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Pasture Access Effects on the Welfare of Dairy Cows Housed in Free-Stall Barns

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Abstract: Despite considerable research regarding the benefits of natural living conditions on several aspects of the health and well-being of dairy cows, the effects of pasture access on their overall welfare are less studied. In this comparative study, the Welfare Quality® protocol was applied in 22 zero-grazing and 17 grazing access farms with an ulterior statistical exploration of the differences found. Moreover, correlations were calculated between pasture access and animal-based welfare measures. Aside from the multiple benefits of pasturing identified within the welfare measures, criteria, and principles, in the overall classification, the farms with permanent confinement ranked lower than the grazing farms. Although both systems used free-stall barns, allowing the cows' movement, the grazing animals showed improved overall welfare. Yet, the origin-related adaptation of the animals could play a role. The authors recommend research-based tailoring whenever these conditions are intended to be transposed in technology, especially in intensive systems.

Keywords: grazing; animal welfare; zero-grazing; welfare quality protocol

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1. Introduction

In terms of animal-based health parameters, cows with access to pasture proved to fare better than those housed continuously indoors [1]. Previous studies have shown less lameness in systems with grazing [2,3], a reduced number of integument lesions [4], and a decreased incidence of mastitis [5] compared to indoor housing. Additionally, mortality was found to be lower in herds with pasture access than in those without [6,7]. Other studies focused on different benefits of pasture access beyond strictly health advantages. Pasture-based systems offer increased freedom for cows to express their full behavioral repertoire [1,8]. When on pasture, they display better herd synchronization [9], spend more time lying [10], and show less agonistic behaviors [11] compared to confined animals. Concluding their study, Crump et al. [12] state that giving dairy cattle pasture access appears to induce more positive emotional states than cubicle housing.

From an economic perspective, including current market tendencies combining the preference for natural products with the ethical considerations of the consumers, the farmers could be encouraged to allow their dairy herds to graze. According to Stampa et al. [13], many consumers are willing to pay a higher price for milk from cows kept on pasture than from cows kept indoors. Yet, some farmers have concerns regarding the challenges the cows may be exposed to while grazing. The risk of encountering internal and external

parasites or contagious diseases from other animals and the vulnerability of facing suddenly changing and possibly extreme weather conditions (such as high temperature) are some possible caveats listed by several authors [1,8]. Especially in the changing environmental conditions increasingly experienced lately, the heat stress during summer months has the potential to impair the welfare of the cows both on the pastures and inside the barns [1]. Thus, grazing per se does not guarantee animal welfare; however, it must be remembered that no management system does. To obtain a standard model of such a type of cattle housing that can serve as a guide for both policymakers and consumers willing to pay a higher price for welfare-friendly products, it is necessary to assess the overall welfare of the cows on pasture.

Continuous indoor housing systems cannot be considered adequate from the animals' point of view. In the past years, the "zero-grazing" system has spread considerably in Romania because of the concerns of the farmers for their animals and often due to workers' convenience or the lack of pasture lands [14]. Especially in large farms with high numbers of cows, leading and handling the herd becomes problematic and requires hiring additional personnel, at least for the warm season. A similar tendency can be observed in most European countries [15]. For the past few years, the proportion of farms offering access to pasture has been declining, as an increasing number of these have been converted to all-year-housing systems [16]. The percentage of farms with access to pasture varies widely between countries and regions [17]. The studies performed until now focused primarily on the impact of grazing on dairy cows' health and behavior and much less on their overall welfare quality [18].

Taking into consideration all the mentioned aspects, this study aimed to compare the overall welfare status of dairy cows with access to pasture to that of animals housed continuously in farms from Transylvania, Romania. In addition, the study investigated the relationship between pasture access and animal-based welfare measures of dairy cows kept in free-stall barns.

2. Materials and Methods

2.1. The Farms

The study was performed during the grazing season (April–October) at 39 dairy farms (17 with access to grazing (GF) and 22 with no access, i.e., zero-grazing (ZGF)) from Transylvania, Romania. The farm selection criteria comprised the following: a free-stall housing system, a minimum of 30 milked dairy cows, and the farmers' agreement to take part in the study. The number of animals per farm varied from 32 to 170, with an average of 81 cows (±32.42 standard deviation). The mean number of milked cows in the ZGFs was 93.41 (±33.76 standard deviation, between 43 and 170 animals). The GFs had slightly fewer, between 32 and 105 cows, with a mean number of 65.59 (±23.16 standard deviation). All the GFs (17 farms) and half of the ZGFs (11 farms) reared Romanian spotted cattle; the rest of the ZGFs (11 farms) had Holstein cows. The daily milk production per cow in the two farming systems was similar: a mean quantity of 19.88 ± 5.13 L (between 12 and 30 L) in the GFs and 20.82 ± 7.11 L (between 10 and 33 L) in the ZGFs. The cattle barns were closed or half-opened, providing cubicles for the cows' rest. None of the farms had outside paddocks or dry lots. In the ZGFs the cows left the housing area only for milking and in the GFs the pasture represented the only outside access. At the assessment moment, the barns were found to either have sawdust (in the majority of the farms) or no bedding (i.e., bare concrete flooring). All farms performed the milking in parlors, twice a day. In the GFs, the cows were pasturing, on average, around eight hours a day, the pasture access of the cows depending on the length of the daylight during the study period.

2.2. Welfare Assessment

Because none of the standardized protocols have specifically assessed the grazing dairy cows' overall welfare to date, the Welfare Quality® protocol [19] was used, which includes four major welfare principles, 11 criteria, and 29 measures (Table 1).

Table 1. The principles, criteria, and parameters of the Welfare Quality® assessment protocol for dairy cows [19].

Welfare Principles	Welfare Criteria	Assessed Parameters
1. Good feeding	1. Absence of prolonged hunger	Body condition score
	2. Absence of prolonged thirst	Water provision; cleanliness of water points; water flow; functioning of water points
2. Good housing	3. Comfort around resting	Time needed to lay down; animals colliding with housing equipment during lying down; animals lying partly or completely outside the ling area; cleanliness of udders, flank/upper legs, lower legs
	4. Thermal comfort	As yet, no measure has been developed
	5. Ease of movement	Presence of tethering; access to outdoor loafing area or pasture
3. Good health	6. Absence of injuries	Lameness; integument alterations
	7. Absence of disease	Coughing; nasal discharge; ocular discharge; hampered respiration; diarrhea; vulvae discharge; milk somatic cell count; mortality; dystocia; downer cows
	8. Absence of induced pain	Disbudding/dehorning; tail docking
4. Appropriate behavior	9. Expression of social behaviors	Agonistic behaviors—assessed by observation of head butts; displacements; chasing; fighting; chasing-up
	10. Expression of other behaviors	Access to pasture
	11. Human-animal relationship	Avoidance distance
	12. Positive emotional state	Qualitative behavior assessment—by observation of the cows' "body language" regarding 20 behavioral terms (active, relaxed, fearful, agitated, calm, content, indifferent, frustrated, friendly, bored, playful, positively occupied, lively, inquisitive, irritable, uneasy, sociable, apathetic, happy, distressed)

The data collection was performed according to the protocol's instructions [19]. The majority of parameters were recorded directly, at animal and herd level. A few measures regarding farm resources and management were scored based on the farmers' declarations. In each farm, two trained assessors evaluated the cows. The overall sample comprised 1662 cows (740 housed in GFs and 922 in ZGFs). The number of animals assessed per farm was established in conformity with the instructions of the Welfare Quality® assessment protocol (between 30 and 62 per farm, depending on the total number of cows on each farm). After having their necessary numbers, the animals were randomly chosen at the morning milking (every nth cow in the milking parlor) and marked. Part of the measurement was immediately recorded (body condition score, integument alterations, nasal, ocular, and vulvar discharge, diarrhea, and lameness while the cows were exiting the parlor), and then the same animals were followed in order to obtain other parameter scores, where random sampling was required by the protocol. Also, the farm resources were examined, and the farmer was interviewed.

After the collection of this first data set, the rest of the cow-related parameters were recorded inside the barns in the ZGFs and at the pasture in the GFs. Also, the water supplies were verified on the pasture, if there were any. The avoidance distance assessment for the grazing cows started 30 min after the arrival of the cows on the pasturing parcel, in actively grazing animals. Even in the absence of a feed bunk and feeding rack/neck rail, the evaluation respected the instructions of the assessment protocol to record the measure. Detailed information about the scoring methodology can be found in the Welfare Quality® Assessment Protocol for Cattle [19].

For the calculation of the criteria and principle scores, and the final classification of the farms (as not classified, acceptable, enhanced, and excellent), the Welfare Quality® scoring system's software (2023) was used [20].

All the procedures involving animals were carried out under the ethical guidelines of the Romanian National Animal Protection Law [21]. Being a purely observational and fully non-invasive study, no approval from the National Ethics Committee was needed.

2.3. Statistical Analysis

All statistical analyses were performed using the SPSS for Windows version 17 software (SPSS version 17, SPSS Inc., Chicago, IL, USA). Descriptive statistical indicators were calculated (median, range) for the scores of the measures, criteria, and welfare principles. The statistical significance of the grazing effect on welfare (measures, criteria, and principles of welfare) in the studied farms was determined by the Mann–Whitney test because the data did not have a normal distribution. To study the relationship between pasture access and animal-based welfare indicators, the Spearman rank correlation was used. The p values of less than 0.05 were considered statistically significant for both comparisons and correlations.

3. Results and Discussion

3.1. The Assessment of the Welfare Measures

Table 2 shows the results obtained by assessing the indicators of "Good feeding" and "Good housing" principles in the GFs and ZGFs. The percentage of very thin cows did not vary significantly between the two management systems, although it was slightly higher in the ZGFs.

Table 2. Scores (median, range) of the animal-based measures related to the principle of good feeding and housing in the GFs (n = 17) versus the ZGFs (n = 22), and the significance of the difference between the two management systems.

Criteria and Measures	GF		ZGF		p Value
	Median	Range	Median	Range	
Very lean cows (%)	11.32	27.17	17.07	30.97	0.230
Duration of lying down movements (s)	4.32	0.75	5.31	1.13	<0.001
Lying down movements with collisions (%)	0.00	0.00	0.00	3.39	0.644
Cows which lie partly outside the lying area (%)	0.00	0.00	0.00	4.35	0.154
Cows with dirty udder (%)	14.89	6.86	19.51	23.46	0.001
Cows with dirty flank and upper legs (%)	16.22	9.18	24.39	21.32	<0.001

GF: farms with grazing access for the cows; ZGF: zero-grazing farms. If the p value is less than 0.05, the difference between the GFs and ZGFs is significant.

In the opinion of several authors [9,22,23], compared to cattle kept exclusively indoors, grazing dairy cows are more prone to the risk of inadequate nutrient intake, possibly leading to lower body condition scores. Thus, in practical farming, this translates to an increased importance of good pasture management, regarding the control of both the floristic composition (and the nutritive value of grasses) and the judicious use of pasturing techniques to avoid overgrazing. Grazing is often seen by farmers as an economical way to spare feed (and thus money), but, especially in cows with high milk production, it must cover their metabolic needs in order to keep them from losing their body condition. Controlling feed intake in grazing cows is indeed more difficult than in cows kept indoors on a mixed unique ration, for example, as in the latter scenario both the composition and the distribution of food allow close monitoring. In severe cases, as mentioned by Brügemann et al. [24], the variable nutrient content of pastures (which depend on several factors, such as meteorological conditions, plant types and their vegetation stage, soil characteristics, and management measures, among others) poses even higher malnutrition risk in cows which have not been selected for pasture-based systems. In our study, most of the assessed

cows were of the well-adapted local breed, Romanian spotted cattle, which could explain the lower percentage of very lean cows in the grazing management compared to the ZGFs. The low body score of the cows in ZGFs evaluated in this study may favor the occurrence of lesions and may be interrelated with lameness; such associations were also demonstrated by Randall et al. [25] and Oehm et al. [26].

The median values for the number and total length of the water troughs were significantly lower ($p < 0.05$) in the GFs (the median for the water troughs' number was 2, and for their length it was 280, respectively) compared to the ZGFs (the median for the troughs' number was 5, and for their length it was 700). For the cleanliness of water points and for the water flow sufficiency the difference was not significant ($p > 0.05$) between the two systems. The majority of the GFs did not have water sources at the pasture; thus, the cows could drink only at the barns (from the moment of evening arrival at the barn until the next morning's departure again to the pasture). A similar setup was reported in the paper of de Andrade Kogima et al. [18]. The main barrier for the farmers to install on-pasture waterers was cost-related, as many times the pasturing areas were at considerable distances and a water pipe system would have had considerable costs. In specific situations, the pastures were not owned by the farmers but rented in yearly terms, adding insecurity to any investment in those lands. Although Wagner et al. [27] note as another possible reason the higher effort needed to check the water cleanliness in the pasture than in the barn (leading to insufficient or soiled water points), in our study this was not mentioned by the farmers.

The lying down movements took longer for cows in the ZGFs than for those in the GFs (Table 2). These results are congruent with the findings of Gieseke et al. [28] in Germany and those of de Andrade Kogima et al. [18] in Brazil. Previous investigations also showed improved lying behavior in cows that have access to pasture [10,29,30] compared to those without it, and our study added one more piece of evidence to these.

The percentage of collisions with elements of the environment was assessed in the barn in all the studied cows and the difference was not significant between the two management systems. In the ZGFs the occurrence of these collisions was considerably lower than that observed in other studies [18,31,32]. A possible reason for our lower values could have been the generous space allowance of resting places in the studied farms. The same reason could explain the low percentage (under 5%) of the cows lying partly or completely outside the resting area in the investigated ZGFs. According to the protocol [19], this does not represent a serious welfare problem.

The ZGFs had a higher percentage of cows with dirty legs and flanks compared to the farms that allowed their animals to have outside access. As mentioned (in the Materials and Methods section), some of the farms did not have any bedding. Unfortunately, even in the barns where sawdust was used, in the ZGFs, the bedding was dirtier than in the GFs, soiling the cows' bodies when they were lying down. As a considerable body of literature signals [14,33,34], the poor body hygiene of cows is mainly caused by deficient cleaning of the barn floors and insufficient changing of the bedding. According to these studies, barn hygiene does not represent a priority for the farmers. Even if the consequences may not be straightforwardly evident, several studies [33,35] note that poor hygiene increases the risk of mastitis and worsens lameness in dairy cows. Unsurprisingly in this context, the Welfare Quality® protocol establishes a warning threshold in this regard with a cutoff of 50% dirty lower hind legs and 19% dirty udders. Exceeding these percentages indicates a serious problem in any dairy herd, regardless of their housing and/or management system. In our study, the cows were cleaner in the GFs than in the ZGFs, in line with the results reported by other researchers [18,27]. Arnott et al. [1] also conclude that the cows are generally cleaner outdoors, except from exposure to adverse meteorological conditions (rainy weather, causing mud in the outside environment).

As Table 3 shows, the medians for most of the animal-based measures indicated significantly better ($p < 0.05$) health of the cows in the GFs than in the ZGFs. The positive effects of pasture access on the overall health status of dairy cows are multiple and the

greater opportunity to exercise plays an important role in this regard. The studies prove that cattle walk more while on the pasture than inside the barn, but also warn that long trips between the barns and grazing area may induce tiredness [8,36]. The most vulnerable category in this scenario is that of the lame cows in which movement may need to be restricted. Thus, the watchperson has an important role and should be experienced enough to decide which cows can walk the distance needed without detrimental effects on their health and welfare.

Table 3. Scores (median, range) of the animal-based measures related to the principle of good health in the GFs (n = 17) versus the ZGFs (n = 22), and the significance of the difference between the two management systems.

Criteria and Measures	GF		ZGF		p Value
	Median	Range	Median	Range	
Lame cows (%)	6.38	12.89	29.78	12.54	<0.001
Cows with at least one hairless patch (%)	6.34	9.06	14.63	29.34	<0.001
Cows with at least one lesion (%)	4.25	10.63	20.97	28.04	<0.001
Cows with ocular discharge (%)	0.00	0.00	0.00	3.22	0.20
Diarrhea (%)	0.00	23.07	0.00	4.83	0.067
Vulvar discharge (%)	0.00	0.00	0.00	7.41	0.122
Mastitis (%)	4.00	6.00	8.00	16.00	<0.001
Mortality (%)	0.00	1.00	1.00	3.00	<0.001
Dystocia (%)	0.00	2.00	1.00	2.00	<0.001
Downer cows (%)	0.00	0.00	0.00	1.00	0.067
Dehorned cows (%)	100.00	50.00	70.00	100.00	0.079

GF: farms with grazing access for the cows; ZGF: zero-grazing farms. If the p value is less than 0.05, the difference between the GFs and ZGFs is significant.

The median of lame cows was lower (good health) in the GFs than in the ZGFs, similar to the findings of other studies [2,3,10]. For example, Haskell et al. [2] found that, in farms with permanent housing, the percentage of lameness was higher than in those that provided pasture access to cows (39% versus 15% lameness prevalence). Other authors suggested, as well, that reduced or no pasture access represents a risk factor for lameness [37,38]. Other elements contributing to the lameness risk in dairy cows include solid concrete flooring, slippery walking alleys [39], uncomfortable and dirty barns [33,37,40], and an increased degree of dirtiness on the cows' hind legs [33,34]. Lameness is considered one of the most important problems in the intensive dairy industry [41]. Its effects interlink and trigger a downward spiral of health and production, severely impacting the welfare of the suffering cow. The discomfort and impaired balance lead to a reduction in time spent feeding, then the lower nutrient intake pairs with a higher metabolic demand imposed by pain, causing not only poor body condition scores but also a lower milk yield. All these have consequences, such as substantial negative effects on reproductive parameters and fertility performance, and, ultimately, an increased culling risk [42]. Even if the main cause of dairy cow lameness is considered to be either infectious or non-infectious claw lesions [43], the pain can be caused by a wide array of issues of the bones, joints, or soft structures (tendons and ligaments) of the locomotor system. Pasturing, due to its context (access to free exercise), seems beneficial for all the components of dairy cows' gait health, as grazing cows are less often lame than those kept indoors [8,10]. The free exercise on a larger surface and the more flexible and shock-absorbing nature of the earth (compared to concrete) seems protective for the upper parts of the cows' legs. At the same time, the cleanliness of the pasture ground and reduced probability of standing in manure act beneficially on the claws' health [15,23], reducing the overall risk of lameness.

The proportion of cows with hairless patches and lesions was significantly ($p < 0.001$) lower in the GFs than in the ZGFs, probably due to softer lying surfaces and lack of contact with injury-producing objects, such as gates, cubicle partitions, and feeding troughs. This finding is congruent with the results of other studies [15,22,23,29].

No significant differences were found between the two studied management systems for the percentage of cows with ocular or vulvar discharge, which is similar to the reports of Corazzin et al. [29] and Matiello et al. [44].

The pasture access did not significantly influence the prevalence of diarrhea in the studied cows. In this regard, our findings are in contrast with the results of other researchers. Several authors [23,27,29] consider that grazing may increase the risk of diarrhea, and Burow et al. [22] note a higher occurrence of this syndrome in cows with pasture access compared to the all-year-round confined ones. The causes of adult dairy cattle diarrhea are very diverse, even when only the nutritional risks are considered, and some may be indeed related to fresh grass consumption. As Armbrecht et al. [23] and Wagner et al. [27] very accurately mention, the high water and/or low protein and crude fiber content of the green fodder has the potential to soften the cows' feces. Especially when sudden diet changes occur, and/or when high quantities of grass are ingested, the manure can become considerably loose in the pasturing cows. The important element of this situation is not always possible to capture during the snapshot of a welfare assessment, but the assessor should always try to avoid confusing these temporarily loose feces with pathological diarrhea. Interviewing the farm personnel may aid this process.

In our research, the percentage of cows with mastitis was significantly ($p < 0.001$) lower in the GFs than in the ZGFs, which may be another advantage of the cleaner lying surfaces, simply limiting the exposure to pathogens, as other authors have also suggested [1,15,23]. Alongside lameness and infertility, mastitis is one of the major issues affecting dairy cattle globally [43]. It is a multifactorial disease recognized, a quarter of a century ago, as being one of the most frequent and costly health problems of the dairy industry [45]. Unfortunately, the past decades have not reduced the challenge of controlling dairy cow mastitis, especially because of the rising threat of antimicrobial resistance, with new and emerging mechanisms of resistance appearing and spreading globally. Not only does treating the cows with mastitis become more difficult, but large quantities of milk become improper for human consumption because of pathogenic bacteria, antimicrobial residues, and/or non-zoonotic micro-organisms, the latter being a source of transferable genetic resistance [46]. In this context, all the means of mastitis prevention or incidence reduction are extremely valuable, and the cows' access to pasture seems beneficial in this regard. White et al. [47] state that grazing lactating cows have a lower prevalence of mastitis. Washburn et al. [5] establish that these are 1.8 times less prone to clinical signs, and eight times less likely to be culled because of mastitis compared to cows with no pasture access. In cases like we found in the ZGFs (mastitis prevalence exceeding 4.5% of the assessed cows), the Welfare Quality® protocol [19] recommends the implementation of a farm-level action plan to remediate this problem as quickly as possible.

Mortality was significantly higher ($p < 0.001$) in the ZGFs than in the GFs. This result is not different from that of other studies reporting the decrease in mortality in dairy herds with pasture access [1,6,8] by up to 75% [48]. In a study [48] grouping Swedish dairy herds according to their mortality percentage, the authors found that the likelihood of being in the high mortality group increased when the cows' pasture access was restricted for the summer season. Additionally, the same authors [48] observed that a herd size ranging from 50 to more than 100 cows per group presented a higher mortality risk compared to smaller herds (from 30 to 50 cows).

In line with other publications [1], in our study, the percentage of cows with dystocia at parturition was higher in the ZGFs than in the GFs.

Regarding the behavioral measures studied in the cows, all of these differed significantly ($p < 0.05$) between the two management systems (Table 4). All the measures were better in GFs.

Table 4. Scores (median, range) of the animal-based measures related to the principle of appropriate behavior in the GFs (n = 17) versus the ZGFs (n = 22), and the significance of the difference between the two management systems.

Criteria and Measures	GF		ZGF		p Value
	Median	Range	Median	Range	
Frequency of butts (per cow per hour)	0.33	0.43	1.78	2.29	<0.001
Frequency of displacements (per cow per hour)	0.20	0.30	1.34	1.87	0.01
Cows that can be touched (%)	43.73	35.42	24.19	17.02	<0.001
Cows that can be approached at 50 cm but not touched (%)	52.54	25.67	23.80	51.05	0.001
Cows that can be approached between 50 cm and 1 m (%)	38.30	42.01	12.76	46.50	<0.001
Cows that cannot be approached (%)	4.25	4.25	8.47	25.77	<0.001
Qualitative Behavior Assessment (QBA)	4.15	1.57	0.61	3.65	<0.001

GF: farms with grazing access for the cows; ZGF: zero-grazing farms. If the p value is less than 0.05, the difference between the GFs and the ZGFs is significant.

The frequency of head butts and displacements was higher in the ZGFs than in the GFs. In the same way, cattle tend to display less agonistic behaviors (e.g., pushing, avoiding, and threatening) while on the pasture or in larger spaces [11] where their movement possibilities are not limited; thus, the submissive individuals can avoid confrontation with the dominant ones. The duration of maintaining established cattle groups is also important because during each regrouping the cows experience the stress of breaking former social bonds and adapting to a new social environment, leading to increased agonistic behaviors, decreased feeding and rumination times, and lower milk production [49].

The parameters measuring the percentage of cows that can be touched or approached explore the human–animal relationship, indicating the quality of previous experiences of the cows with their human handlers. Our results for these measures are similar to those of de Andrade Kogima [18]. In the comparative evaluation of confined versus pasturing cattle, many authors found that grazing cows are often more avoidant when approached than those in the barn. Batini [50], for example, concludes that the cows become less approachable after being re-confined following a grazing season of four months. The possible explanation provided is the lesser extent of human manipulation on the pasture (as frequency), which leads to the need to re-habituate to human handling. In similar terms, Armbrecht et al. [23] emphasize the importance of improved animal handling on pasture for the added cow welfare benefits of grazing. Not only the avoidance of aversive stimuli (e.g., the use of electric prodders, yelling, hitting the cows while leading them between the pasture and farm) but the addition of positive interactions (e.g., gentle scratching, food rewards) would be needed in the very well-justified opinion of these authors. Yet, the mentioned studies do not fully describe the practical daily management of the pasturing and confined cows. Even if grazed daily, the cows in our study were still handled for milking twice a day, and thus their habituation to human handling could not be "forgotten". In our viewpoint, the human-related response of the cows at each farm (approachability, avoidance distance, willingness to be touched) depends very much on the quality of interactions with the personnel of that specific farm, reinforced continuously by daily experiences. Some of the farms used electric fences only, but others had a watchperson guarding the cows on the pasture. In the latter scenario, the interactions with that person could substantially shape the human-related on-pasture behavior of the cows, because even if cows can discriminate between humans, they also generalize their experience with one person to other people, especially in similar contexts [51].

The Qualitative Behavior Assessment (QBA) was scored by the assessor after observing the behavior and body language of the cows, taking into consideration the descriptors pre-established in the Welfare Quality® protocol [19] (Table 5).

Table 5. Descriptive statistics (median, range) for descriptors (expressed in millimeters) of the Qualitative Behavior Assessment (QBA) in the GFs (n = 17) versus the ZGFs (n = 22), and the significance of the difference between the two management systems.

Descriptor	GF		ZGF		p Value
	Median	Range	Median	Range	
Active	100.10	17.0	80.30	43.00	<0.001
Relaxed	68.30	74.00	45.40	66.90	0.005
Fearful	30.20	25.00	50.20	45.00	0.003
Agitated	0.00	0.00	25.20	37.10	<0.001
Calm	110.20	26.50	95.30	34.90	<0.001
Content	120.20	14.90	95.00	55.10	<0.001
Indifferent	20.00	10.00	30.00	28.00	0.001
Frustrated	0.00	0.00	10.00	15.40	<0.001
Friendly	60.00	25.30	25.00	29.80	<0.001
Bored	15.20	9.90	20.00	30.30	0.219
Playful	45.40	40.40	30.00	35.20	<0.001
Positively occupied	100.00	15.20	90.00	35.00	<0.001
Lively	60.00	73.20	40.00	30.20	0.004
Inquisitive	0.00	0.00	5.00	15.00	<0.001
Irritable	0.00	0.00	5.00	15.00	<0.001
Uneasy	0.00	15.30	10.00	25.20	<0.001
Sociable	119.70	7.10	100.20	35.30	0.001
Apathetic	0.00	0.00	5.00	10.00	<0.001
Happy	120.00	14.50	90.00	40.00	<0.001
Distressed	0.00	15.00	20.00	29.80	<0.001

GF: farms with grazing access for the cows; ZGF: zero-grazing farms. If the p value is less than 0.05, the difference between the GFs and the ZGFs is significant.

The QBA was meant to bring the positive emotional state indicators of the evaluated animals to the welfare assessment protocol [19]. Although it is not generally accepted as an ideal method and its limitations are extensively discussed in the literature [52–54], QBA continues to be used until the development of more appropriate indicators.

The emotional state of cows on pasture assessed by the QBA method by other researchers seems to be at least similar, or even more positive, than that of cows kept indoors [23,27]. Emotional states that refer to positive feelings (such as active, relaxed, calm, content, friendly, playful, positively occupied, and happy) were shown at a higher frequency by the cows in the GFs than in ZGFs (Table 5). On the farms without pasture access, the cows displaying negative emotional states (such as frustration, irritableness, apathy, and distress) were significantly more prevalent ($p < 0.05$). The inquisitive behavior was recorded at a higher rate in the ZGFs than in the GFs. Although it is less researched in cattle, curiosity and the tendency to investigate are considered parts of a mindset related to play behavior, which is at the foundation of complex object-related and social abilities in cows, but play behavior can indicate both positive and negative emotional states [55]. Another perspective on curiosity is its relationship with learning (motivation to explore, to acquire novel information), but this topic has been scarcely researched in cattle [56]. Thus, neither the valence of this behavior displayed more frequently in the ZGFs, nor the significance of its underlying emotional state, is conclusive.

The explanation for the higher scores of positive emotional state indicators in the grazing cows may be the possibility for them to exercise relatively unrestricted movement, the natural environmental enrichment, and their access to comfortable resting surfaces, which would explain their preference to spend more time on the pasture than in confined areas [57]. Although animal preferences do not always directly relate to their better welfare [58], they indicate the pursuit of more positive emotional states. For example, feeding occupies considerably less of the confined cows' daily time budget (a third) compared to those kept on the pasture [9], well below what is considered usual in the natural bovine

behavioral repertoire [59]. Yet, this time "saving" brings no benefit for the confined cows, it only favors temporal leisure and negative emotional states [12].

Several studies show that access to grazing enables natural social behaviors in dairy cows [1,8,12,44], which is an important welfare aspect. When the competition for resources is low (as it happens on adequate pastures) the feeding and lying (ruminating) behaviors synchronize much better in the grazing herds than in the confined groups. Several preference studies [57,60,61] demonstrate that spending time on grasslands is valuable for these animals. The reported results prove that if they are given free choice, the cows favor the simple grass over the more nutritious (and assumably more palatable) rations, preferring to spend time on the pasture. Even if compared to free-stall housed herds (similar to our study) which are free to move inside the barns, the species-specific behaviors of pasturing animals are superior both as duration and as frequency and display range [62]. Therefore, the better positive emotional state of the cows on pasture found in our research is not surprising.

3.2. Wefare Criteria and Principles Assessment

The comparison in terms of criteria showed no significant difference between the two management systems, except for the "Absence of prolonged hunger" and the "Absence of pain induced by management procedures". Significant differences ($p < 0.05$) were found for all the welfare principles between the two management systems, three of these being in favor of the GFs (Table 6).

Table 6. Descriptive statistics (median, range) for welfare criteria and principle scores in dairy farms with or without access to pasture and the significance of the difference between the two management systems (GF, ZGF).

Principles and Criteria *	GF		ZGF		*p* Value
	Median	Range	Median	Range	
Good feeding	47.90	56.60	64.80	11.20	<0.001
APH *	83.50	48.70	76.19	40.00	0.070
APT *	3.00	57.00	60.00	40.00	<0.001
Good housing	74.00	10.00	70.90	18.10	0.01
CAR *	58.70	16.00	31.15	13.50	<0.001
Good health	48.40	18.00	39.60	34.30	<0.001
AI *	85.40	18.30	46.00	43.50	<0.001
AD *	100.00	13.90	86.10	59.50	0.006
APIMP *	14.00	28.00	13.00	87.00	0.147
Appropriate behavior	69.60	16.60	27.50	39.40	<0.001
ESB *	96.00	4.90	57.00	37.90	0.05
GHAR *	60.00	26.50	38.10	22.70	<0.001
PES *	88.90	13.10	56.90	39.60	<0.001

* marks the criteria (the entries without are the principles). GF: farms with grazing access for the cows; ZGF: zero-grazing farms. If the *p* value is less than 0.05, the difference between the GFs and the ZGFs is significant. APH: Absence of prolonged hunger; APT: Absence of prolonged thirst; CAR: Comfort around resting; AI: Absence of injuries; AD: Absence of diseases; APIMP: Absence of pain induced by management procedures; ESB: Expression of social behaviors; GHAR: Good human–animal relationship; PES: Positive emotional state.

When the welfare criteria and principles scores are compared in the two types of farms (GF vs. ZGF) in Table 6, the significantly higher scores ($p < 0.05$) of those farms providing their cows with access to pasture compared with the farms that housed their animals permanently became evident for the majority of the assessed criteria and three of the four welfare principles.

Although no significant differences were found for the "Good feeding" principle between the two farm types, slightly higher scores were obtained in the ZGFs than in the GFs for the criterion "Absence of prolonged hunger", and higher for the criterion "Absence of prolonged thirst". The lower scores for the criterion "Absence of prolonged thirst" in the GFs are related to the insufficient water supplies on the pastures. Similar results are given

by other research papers [18,27], as well. Prolonged thirst has a stronger negative impact on the animals' welfare than prolonged hunger. This effect can be more detrimental in the case of milking cows, whose metabolism uses considerable water quantities (in addition to the animals' maintenance needs) to produce milk. The higher their milk production is, the more important it is that they have uninterrupted free access to water. The Romanian spotted is a mixed breed, not primarily specialized for milk production. This feature could aid the adaptation of these cows to periodic water restrictions (eight hours per day, on average, while grazing). Although all the GFs (and half of the ZGFs) had exclusively cows of this breed, continuous access to water is paramount for dairy cows. Unfortunately, the studied GFs did not fulfill this requirement. Some of the farmers insisted that their cows were used to this drinking schedule (only when at the barns, during the night), their intake was not restricted quantitatively when they had access to water, and the water content of grass (higher than that of hay or other "dry" forage) should contribute to the animals' overall daily fluid requirement. In more specific studies, the veracity of these assertions could be verified by testing the dehydration degree of the cows, or by simply offering them water at different moments of the day, to assess their thirst level.

The scores for the principle of "Good housing", and also for the criterion "Comfort around resting" were significantly higher ($p < 0.05$) on the farms with pasture access, meaning that the cows felt more comfortable on the pasture than inside the barn. Recently, de Andrade Kogima et al. [18] reported similar results in a study performed in Brazil. Previous research also showed an improved lying behavior in dairy cows on pasture [27,29].

The "Good health" welfare principle and the criteria "Absence of injuries" and "Absence of diseases" were significantly influenced by grazing ($p < 0.05$). These results are in line with those in the scientific research proving that cows with access to pasture have a better health status. The access of dairy cows to pasture prevents and reduces the incidence of lameness [2], improves the behavioral parameters in the sense of displaying natural behaviors [63], increases the resistance of their immune system, stimulates the reproductive function, and thus enhances their overall degree of welfare [64].

Significant differences ($p < 0.05$) were found between the median scores for the "Appropriate behavior" welfare principle and the criteria included when the two farming types were compared. The pasture-based systems are perceived to offer greater behavioral freedom than those with continuous housing [1].

The evaluation of the "Expression of social behaviors" criterion is performed by observing the agonistic behaviors of the cows. The results obtained for this criterion are in agreement with previous studies, namely less agonistic behaviors when on pasture compared to during the housed period [1].

The significantly higher scores for the criterion "Good human-animal relationship" in GFs are rooted most probably in the positive experiences of the cows during interactions with their handlers. The overall positive effects of pasturing on the emotional balance of the cows would be very difficult to prove, because of the multitude of interlinked factors, but de Andrade Kogima et al. [18] reported similar results to those in the present research.

In this study, the "Positive emotional state" was significantly higher in the GFs than in the ZGFs ($p < 0.001$). These results are congruous with those obtained by other researchers [23,27].

3.3. The Overall Welfare Assessment

Based on the scores obtained for the four welfare principles, each farm was classified into a welfare category.

The GFs were in the "enhanced" (15 farms) and in the "acceptable" (two farms) categories, while the ZGFs were categorized as "enhanced" (five farms), "acceptable" (14 farms), and "not classified" (three farms). None of the assessed farms reached the "excellent" level (Figure 1). A better overall welfare quality in grazing dairy cows was reported recently by de Andrade Kogima et al. [18].

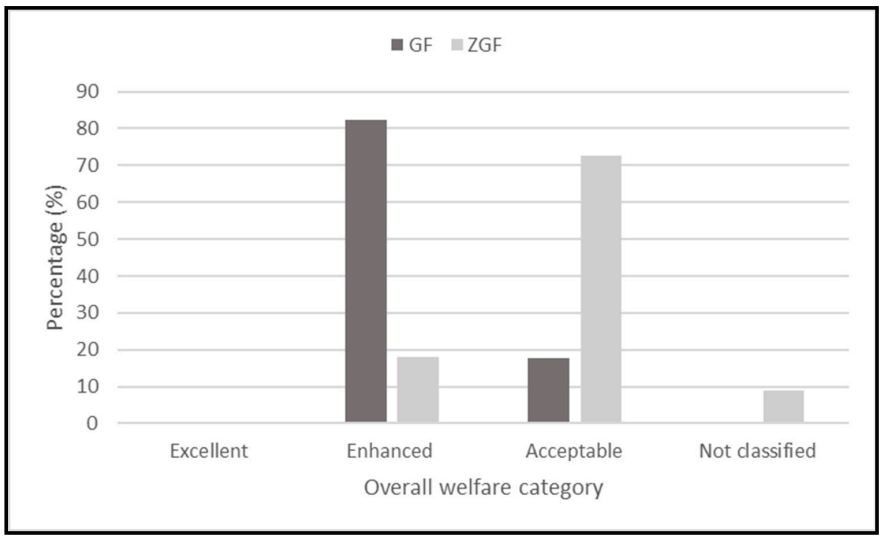

Figure 1. Classification of the assessed farms in the overall welfare categories comparatively, according to their management system. GF: farms with grazing access for the cows; ZGF: farms without pasture access (zero-grazing).

3.4. Correlations between Pasture Access and Animal-Based Welfare Parameters

Table 7 presents the correlations found between pasture access and certain animal-based welfare measures. Pasture access correlated positively with certain indicators and negatively with others (Table 7).

Table 7. Significant correlations between pasture access and animal-based welfare measures in the dairy cows in the assessed farms.

Pasture Access	r_s	Pasture Access	r_s
Very lean cows	−0.62	Mortality	−0.63
Duration of lying down movements	−0.76	Dystocia	−0.59
Cows with dirty lower legs	−0.67	Frequency of head butts	−0.74
Cows with dirty udder	−0.42	Frequency of displacements	−0.66
Cows with dirty flank and upper legs	−0.52	Cows that can be touched	0.51
Lame cows	−0.72	Cows that can be approached by 50 cm but not touched	0.41
Cows with at least one lesion	−0.68	Cows that cannot be approached	−0.47
Vulvar discharge	−0.44	QBA	0.88
Mastitis	−0.58		

The negative correlations between pasture access and comfort and health-related indicators sustain the conclusions of several studies stating that grazing cows need less time to rise and lay down [27]. Their increased comfort around resting while on the pasture may be due to more space available, as well as softer and more comfortable lying surfaces [1], and also because they can freely select and choose the spot where they want to rest. Cows are generally cleaner outdoors [1], are less lame and injured (i.e., having fewer lesions, swellings, and hairless patches) [23], have a better general health status, and decreased mortality [8]. The negative correlations found between pasture access and behavioral indicators underline the observations that cows on pasture engage in less agonistic interactions [1]. The positive correlations with the indicators comprised in the "Good human-animal relationship" criterion suggest that pasturing cows are less reactive

and avoidant to the approach of people, as noted in our study too. Similar results have been reported in working horses [65]. The strong correlations with QBA highlight the importance of pasture access for the well-being of dairy cows. The association between positive emotions and pasturing was also demonstrated by Motupalli et al. [57].

4. Conclusions

This study showed that the overall welfare of dairy cows was better when they had access to pasture than in permanent confinement. Even if grazing was limited to the daylight period only in the warm season and both farm types provided free-stall management, the positive effects of freedom on grasslands were evident. Due to the high number of significant differences in the assessed welfare measures, criteria, and principles, the GFs ranked higher in the final farm classification, proving the superiority of a management system that allows the cows to display a wide range of natural behaviors. Because most assessed animals were of a local breed (Romanian spotted cattle), thus well adapted to the local conditions and a grass-based diet, the study conditions do not represent a guideline for managing highly productive ultra-ameliorated dairy cows that may have different needs. Yet, the authors consider that, regardless of breed, all dairy cows would benefit from pasture access, tailored to their characteristics, to achieve better health and a higher welfare quality.

5. Study Limitations

The main limitation of the present study was the need to adapt the Welfare Quality® assessment protocol for dairy cows to on-pasture evaluation because of the lack of a specifically developed protocol. This implied a slight modification for the measurement of the avoidance distance, for example. Other authors also noted the shortcomings of the protocol while assessing dairy cows on the pasture [66]. One aspect which needs special attention is the lack of a measure for the thermal comfort of the dairy cows. Although several measures are equally feasible for indoor and outdoor assessments, a specific and standardized welfare assessment protocol for dairy cows on pasture is needed that is representative of the overall welfare status of the cows [66].

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