



On-farm welfare conditions of dairy donkeys: A case study in Northern Serbia

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ABSTRACT

The use of donkey milk in human nutrition and the cosmetic industry has led to increased interest in donkey breeding and, consequentially, the intensification of dairy donkey farms, particularly in Europe. Despite the expanding number of farms and greater milk production, there is still no consensus on the management and welfare conditions of donkeys. Therefore, this study aimed to assess and compare the welfare, health and housing conditions of dairy donkeys on five farms in Northern Serbia. The welfare of dairy donkeys on the five farms (A, B, C, D and E) was assessed using the Animal Welfare Indicator (AWIN) protocol for donkeys, represented by four principles (Good Feeding, Good Housing, Good Health and Appropriate Behaviour). Body condition scores were the highest on farms C and D. In addition, none of the examined dairy donkeys on farm D showed any signs of the examined health indicators (except for nasal discharge and hoof neglect) or inappropriate behaviour. Furthermore, the lowest percentage of nasal discharge and hoof neglect was recorded in dairy donkeys on farm D. In contrast, the highest frequency of alopecia, skin lesions, unhealthy hair coat, faecal soiling and hoof neglect was recorded in dairy donkeys on farm A. In conclusion, welfare conditions on farm A were rated as the most unacceptable, while the welfare conditions on farm D were rated as the most acceptable.

1. Introduction

Interest in donkey breeding has grown rapidly in recent years, mainly due to the use of donkey milk in human nutrition and the cosmetic industry (Raspa *et al.*, 2019; Čobanović *et al.*, 2023). The importance of donkey milk is reflected in its composition, as it is most similar to human breast milk, which qualifies it as an ideal food for infants who have no possibility of being breastfed. Additionally, the hypoallergenic feature of donkey milk provides a quality substitution for children prone to multiple allergies (e.g. allergy to cow milk, hydrolysed cow milk protein, soy, goat milk) (Dai *et al.*, 2018; Martini *et al.*, 2021). The growing

interest in donkey milk has led to the intensification of its production, as well as popularisation of dairy donkey farms (Valle *et al.*, 2017). In Europe, the production systems for donkey farms vary from semi-extensive to semi-intensive. When it comes to Serbia, all donkey farms belong to the extensive system type.

However, despite the increasing number of donkey farms and greater milk production, there is still no consensus regarding the management and welfare aspects of these farms (including dairy farms) (Dai *et al.*, 2018; Dalla Costa *et al.*, 2021). At the end of 2017, the guidelines *Dairy donkeys: good practice principles for sustainable donkey milk production* were compiled, containing suggestions for the proper management of

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dairy donkeys (Dai *et al.*, 2019). Despite that, these guidelines are still not widespread enough. The reason for the lack of consensus lies in the fact that very little information is available regarding the proper and adequate care and management of these animals (Dai *et al.*, 2017). Additionally, given the different production requirements under which donkeys are kept, including milk and meat production, as well as their involvement in labour and being treated as pets and therapy animals, there are different viewpoints and definitions of donkey welfare (McLean and Navas Gonzalez, 2018; Davis, 2019). At the level of the European Union, protocols for the evaluation of the welfare of equids (including donkeys) have been developed and proposed in the last few years. The Animal Welfare Indicator (AWIN) assessments protocol for donkeys is based on four Welfare Quality principles and their welfare criteria (AWIN, 2015).

In Serbia, the most abundant breed of donkey is the Balkan donkey, which is an autochthonous breed, highly important for the preservation of Serbia's genetic resources. Balkan donkeys are typically medium-sized, with males averaging around 100 cm at the withers and females around 95 cm. Males can weigh up to 250 kg and females up to 200 kg. Their coat colour varies from grey, dark-grey, brown, to chestnut, with most individuals having a darker stripe along the back and a distinct cross pattern on the withers (Trailović *et al.*, 2011; Stanišić *et al.*, 2017). Known for their resilience, they can thrive in harsh environments with minimal care, enduring poor-quality forage, rough terrain and variable weather (Trailović *et al.*, 2011). However, this adaptability can make it difficult to assess their health, as they can often hide signs of distress even in severe conditions (Deng *et al.*, 2021).

Due to the fact that a central database of donkeys in Serbia is still lacking, monitoring the health and welfare of these dairy animals is especially difficult. Therefore, the aim of this study was to determine and compare the welfare, health status and housing conditions of dairy donkeys on five farms in Northern Serbia.

2. Materials and Methods

Ethical approval: No ethical approval was obtained because this study did not involve laboratory animals and only involved non-invasive procedures.

This study included a total of 329 dairy donkeys that originated from five different farms in Northern Serbia, visited in March and April 2022. Of the five included farms, one (Farm A) was located in Srem region (n=103), three farms (Farm B,

Farm C and Farm D) were located in Bačka region (n=19; n=17; n=30, respectively), and one farm (Farm E) was located in Mačva region (n=160). As a sample for welfare assessment, a minimum of 25% of the total number of donkeys (only lactating individuals) from each farm was evaluated.

The assessment of donkeys was performed according to the AWIN welfare assessment protocol for donkeys (AWIN, 2015). The welfare indicators included four principles – Good Feeding, Good Housing, Good Health and Appropriate Behaviour – and twelve criteria, described by the *Welfare Quality®* (2009). The Good Feeding principle was assessed by evaluating the Body Condition Score (BCS), estimation of dehydration by skin tent test and by evaluating water availability. BCS is a standardised method used to monitor the health and productivity of donkeys by assessing their body fat, and it was the only indicator within the Appropriate Nutrition welfare criteria (AWIN, 2015). Evaluation of BCS included visual assessment and palpation, and based on the AWIN protocol, was determined using a 5-point scale (score 1 – poor, score 2 – moderate, score 3 – ideal, score 4 – fat, score 5 – obese) (Burden, 2012). Assessment of water availability included evaluation of the presence and type of water points, and their functionality and cleanliness. The Good Housing principle was assessed by recording the presence of bedding and its quality, shelter dimensions, and by evaluating the animals for signs of thermal stress. The Good Health principle was assessed by evaluating the condition of hair coat, and by recording the evidence of integument alterations, swollen joints, lameness, prolapses, faecal soiling, discharges (ocular, nasal, genital), abnormal breathing, cheek abnormalities, hoof neglect and hot branding. In individuals with detected discharge, its character was assessed (consistency, transparency, colour and presence of blood). The Appropriate Behaviour principle was assessed by recording the social interaction of donkeys, evidence of stereotypies and by testing the human-animal relationship, which included the Avoidance Distance (AD) test, Walk Down the Side test and Tail Tuck test.

Statistical analysis of the results was conducted using the software GraphPad Prism version 9.5.1 for Windows (GraphPad Software, San Diego California USA, www.graphpad.com). Differences between farms in most examined welfare indicators (except for BSC) were evaluated using the Chi-squared test. Significant differences for BSC between farms were assessed using the one-way analysis of variance

(ANOVA) and post hoc pairwise comparisons using Tukey’s test (mean value and standard deviation). In all cases, significance was fixed at the level of $p\leq0.05$.

3. Results

Good Feeding and Good Housing principles

The results for Good Feeding and Good Housing principles recorded on five dairy donkey farms in Northern Serbia are displayed in Table 1. The BCSs recorded on farms C and D ($p<0.0001$) were higher than those of the other farms. None of the examined donkeys on the five farms showed signs of dehydration (they were all negative on the skin tent test) or thermal stress.

On all visited farms, the water points were troughs. Troughs were dirty on farms A, C and E, partly dirty on farm B, while on farm D, the troughs were

clean. No bedding was recorded on any of the assessed farms, while the surroundings where the donkeys were kept were dirty on farms A, C and E, partly dirty on farm B, and clean on farm D. All of the assessed farms provided shelter for their dairy donkeys. The shelter area provided per donkey by the assessed farms were 2.43 m², 2.11 m², 11.76 m², 16.67 m² and 7.50 m² (farms A, B, C, D and E, respectively).

Good Health principles

The results for Good Health principles recorded on five dairy donkey farms in Northern Serbia are presented in Table 2. Integument alterations were recorded in donkeys from all of the examined farms, except farm D. The highest frequencies of integument alterations were recorded in donkeys from farm A, where alopecia (90.00%) ($p<0.0001$) and skin lesions (30.00%) ($p=0.0009$) were the most

Table 1. The results for Good Feeding and Good Housing principles recorded on five farms in Northern Serbia

	Farm A	Farm B	Farm C	Farm D	Farm E	Chi-square	df	p-value
Number of animals (per farm)	103	19	17	30	160			
Sample size (per farm)	40	15	15	20	40			
Good feeding								
Body condition score	2.25 ± 0.25 ^a	2.50 ± 0.42 ^a	2.83 ± 0.24 ^b	3.00 ± 0.00 ^b	2.44 ± 0.40 ^a	-	-	<0.0001
Dehydrated animals (%)	0.00	0.00	0.00	0.00	0.00	-	-	-
Type of water point	Trough	Trough	Trough	Trough	Trough	-	-	-
Water point cleanliness	Dirty	Partially clean	Dirty	Clean	Dirty	-	-	-
Good housing								
Signs of thermal stress (%)	0.00	0.00	0.00	0.00	0.00	-	-	-
Shelter	Yes	Yes	Yes	Yes	Yes	-	-	-
Shelter area (m ² /donkey)	2.43	2.11	11.76	16.67	7.50			
Bedding	No	No	No	No	No	-	-	-
Surrounding cleanliness	Dirty	Relatively dirty	Dirty	Clean	Dirty	-	-	-

Note: Significant differences (except for BSC) between farms were evaluated using the Chi-squared test. Significant differences for BSC between farms were evaluated using the ANOVA test and post hoc pairwise comparisons using Tukey’s test. Different letters in the same row indicate a significant difference at $p\leq0.05$ ^(a-b).

Table 2. The results for Good Health principles recorded on five farms in Northern Serbia

	Farm A	Farm B	Farm C	Farm D	Farm E	Chi-square	df	p-value
Number of animals (per farm)	103	19	17	30	160			
Sample size (per farm)	40	15	15	20	40			
<i>Good health</i>								
Alopecia (%)	90.00 ^a	0.00 ^b	40.00 ^c	0.00 ^b	30.00 ^c	65.76	4	<0.0001
Skin lesions (%)	30.00 ^a	0.00 ^b	0.00 ^b	0.00 ^b	10.00 ^b	18.82	4	0.0009
Swelling of hoof and coronet area (%)	0.00 ^a	20.00 ^b	0.00 ^a	0.00 ^a	0.00 ^a	23.54	4	<0.0001
Swollen joints (%)	0.00 ^a	20.00 ^b	20.00 ^b	0.00 ^a	0.00 ^a	20.97	4	0.0003
Unhealthy hair coat (%)	100.00 ^a	0.00 ^b	0.00 ^b	0.00 ^b	0.00 ^b	130.0	4	<0.0001
Lameness (%)	0.00	0.00	0.00	0.00	0.00	-	-	-
Prolapse (%)	0.00	0.00	0.00	0.00	0.00	-	-	-
Faecal soiling (%)	90.00 ^a	20.00 ^b	20.00 ^b	0.00 ^c	0.00 ^c	91.59	4	<0.0001
Ocular discharge (%)	50.00 ^a	20.00 ^b	20.00 ^b	0.00 ^c	90.00 ^d	56.24	4	<0.0001
Nasal discharge (%)	50.00 ^a	0.00 ^b	20.00 ^c	10.00 ^{bc}	50.00 ^a	23.08	4	0.0001
Genital discharge (%)	0.00	0.00	0.00	0.00	0.00	-	-	-
Cheek abnormalities (%)	0.00	0.00	0.00	0.00	0.00	-	-	-
Abnormal breathing (%)	0.00	0.00	0.00	0.00	0.00	-	-	-
Hoof neglect (%)	90.00 ^a	40.00 ^b	60.00 ^b	10.00 ^c	20.00 ^c	53.71	4	<0.0001
Hot branding (%)	0.00	0.00	0.00	0.00	0.00	-	-	-

Note: Significant differences between farms were evaluated using the Chi-squared test. Different letters in the same row indicate a significant difference at $p \leq 0.05$ (a–d).

common findings. The highest frequency of swelling of the hoof and coronet area was recorded on farm B (20.00%, $p < 0.0001$). Swollen joints were observed in donkeys on farms B and C, with a frequency of 20.00% ($p = 0.0003$). Hair coat was healthy in most of the assessed donkeys, with the exception of farm A donkeys, where all examined individuals (100.00%) had poor quality hair coat ($p < 0.0001$). None of the examined donkeys from the five farms showed signs of lameness, prolapse, genital discharge, dyspnoea, cheek abnormalities or hot branding.

The highest percentage of faecal soiling ($p < 0.0001$) was detected in donkeys from farm A, followed by farms B and C, while it was absent in donkeys from farms D and E. Ocular and/or nasal discharges were observed in donkeys from all assessed farms, with the highest frequency on farm E, where 90.00% of individuals had ocular discharge ($p < 0.0001$) and 50.00% had nasal discharge ($p = 0.0001$). In all cases, the discharge was watery,

transparent, colourless and blood-free. On each visited farm, most of the assessed donkeys showed some signs of hoof neglect, with the highest frequency (90.00%) on farm A ($p < 0.0001$).

Appropriate Behaviour principles

The results for Appropriate Behaviour principles recorded on the five dairy donkey farms in Northern Serbia are presented in Table 3. All of the assessed donkeys (100.00%) from five farms had social contact with other conspecifics. The human-animal relationship tests showed that most (93.08%) of the donkeys had a positive relationship with humans. The only exception was noted among donkeys on farm C, with 40.00% of animals showing avoidance behaviour ($p < 0.0001$) and 20.00% having a negative reaction to the walk down the side test ($p < 0.0001$). None of the examined donkeys on the five farms showed signs of fear (negative tail tuck test) and stereotypies.

Table 3. The results for Appropriate Behaviour principles recorded on five farms in Northern Serbia

	Farm A	Farm B	Farm C	Farm D	Farm E	Chi-square	Df	p-value
Number of animals (per farm)	103	19	17	30	160			
Sample size (per farm)	40	15	15	20	40			
Social contact (%)	100.00	100.00	100.00	100.00	100.00	-	-	-
Stereotypies (%)	0.00	0.00	0.00	0.00	0.00	-	-	-
Avoidance behaviour (%)	0.00 ^a	0.00 ^a	40.00 ^b	0.00 ^a	0.00 ^a	48.23	4	<0.0001
Negative walking down the side (%)	0.00 ^a	0.00 ^a	20.00 ^b	0.00 ^a	0.00 ^a	23.54	4	<0.0001
Tail tuck (%)	0.00	0.00	0.00	0.00	0.00	-	-	-

Note: Significant differences between farms were evaluated using the Chi-squared test. Different letters in the same row indicate a significant difference at $p \leq 0.05$ ^(a-b).

4. Discussion

This study assessed the welfare conditions of dairy donkey farms in Northern Serbia, and using the AWIN Welfare Protocol, the observed animals were evaluated according to several welfare criteria.

Determination of BCS answers whether the donkey’s energy requirements have been fulfilled. BCS can vary depending on the several factors, like season, food availability, physical activity, reproductive condition, dental problems, parasitic infections, diseases etc. (AWIN, 2015). In the present study, most of the dairy donkeys had a BCS between 2.0 and 3.0, except on farm A, where the BCSs were between 2.0 and 2.5. The obtained results indicate that dairy donkeys on these farms are more likely to be slightly thin rather than obese, which is consistent with the results reported by Dai et al. (2018). This can also be attributed to the fact that donkeys, during the first few months of lactation, can lose body weight, despite being on a balanced diet (Cruz et al., 2021). For this reason, BCS is an important parameter in dairy donkeys, and it is recommended a BCS between 3.5 and 4.0 is reached before foaling (Raspa et al., 2019).

Based on the AWIN protocol (2015), the shelter area per donkey was satisfactory on farms C, D and E, and higher than the recommended 7 m² per animal (height at the withers between 120 and 148 cm). In contrast, the space allowance per donkey in the shelter area was unsatisfactory on farms A and B, indicating inappropriate housing conditions on these farms (AWIN, 2015). All of the visited farms were equipped with troughs as water points. The trough and water were clean only on farm E, while on the other farms, the troughs were either dirty or partly dirty. Dirty water

is one of the reasons donkeys may refuse to drink, and if insufficient water is intaken, gastrointestinal problems, such as constipation and colic, can result (Smith and Burden, 2013; Raspa et al., 2019). The donkey’s natural adaptations to survive in poor environmental conditions are possibly the reasons why the provision of water is often neglected in the literature (Pearson, 2005; Deng et al., 2021). Although donkeys have lower water needs than other domesticated animals, lactating donkeys need twice as much water compared to non-producing donkeys (Raspa et al., 2019; Fari-as et al., 2021). Despite the fact that the results of this investigation showed non-ideal conditions of some water points, the dairy donkeys on the observed farms did not show signs of dehydration (skin tent tests were negative). Considering this, it can be assumed that these dairy donkeys did not refuse to drink water even when it was supplied from dirty troughs. Nonetheless, adequate water intake is an important welfare parameter, and owners should be educated about donkeys’ water needs (Dai et al., 2016).

Integument alterations were one of the most common welfare problems found in this study, while various factors can lead to these pathologies: equipment used on animals, the type and intensity of the work performed by animals, trauma/injuries, diseases etc. (Cruz et al., 2021). The changes noted in this study included hairless patches (alopecia), scabs, skin lesions, wounds and swellings. Alopecia was the most frequently observed integument alteration, with the highest occurrence on farm A. The possible reasons for this condition could be ectoparasites, fungal diseases or other conditions that cause pruritus (Dai et al., 2016). Among other

integument changes, skin lesions were observed in donkeys from farms A and E, while swelling in the hoof area was seen in individuals from farm B. The fact that the farms did not have bedding for the animals could have contributed to the observed skin lesions, given that there is literature data on the connection between the lack of bedding and the occurrence of skin lesions (Dalla Costa *et al.*, 2014; Dai *et al.*, 2018). Also, the mutual contact of animals is an additional risk factor for the occurrence of skin lesions (Dalla Costa *et al.*, 2014).

Joint swelling was observed in dairy donkeys from farms B and C, in about 20% of the animals. This swelling occurs due to an increase of fluid in the tissue surrounding the joint (AWIN, 2015). As an extremely painful condition for the individual, joint swelling can potentially indicate the presence of arthritis, injury, infection or broken bones (AWIN, 2015).

Hair coat was evaluated as healthy in all assessed donkeys, except on farm A, where 100% of individuals had unhealthy hair coat. Hair coat condition indicates the hair coat health, as well as the health status of the animal in general, considering that the coat loses its quality if the individual is sick or has poor nutrition (AWIN, 2015; Cruz *et al.*, 2021).

The presence of faecal residues on hind limbs was observed in dairy donkeys from farms A, B and C, with the highest frequency on farm A (90.00%). When faecal soiling is detected, it is an indicator of diarrhoea, which mostly suggests a clinical condition (Dalla Costa *et al.*, 2014).

Ocular and nasal discharges were found in the donkeys on all evaluated farms, with different frequencies. Depending on its characteristics, discharge from the nostrils and/or eyes can be a symptom of a specific localised or generalised disease. Based on the character of discharge, and the fact that the assessment of well-being on these farms was carried out in the period of transition from winter to spring and there were still notable temperature variations during the day, it can be assumed that the discharge is not indicative of a specific disease, but a consequence of the individuals being in the cold. Nonetheless, when nasal and/or ocular discharge is observed, it is advised that a more detailed physical examination is carried out (Cruz *et al.*, 2021; Mshelia *et al.*, 2023).

Within the framework of this research, some degree of hoof neglect was seen in most dairy donkeys on the visited farms, with the highest frequency on farm A. The condition of the hooves is one of

the leading welfare problems of this animal species (Dai *et al.*, 2018). Adequate hoof care implies regular and proper hoof trimming, as well as a number of other factors that consequently affect the hoof condition, such as a balanced diet and adequate pens on the farm (floors, fences, gates and corridors) (Raspa *et al.*, 2019). The problem of neglected hooves is, consequently, related to many other conditions and problems interfering with health and well-being of donkeys (Dai *et al.*, 2018; Thiemann and Poore, 2019). The pain and stress that donkeys experience due to overgrown or improperly trimmed hooves lead to more frequent and longer periods of lying down, lack of movement and reduced food intake. This may be the reason why the dairy donkeys from farm A, where the highest frequency of hoof neglect was observed (90.00%), had the lowest BCSs, compared to individuals from other farms. On the other hand, improper care of a donkey's hooves can cause extremely painful conditions for the animal, including lameness, laminitis and chronic hoof disease (Dai *et al.*, 2016; Dai *et al.*, 2018; Raspa *et al.*, 2019). It is important to note that the education of owners and keepers on adequate hoof care procedures of dairy donkeys is immensely important for the prevention of these conditions.

Based on the behavioural observations in this study, all of the assessed dairy donkeys had positive human-animal relationships, except those on farm C, where avoidance behaviour (40.00%) and negative reaction to the walking down the side test (i.e., negative reaction to the observer's movement) (20.00%) were noted. Human-animal relationship tests can show the quality of the relationship between the animals and humans. The welfare of donkeys is directly influenced by the way they perceive and engage with humans (AWIN, 2015). The presence of avoidance behaviour and negative reaction to the observer's movement could indicate mistreatment by the animal's owner (or carer) and, therefore, a state of poor welfare. However, whether the tests were conducted by a person unfamiliar to the animal, to whom the donkeys were not adapted, should be taken into account (Mshelia *et al.*, 2023). This may explain the negative results obtained in this research, and not necessarily indicate mistreatment by the animals' owner. Nonetheless, the assessment of human-donkey relationship as an indicator of welfare is highly significant, and it is essential to highlight the importance of educating owners regarding the proper treatment of their donkeys (Cruz *et al.*, 2021).

5. Conclusion

The results of this study showed different housing and welfare conditions between five dairy donkey farms in Northern Serbia. The greatest differences were observed in terms of integument alterations and hoof condition. The significance of these parameters lies in their connection with potential health disorders and pain, which can seriously compromise on-farm

donkey welfare. The poorest welfare conditions were observed on farm A, shown by the highest frequency of alopecia, skin lesions, unhealthy hair coat, faecal soiling and hoof neglect. On the other hand, the most acceptable welfare conditions were observed on farm D, whereby none of the examined dairy donkeys showed any signs of poor health (except the lowest frequencies of nasal discharge and hoof neglect among the five farms) or inappropriate behaviour.

Uslovi dobrobiti muznih magarica na farmi: prikaz slučaja u severnoj Srbiji

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INFORMACIJE O RADU

Ključne reči:

Muzne magarice
Zdravlje
Mleko
Dobrobit
Balkanski magarac

APSTRAKT

Upotreba mleka magarica u ishrani ljudi i kozmetičkoj industriji je dovela do povećanog interesovanja za uzgoj magaraca i posledično, do intenziviranja farmi muznih magarica, posebno u Evropi. Uprkos povećanju broja farmi i proizvodnje mleka, još uvek ne postoji konsenzus u pogledu menadžmenta i uslova dobrobiti magaraca. Cilj ovog rada je procena i poređenje dobrobiti, zdravlja i uslova smeštaja muznih magarica na pet farmi u severnoj Srbiji. Dobrobit muznih magarica sa pet farmi (A, B, C, D i E) procenjena je upotrebom AWIN protokola za magarce, predstavljenog kroz četiri principa (dobra ishrana, dobar smeštaj, dobro zdravlje i adekvatno ponašanje). Ocena telesne kondicije je bila najviša na farmama C i D. Pored toga, nijedna od ispitanih muznih magarica sa farme D nije pokazala znake loše dobrobiti u okviru ispitanih zdravstvenih parametara (osim nosnog iscetka i zanemarenih kopita), kao ni znake neadekvatnog ponašanja. Takođe, najmanji procenat nosnog iscetka i zanemarenih kopita je zabeležen kod muznih magarica sa farme D. Nasuprot tome, najveća učestalost alopecije, lezija kože, nezdravog dlačnog pokrivača, zaprljanosti fecesom i zanemarenih kopita zabeležena je kod muznih magarica na farmi A. U zaključku, uslovi dobrobiti na farmi A ocenjeni su kao najneprihvatljiviji, dok su uslovi dobrobiti na farmi D ocenjeni kao najprihvatljiviji.

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