

[doi.org/10.51452/kazatuvc.2023.2.\(002\).1419](https://doi.org/10.51452/kazatuvc.2023.2.(002).1419)

UDC 57.636.034

EVALUATION THE DAIRY COWS' WELFARE IN NORTHERN KAZAKHSTAN FARMS

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Abstract

In modern society animal welfare is an important attribute of the food quality general concept. Research purpose was to identify the dairy cows' welfare problems in Kazakhstan. In 2022 and 2023, studies were organized at two industrial dairy farms in the central (Kamyshenka LLP) and northern (Ayna Dairy Farm LLP) zones of the Akmola region. Here, the welfare of 110 cows was measured in accordance with 33 parameters, 12 criteria and 4 principles (according to the Welfare Quality[®] protocol). On both farms, the main animal welfare indicators were approximately within the same limits. The criterion "Absence of prolonged thirst" was 60.0 scores. In both farms, such criteria indicators as "Absence of prolonged hunger", "Absence of diseases" had relatively low values in the range of 3.5-19.98 points. The criteria "Absence of injuries", "Lameness", "Integument alterations", "Positive emotional state" were also below 53.9 points. Scores of criteria "Comfort during rest", "Absence of pain caused by management procedures", "Manifestation of other forms of behavior", "Good relations between man and animal" exceeded 55 points and reached a maximum value of 80.01 points at the Ayna Farm. Overall, farms scored from 20.1 to 50.4 points on the basic principles of welfare, with the exception of the principle of "Good Health", according to which Ayna Dairy Farm scored 64.4 points, but Kamyshenka Farm had a lower level – 38.2. Thus, both farms were classified by the Welfare Protocol as "Acceptable". The study has been shown that the housing of dairy cows needs to be improved for increasing the comfort of rest and reduce cow injuries.

Key words: Akmola region; cattle; criteria of welfare; dairy farm;

measurements of welfare; principles of welfare; welfare of dairy cows.

Basic position and Introduction

The dairy herd in Kazakhstan has more than 1.2 mln cows, which are bred in more than 3.415 productive and 821 breeding farms. Over the past 10 years, the number of productive farms has increased by more than 7.5 times, and breeding farms by 3.3 times [1]. Repeated multiple fertilization, short intervals between calving, overproduction of milk, restrictive maintenance systems, poor nutrition and physical disorders worsen the welfare of animals in industrial dairy enterprises. Due to the milk yield increase cows have additional health problems for high metabolic productivity. In the 20th century, selective breeding of dairy cattle was mainly focused on increasing dairy productivity with insufficient attention to improving qualities important for health and welfare [2, 3]. According to the WOAHA definition “Animal welfare means the physical and mental state of an animal in relation to the conditions in which it lives and dies” [4].

The lactating and dry cows' farming systems are determined by the climate and the vast majority of dairy enterprises in the world keep cows mainly indoors, and only in 9.9% of farms the lactating cows are raised mainly on pasture [5], although the preventing access to pasture had been considered among the main hazards to welfare of dairy cows [6].

Thus, different production technologies determine different levels of welfare of the dairy herd, the definition of which is currently considered one of the main criteria for

assessing the overall management of livestock enterprises. In countries with industrialized animal husbandry, public concern and expectations in this matter are constantly growing. Consequently, the dairy sector should actively work to ensure high standards of animal welfare in order to maintain consumer confidence.

In addition, over the past decade, new scientific data, tools and animal welfare standards have been published (WOAHA, 2018; ISO, 2016), which are regulated by the legislation of many countries (for example, Directive 98/58/EC in Europe) [4, 7, 8]. The European Food Safety Authority (EFSA) has identified lameness, mastitis, metabolic disorders, low fertility and short life expectancy as the main problems affecting the welfare of the dairy herd [9].

Based on the research of various experts from different animal sciences' area a Welfare Quality[®] protocol for assessing the welfare of dairy cows was developed [10]. The overall rating scale allows comparing the results according to different criteria, so that it is easier to set priorities. Thus, the results should serve as a guide to identify the main risks to welfare on the farm and, in turn, at the population level. One of the important questions is to what extent the characteristics of the farm inform us about the risks to animal welfare.

These studies aimed to identify the most important problems of welfare on Kazakh dairy farms based

on their assessment according to the Welfare Quality® protocol.

Materials and methods

In 2022 and 2023, field studies were organized on two industrialized dairy farms in central (Kamyshenka LLP) and northern (Ayna Dairy Farm LLP) Kazakhstan, when cows were indoors. Here the welfare of 110 cows was measured according to 33 parameters, 12 criteria and 4 principles. Figure 1 shows the moments of animal-oriented measurements in conditions of the Kamyshenka Dairy Farm.



Figure 1 – Housing conditions in Kamyshenka Dairy Farm

Five characteristics of dairy farms were selected as stratification parameters. They included: location (central and northern parts of the Akmola region steppe zone), breed of cows (Holstein), milking system (automated milking system – AMS), housing system (loose) and the number of cows on each farm (Table 1).

Table 1- Characteristics of the farms studied

Housing system	Breed	Milking system	Geografic zone	Number of lactating cows	Farm
Loose housed	Holstein	AMS	Steppe	395	Ayna Dairy Farm
Loose housed	Holstein	AMS	Steppe	439	Kamyshenka

There was used a Protocol for Assessing the Quality of Welfare for Dairy Cattle (Welfare Quality ® 2009), which is based on four principles (“Good feeding”, “Good housing”, “Good health” and “Appropriate behavior”) [10]. They are divided into 12 criteria (for example, the “Good feeding” principle includes the criteria “Absence of prolonged hunger” and “Absence of prolonged thirst”). Each criterion was evaluated using from one to seven measurements, resulting in a total of 33 measurements giving baseline data, such as the % of animals with a given problem or the frequency of social interactions. Most of the measurements were performed on animals (clinical and behavioral observations). Some measurements are based on resources (for example, the number of water points) or on management (for example, the method of dehorning). Measurements on animals made at the individual level were carried out on a sample of animals randomly selected in the herd, depending on the size of the herd, according to the protocol. The data obtained using measurements that relate to this criterion were collected into scores that reflect how well the farm meets this criterion. The assessment summarizes information on the prevalence and severity of problems according the protocol. The score was expressed on a scale of 0-100, where 0 means very low welfare and 100 means excellent welfare.

There were performed three main types of calculations:

Measurements the criteria “Absence of prolonged hunger”, “Absence of injuries”, “Expression of

social behaviours”, “Expression of other behaviours”, “Good human-animal relationship”, “Positive emotional state” provided continuous data on similar scales. The severity of the problem was taken into account (for example, the % of non-lame, moderately lame and severely lame cows). Then a weighted sum was calculated (for example, the % of lame animals weighted taking into account the severity of lameness). Then cubic functions were used to convert the weighted sum into an estimate of the criterion. According to the “Absence of injuries” criterion, two partial scores were calculated – one for integument alterations (i.e. skin changes: hairless areas and lesions/swellings with a diameter of 2 cm or more) and one for lameness, which were then combined into a criterion score.

Measurements of the criteria “Comfort around resting” and “Absence of diseases” gave continuous data expressed in different scales. For each type of data (proportion of affected animals, average lying time, etc.), three levels were determined: the data collected on the farm corresponded to the absence of problems, moderate problem or serious problem. The number of problems noted on the farm was then converted into an estimate using cubic functions (as indicated above).

Measurements of the criteria “Absence of prolonged thirst”, “Ease of movement” and “Absence of pain induced by management procedures” gave data expressed in a limited number of categories, and a decision tree was used to calculate discrete scores. For example, to assess the

“Absence of pain induced by management procedures”, the procedure used for dehorning (without dehorning, disbudding by thermocoagulation, chemical disbudding, dehorning in adult cows) and the use of drugs (no, anesthetics, analgesics, both) were taken into account.

Data collection began immediately after morning milking and ended in the afternoon. The assessment was made on one visit per day.

Criteria scores of the farm in relation to such measurements as “Absence of hunger”, “Comfort around resting”, “Absence of injuries”, “Absence of lameness”, “Absence of diseases”, “Expression of social behavior”, “Good human-animal relationship”, “Positive emotional state” were calculated based on the primary data using the I-spline function according to the general formula:

Score = $a + b \times I + c \times I^2 + d \times I^3$ with the specified values for each coefficient.

Partial assessment of skin changes was calculated by the index for integument alterations

$$I_s = \left(100 - \frac{(\%mild) + 5(\%severe)}{5}\right).$$

Partial score for lameness was determined by the index

$$L_l = \left(100 - \frac{2(\%moderate) + 7(\%severe)}{7}\right).$$

Index of social behavior was determined by the formula

$$I = 100 \times [(43,8) - (x \text{ (head$$

Results

General assessment the welfare of dairy cows in studied farms

butts) + y(displacements)]/43.8,

Index for good human-animal relationship – by

$$I = \left(100 - \frac{3(\%cat2) + 11(\%cft3) + 26(\%cat4)}{26}\right).$$

Behaviour scores are converted to an index using a weighted sum:

Index = $-3.40496 + \sum_{k=1}^{20} W_k N_k$, where N_k is the value obtained by the farm for a given period k , W_k – the weight attributed to this term k .

Then these indicators were recalculated by the I-spline function. Two partial estimates for the absence of injuries were combined using the discrete Choquet integral of a function $g: N \rightarrow R$ defined by:

$C_\mu(g_1, \dots, g_n) = \sum_{i=1}^n (g_{(i)} - g_{(i-1)}) \mu(A_{(i)})$, where μ is a fuzzy measure, $\mu: 2^N \rightarrow [0,1]$. (i) means that the indices are permuted as $\{0 \leq g_{(1)} \leq g_{(2)} \leq g_{(3)} \dots \leq g_{(n)}\}$; $A_{(i)} = \{(i), \dots (n)\}$, and $g_{(0)} = 0$.

Criterion scores for measurements “Absence of prolonged thirst”, “Ease of movement”, “Absence of pain induced by technological procedures” were determined according to the decision tree. Then the obtained criterion scores were combined into principle scores by the Choquet integral. For each principle, a score (on a scale of 0-100) was calculated, summarizing the estimates received by the firm according to various criteria related to a specific principle, which served as the basis for assessing the welfare of cows on the farm.

These studies have shown that in both farms, the principal scores for assessing the state of animal welfare are approximately within similar limits, with some excess in Ayna Dairy Farm (Figure 2).

Overall, farms scored from 20.1 to 50.4 points on the main principles of welfare with exception the "Good Health" principle, according to which the Ayna Dairy Farm's scores were 64.4, but Kamyshenka Fairy Farm had a lower level - 38.2. Thus, both farms were classified by animal welfare as "Acceptable".

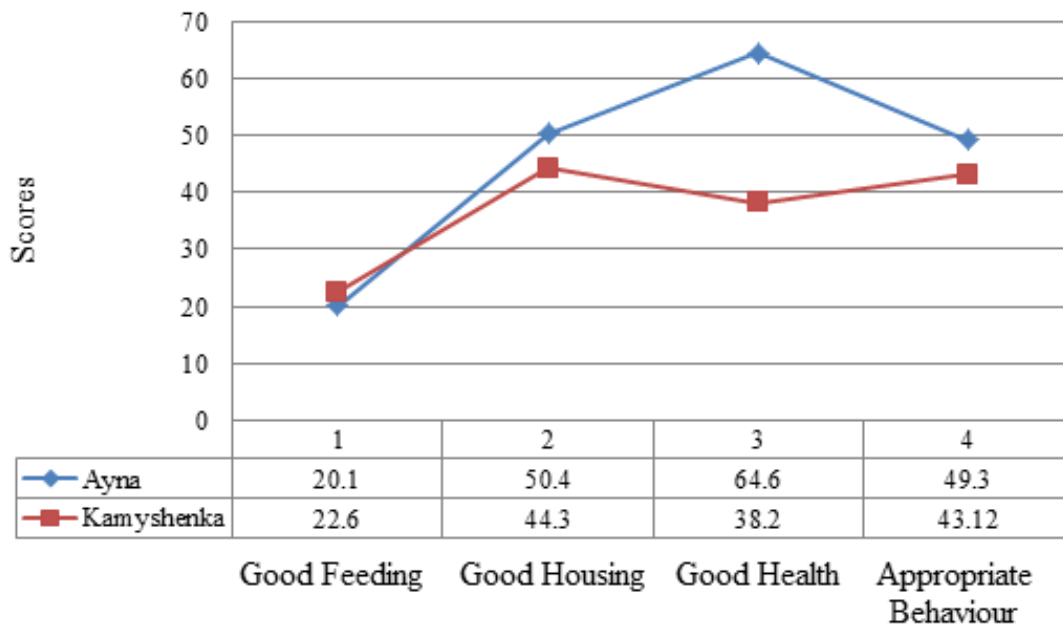


Figure 2- Welfare indicators of dairy herds by principal scores (on a scale of 0-100, where 0 is a low level and 100 is an excellent level)

Determination the criterion-scores

In both farms, criterion scores showed similar results, while in Ayna Dairy Farm, relatively high values of indicators of the welfare of dairy cows were observed. As for the criterion "Absence of prolonged hunger", more than 18% of very lean cows were observed in both farms, which is explained by the breeding of Holstein cows on both farms (Table 2).

Although on farms, in general, the water supply is sufficient, the criterion "Absence of prolonged thirst" reached a value of 60.0, since the length of the water points and the water pressure was below the standard specified in the protocol.

Table 2 - Main indicators of welfare of dairy herds by criterion score (on a scale of 0-100, where 0 means low and 100 – excellent welfare) for two farms

Welfare Criteria	Scores	
	Ayna Dairy Farm	Kamyshenka Dairy Farm
Absence of prolonged hunger	3.50	5.7

Absence of prolonged thirst	60.00	60.0
Comfort around resting	66.3	55.7
Ease of movement	100	100
Absence of injuries	53.90	49.3
Lameness	22.9	28.8
Integument alternations	42.50	43.7
Absence of disease	19.98	4.18
Absence of pain induced by management procedures	60.0	65.0
Expression of social behaviours	80,01	61.93
Expression of other behaviours	0	0
Good human-animal relationship	56.09	49.09
Positive emotional state	24.45	22.06

In both farms such criteria indicators as “Absence of prolonged hunger”, “Absence of disease” had relatively low values in the range of 3.5-19.98 scores. Criteria “Absence of injuries”, “Lameness”, “Integument alternations”, “Positive emotional state” were also below 53.9 scores. Criterion points for “Comfort around resting”, “Absence of pain induced by management procedures” “Expression of other behaviours”, “Good human-animal relationship” exceeded 55 points and reached a maximum value

of 80.01 scores at the Ayna Dairy Farm. The value of the criterion indicator “Accessibility of movement” was absolute in both farms, since here loose keeping of livestock is practiced (Table 2).

Results of primary animal-, housing- and resource-oriented measurements

The primary data collected on farms show the presence of serious problems on certain aspects of welfare in the dairy herds of both farms (Table 3).

Table 3 - Main indicators of dairy herds’ welfare at the farms

Measures	Dairy Farms	
	Ayna	Kamyshenka
Absence of prolonged hunger		
% of very lean cows	18.33	29.6
Comfort around resting		
Mean time to lie down (in seconds)	6.87	6.8
% of animals colliding with housing equipment during lying down	30	13.3
% of animals lying partly/completely outside lying area out of all lying animals	0	0
% of animals with dirty udder	31.66	16.6
% of animals with dirty hindquarters	73.3	16.0
% of animals with dirty lower hind legs	83.3	57.4
Absence of injuries		
% of moderate lame animals	30	18.5
% of severe lame animals	18.33	14.8

% of animals with mild integument alterations	21.7	22.2
% of animals with severe integument alterations	25	24.1
Absence of disease		
Mean number of coughs per animal and per an hour		0.6
% of animals with nasal discharge	8.33	27.7
% of animals with ocular discharge	0	12.6
% of animals with hampered respiration	0	7.4
% of animals with diarrhoea	11.7	14.8
% of animals with vulvar discharge	8.33	1.85
% of cows with somatic cell count of 400,000 or above	8.75	19.0
% of dystocia	0	11.3
% of downer cows	0	8.8
% of mortality on the farm during the last 12 months	5.4	15.9
Expression of social behaviours		
Mean number of head butts per animal an hour	1	0.8
Mean number of displacements (agonistic behaviours except head butts) per animal an hour	0	2.0
Expression of other behaviours		
Number of days with access to pasture per year	0	0
Number of hours per day on pasture	0	0
Good human–animal relationship		
% of animals that can be touched	73.3	48.0
% of animals that can be approached closer than 50 cm but not be touched	10	28.0
% of animals that can be approached as closely as 100 to 50 cm	3.3	12
% of animals that cannot be approached as closely as 100 cm	13.3	12

In both enterprises, there are problems with the herd health that significantly affect and determine the dairy animals' welfare.

Discussion

According to our research on Ayna and Kamyshenka dairy farms, respectively, more than 48.8 and 32.6% of animals suffer from moderate and severe lameness and the proportion of cows with severe lameness is quite high. Similarly high rates of traumatic skin injuries were observed in studied cows (46.7 and 46.3%, respectively).

It should be noted that lameness is one of the most serious problems of welfare in dairy farms and at the most of industrialized dairy enterprises described a similar situation. For

example, in the USA, the level of lameness in a herd of dairy cows reached 24.6% [11]. In the review of the main causes of cow mortality, lameness and injuries occupy the highest place – 20%, followed by mastitis – 16.5% and calving problems – 15.2%. It is also known that after mastitis and calving problems, lameness is the third most common reason why dairy cows are culled [12]. Lameness causes pain and discomfort. Cows suffering from lameness develop hypoalgesia; they change their behaviour in an attempt to relieve pain

by changing the position of the body, reducing activity when walking and more frequent weight transfer from one leg to the other [13]. The main cause of lameness is damage to the hooves, and they are associated with a concrete floor. There is an assumption that the frequency of lameness increases with increasing milk yield. Lameness is also associated with insufficient physical activity. Increased physical activity and access to pasture can improve the gait of cows and have a positive effect on hoof health [14].

Studies have shown that in both dairy farms, percentage of cows with a high number of somatic milk cells reach a significant value: 8.75% in Ayna Dairy Farm and 19.0% in Kamyshenka LLP (Table 3). This indicator serves as proof of the presence of mastitis in the herd of dairy cows.

Clinical mastitis is the most frequently reported herd health problem in the dairy industry and causes the death of 16.5% of animals with this disease. Injury of nipple tissues by milking machines and genetic selection to obtain extremely high milk yields are considered the main predisposing factors of painful swelling of the udder. Most cases of mastitis are caused by infections with pathogenic microflora penetrating through the nipple opening [15]. Thus, poor cleanliness of the premises and the cows themselves increases the frequency of mastitis [16]. The results of these studies indicate that in Ayna Dairy Farm, the proportion of cows with dirty udders, sides and upper limbs, as well as lower limbs, is, on

average, 31.66, 73.3 and 83.3%, respectively. In Kamyshenka Dairy Farm, these indicators were, respectively, 16.6, 16.0 and 57.4%, which indicates the omissions of farms on animal welfare (Table 3). Nevertheless, it is known that frequent change of bedding and good sanitary conditions in the milking parlor can reduce the risk of udder inflammation. Reducing the density of cows in loose housing systems can also reduce the risk of mastitis by improving hygiene and reducing the frequency of nipple injuries.

Apparently, insufficiently satisfactory sanitary conditions and poorly balanced feeding contributed to the fact that proportion of cows with nasal discharge, eye discharge, difficulty breathing, diarrhea and vulva discharge at Kamyshenka Dairy Farm averaged 27.7, 12.6, 7.4, 14.8 and 1.85%, respectively. These indicators at Ayna Dairy Farm were an lower, with exception of the vulva discharge rate, which was for 4.5 times higher here (Table 3). Such unfavorable factors of housing and managing are reflected in fairly high mortality rates of lactating cows, which is 5.4% in Ayna Dairy Farm and 15.9% in Kamyshenka Dairy Farm.

It should be noted that in traditional cattle breeding dairy cows graze on pasture throughout the day, but in modern dairy farms cows are fed only once or twice a day [18]. Even if the diet contains all necessary nutrients, the cow may still have a behavioural need to perform oral feed manipulation, as would be normal in nature conditions [19]. As a result of

genetic selection for high milk yields, used in modern dairy production cows are unable to receive all necessary energy only from feed to maintain their abnormally high milk productivity. Thus, the feed for industrially raised dairy cows has become very concentrated with the use of high-calorie nutrients, and the diet of lactating cows consists of feed concentrates by 30-60% [20].

An abnormally concentrated diet leads to the formation of organic acids, which can lead to rumen acidosis in cows [14]. Another problem closely related to concentrate feeding is laminitis, which can lead to lameness [21]. Excessive mobilization of fat reserves causes ketosis, which in serious cases can lead to signs of neurological dysfunction, such as walking in circles, excessive self-care,

Conclusion

Welfare issues vary depending on the conditions in which animals are housed. As a result of a cross-sectional study, two geographically remote farms in the center and north of the Akmola region were recognized as “Acceptable” from welfare points according to the classification of Welfare Quality[®] protocol. Scores for feeding, housing, health, and behavior ranged from 20.1 to 64.6.

Dairy cows in the studied farms have various welfare problems, the most important (in terms of severity and prevalence) of which are health disorders, including diseases and injuries. The results can be used by

Information on funding

The research was carried out within the program-targeted funding project BR10764965 “Development of technologies for keeping, feeding, growing and

wandering and excessive salivation [22].

As a result of described above factors, an increase in the number of cows with dystocia and downer cows is observed in industrialized farms. At the studied farms the proportion of cows with dystocia and downer cows is fixed only at Kamysheuka Dairy Farm with percentage 11.3 and 8.8%, respectively (Table 3). Dairy producers have to cull cattle before they become physically unsuitable for transportation to the slaughterhouse [23].

This investigation had shown necessity for future research of animal welfare in different regions of the country for understanding the core problems of industrialised dairy farms and developing domestic standards for quality assessing the management of row milk producing entities.

stakeholders to prioritize corrective actions in welfare plans, paying particular attention to characteristics that are at high risk of specific health problems.

Dairy technology management should be prioritized with respect to these core issues. More specifically, our study shows that the housing of dairy cows needs to be improved for increasing the comfort of rest and reduce cow injuries, as well as the fact that Holstein cows are at high risk of thinness and diseases. This shows that the cows’ welfare depends not only on the characteristics of the farm, but also on its management.

reproduction in dairy cattle breeding, adapted resource-energy-saving, digital technologies for various natural and climatic zones of Kazakhstan”.

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