Hydration					
Hydrated	39 (39)	50 (50)	89 (89)	12.360	.000
Dehydrated	11 (11)	0 (0)	11 (11)		
Mucous membrane color					
Normal	47 (47)	50 (50)	97 (97)	3.093	.242
pale	3 (3)	0 (0)	3 (3)		
Respiration rate					
Normal	8 (8)	42 (42)	50 (50)	46.240	.000
Polypnea	42 (42)	0 (0)	42 (42)		
Oligopnea	0 (0)	8 (8)	8 (8)		
Pulse rate					
Normal	19 (19)	44 (44)	63 (63)	26.813	.000
Increased	31 (31)	0 (0)	31 (31)		
Decreased	0 (0)	6 (6)	6 (6)		

nonworking donkeys) and 34% of owners used a stick (33% working, 1% nonworking donkeys). For the feeding practices, 82% of owners were feeding one to three times daily, most of them owners of working donkeys and 18% provided free access feeding observed in nonworking donkeys only. There was no significant difference in the type of feed between donkeys.

4. Discussion

Donkeys in developing countries like Sudan are often owned by communities affected by poverty. The lack of motorization has

made people dependent on donkeys to earn livelihoods and income generation. For this reason, it is essential to improve the welfare of these animals. Therefore, this present study aimed to compare the welfare problems of working and nonworking donkeys in Nyala city. In this study, the presence of wounds was significant and highly observed in working donkeys, which agrees with the observation reported by [21,22] under similar environmental conditions. Multi-factorial reasons often cause these wounds. The variance in management and environmental factors, the type of equipment used, the owner's behavior, rate of work and overloading were among the risk factors that contributed to the different types

Table 4

Show interviews of 100 owners of working and nonworking donkeys, the *P* value ($P < .05$) significantly different between groups of owners' donkeys.

Variables	Working (%)	Nonworking (%)	Total (%)	(χ^2)	<i>P</i> value	
Hitting tool	Whip	17 (17)	7 (7)	24 (24)	76.284	.000
	Stick	33 (33)	1 (1)	34 (34)		
	Not	0 (0)	42 (42)	42 (42)		
Feeding type	Grass	33 (33)	32 (32)	65 (65)	.044	.5
	Grain	17 (17)	18 (18)	35 (35)		
Feeding times per day	One to three	50 (50)	32 (32)	82 (82)	21.951	.000
Free access	0 (0)	18 (18)	18 (18)			

of wounds in working donkeys [23]. Researchers have reported low body condition scores in different parts of Ethiopia [3,14], which might be due to similar owner perceptions. The commonness of emaciation is perhaps related to poor knowledge, lack of veterinary and extension services, poor feeding and general administration [24]. In the present study, the behavioral problems observed, i.e., depressive behavior and aggression were significant between groups donkeys, which agreed with those reported in many different parts of the world [14,25,26]. The similarity might be due to similar environmental conditions and treatment. This study's observation of hoof problems (e.g., cracks) was significant, with a higher prevalence in working donkeys than nonworking donkeys. Our findings agree with previous data reported by [27,28], and this might be due to similar land topography. Hoof problems could be due to a lack of proper hoof trimming and veterinary services, and overuse may cause poor conditions [13,29]. This study showed no significant differences in external parasites' presence between working and nonworking donkeys, which disagrees with the report by [26], which might be due to differences in environmental conditions and level of health care for the donkeys.

The relative abundance of external parasites (ticks, mites and flies) was seasonal, often appearing during the rains [30]. Ocular discharge in the present study showed a significant difference between the donkey groups, which agreed with the report by [26]. The presence of lacrimation is closely in agreement with earlier reports [31], which might be due to the same environmental conditions in different places. Here we reported significant differences in hair position and coat appearance of donkeys for the first time. The higher prevalence of erected hair position and not bright appearance of the coat were observed in working more than nonworking donkeys. The abnormal cases could be due to some nutritional deficiency such as zinc and copper [32], and will be treated by providing the animal a balanced feeding.

The emotions experienced by donkeys can be shown through body language, for instance, signs of happiness with ears forward and bright eyes [15,29]. The emotional well-being of equines may be developed or repressed due to husbandry practices, health issues, environmental conditions and interactions with other donkeys, other animals or human beings [33–35]. The current study revealed no significant difference in emotional parameters between the two groups of donkeys. This finding contradicts the report by [28,36], which stated that the higher prevalence of different emotional parameters might be due to variation in environmental conditions and awareness of the owners.

Beating a donkey does not only cause wounds and physical pain, but it also causes fright and severe stress to the animal [37]. Beating donkeys with different tools, whips, and sticks were significantly different ($P < .00$), with a higher prevalence in working donkeys. This finding was in agreement with the prevalence reported by [26], which might be due to similar owner perceptions (Table 4).

5. Conclusion

The present study revealed that working donkeys suffer from multiple welfare problems as body condition scores, abnormal gait, abnormal orifices discharges and lesions more than nonworking donkeys in Nyala city, due to poor owner awareness and veterinary care. The result of this study could be given to owners in feedback by creating awareness and educational programs, training and extension services to improve the positive welfare status, and to sensitize the donkey owners that enhancing their welfare and health by caring for working donkeys. Thus, promoting the donkeys' work efficiency.

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References

- [1] Dai F, Dalla Costa E, Murray L, Canali E, Minero M. Welfare conditions of donkeys in Europe: initial outcomes from on-farm assessment. *Animals*. 2016;6:5.
- [2] Abebe R. Observation on major welfare problems of equine in Meskan district, Southern Ethiopia. *Livestock Res Rural Dev* 2010;22:22.
- [3] Burn CC, Dennison TL, Whay HR. Environmental and demographic risk factors for poor welfare in working horses, donkeys and mules in developing countries. *Vet J* 2010;186:385–92.
- [4] Svendsen ED, Duncan J, Sanctuary D, Hadrill D. *The professional handbook of the donkey*. Whittet Books; 2008.
- [5] Starkey P, Starkey M. Regional and world trends in donkey populations. *Donkeys People Dev* 2000:10–21.
- [6] Shrikhande GB, Rewatkar SG, Deshmukh S, Maske DK, Raghorte YM. The incidence of helminth parasites in donkeys. *Vet World* 2009;2:224.
- [7] Hailu Y, Ashenafi H. Epidemiological study on Gastrointestinal Helminths of horses in Arsi-Bale highlands of Oromiya Region, Ethiopia. *Ethiopian Vet J*. 2014;17:51.
- [8] Björkengren J. Assessment of donkeys' welfare in Addis Ababa and Ambo, Ethiopia; 2016.
- [9] Pritchard JC, Lindberg AC, Main DCJ, Whay HR. Assessment of the welfare of working horses, mules and donkeys, using health and behaviour parameters. *Prev Vet Med* 2005;69:265–83.
- [10] McLean A, Heleski C, TYokoyama M, Wang W, Doumbia A, Dembele B. Improving working donkey (*Equus asinus*) welfare and management in Mali, West Africa. *J Vet Behav Clin App Res* 2012;7:123–34.
- [11] Getachew A, Trawford A, Feseha G, Reid S. Gastrointestinal parasites of working donkeys of Ethiopia. *Trop Anim Health Prod* 2009;42:27–33.
- [12] Reix C, Burn C, Barr A, Whay H. The range and prevalence of pathological abnormalities associated with lameness in working horses from developing countries. *Equine Vet J* 2009;41:474–81.

- [13] Reix C, Burn C, Pritchard J, Barr A, Whay H. The range and prevalence of clinical signs and conformation associated with lameness in working draught donkeys in Pakistan. *Equine Vet J* 2014;46:771–7.
- [14] Kumar N, Fisseha KK, Shishay N, Hagos Y. Welfare assessment of working donkeys in Mekelle city, Ethiopia. *Global Vet* 2014;12:314–19.
- [15] van Dijk L, Pritchard J, Pradhan S, Wells K. *Sharing the Load: a guide to improving the welfare of working animals through collective action* 2011.
- [16] Ashley F, Waterman-Pearson A, Whay H. Behavioural assessment of pain in horses and donkeys: application to clinical practice and future studies. *Equine Vet J* 2005;37:565–75.
- [17] Pritchard J, Lindberg AC, Main DCJ, Whay HR. Assessment of the welfare of working horses, mules and donkeys, using health and behaviour parameters. *Prev Vet Med* 2005;69:265–83.
- [18] Tesfaye S, Deressa B, Teshome E. Study on the health and welfare of working donkeys in Mirab Abaya District, Southern Ethiopia. *Aca J An Dis* 2016;40–52.
- [19] Pritchard JC, Lindberg AC, Main DC, Whay HR. Assessment of the welfare of working horses, mules and donkeys, using health and behaviour parameters. *Prev Vet Med* 2005;69:265–83.
- [20] Hodges M. *Training mules and donkeys : a logical approach to longears*. Loveland, CO: Alpine Publications; 1993.
- [21] Burn CC, Pritchard JC, Farajat M, Twaissi AAM, Whay HR. Risk factors for strap-related lesions in working donkeys at the World Heritage Site of Petra in Jordan. *Vet J* 2008;178:263–71.
- [22] Martin Curran M, Feseha G, Smith D. The Impact of Access to Animal Health Services on Donkey Health and Livelihoods in Ethiopia. *Tropical animal health and production*. 2005;37 Suppl 1:47–65.
- [23] Mekuria S, Mulachew M, Abebe R. Management practices and welfare problems encountered on working equids in Hawassa town, Southern Ethiopia. *J Vet Med Animal Health*. 2013;5:243–50.
- [24] Biswas P, Dutt T, Patel M, Kamal R, Bharti P, Sahu S. Assessment of pack animal welfare in and around Bareilly city of India. *Vet World* 2013;6:332–6.
- [25] Burn C, Dennison T, Whay H. Environmental and demographic risk factors for poor welfare in working horses, donkeys and mules in developing countries. *Vet J* 2009;186:385–92 London, England : 1997.
- [26] Herago T, Kebeta M, Alemu A, Feyera T. Assessment on Working Donkey Welfare Issue in Wolaita Soddo Zuria District, Southern Ethiopia. *Glob Vet* 2015;14:867–75.
- [27] Scantlebury C, Pinchbeck G, Reed K, F G, Abreham A, Aklilu N, et al. Participatory assessment of the impact of epizootic lymphangitis in Ethiopia. p 184–186 2010.
- [28] Geiger M, Hovorka A. Using physical and emotional parameters to assess donkey welfare in Botswana. *Vet Record Open* 2015;2:e000062 -e.
- [29] Weaver S. *The donkey companion : selecting, training, breeding, enjoying & caring for donkeys*. North Adams, MA: Storey Pub; 2008.
- [30] Chemonges S, Siefert L, Opuda-Asibo J. Disease and health problems of donkeys: a case study from eastern Uganda. *DAN*; 1997.
- [31] Fshahay S, Kumar N, Kebede E, Abebe N. Health and welfare assessment of working donkeys in and around Rama town, Tigray, Ethiopia. *Ethiopian Vet J* 2018;22:26.
- [32] Wichert B, Frank T, Zinc Kienzle E. Copper and selenium intake and status of horses in Bavaria. *J Nutr* 2002;132:1776S–1777S.
- [33] Parker R, Yeates JW. Assessment of quality of life in equine patients. *Equine Vet J* 2011;44:244–9.
- [34] Popescu S, Diugan E-A. The relationship between behavioral and other welfare indicators of working horses. *J Equine Vet Sci* 2013;33:1–12.
- [35] Dalla Costa E, Murray L, Dai F, Canali E, Minero M. Equine on-farm welfare assessment: a review of animal-based indicators. *Anim Welfare* 2014;23.
- [36] Geiger M, Hovorka AJ. Using physical and emotional parameters to assess donkey welfare in Botswana. *Vet Record Open* 2015;2:e000062 -e.
- [37] Swann W. Improving the welfare of working equine animals in developing countries. *Appl Animal Behav Sci* 2006;100:148–51.