**Assessment of welfare indicators in dairy farms offering pasture at differing levels**

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*animal* journal

**Supplementary material**

**Table S1** *Data collected for the assessment of the overall score of dairy cows using the Welfare Quality® protocol (modified according to COIGNARD et al., 2013)*

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| --- | --- | --- | --- |
| **Indicator** | **Type** | **Frequency calculation** | **Description of the method for collecting data** |
| Principle Good Feeding | | | |
| Body condition score (BCS) | Animal-based indicator | BCS observed on a sample of cows | BCS of an animal is observed without being touched and categorized into  0: regular body condition  1: very lean body condition  2: very fat body condition |
| Water provision | Resource-based indicator | Length, cleanliness and functionality of water troughs and bowls on the day of the visit | Troughs: length indicator in cm and test of sufficient water flow (sufficient = 20 l/min)  Bowls: number of bowls and test of sufficient water flow (sufficient = 10 l/min)  Check of cleanliness in all water troughs or bowls |
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| Principle Good Housing | | | |
| Time needed to lay down | Animal-based indicator | Mean time to lie down observed on a sample of at least 6 cows on the day of the visit | Recording of time needed to lay down in seconds with a chronograph. From the moment, the carpal joint was bent and lowered to touch the ground, the time measure started. With the movement of pulling the front legs out from underneath the body, when the hind quarter had already fallen down, time measure stopped |
| Cleanliness | Animal-based indicator | Cleanliness observed on a sample of cows (Nfin1) on the day of the visit | Assessment on lower hind legs, hind quarters and udder, Animal is observed without being touched. Assessed using this scale:  0: no dirt or minor splashing  2: separate or continuous plaques of dirt |
| Collisions | Animal-based indicator | Observed on a sample of at least 6 cows on the day of the visit | Definition of a collision: during the lying down, the cow collides with the housing equipment.  0: no collision  2: collision |
| Lying outside the lying area | Animal-based indicator | Observed in repre-sentative segments of the barn/ pasture on the day of the visit | Percentage of animals lying partly or completely outside the designated lying area, out of all lying animals |
| Presence of tethering | --- | --- | Only farms with cubicle housing systems were chosen for this study |
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| Principle Good Health | | | |
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| Lameness | Animal-based  indicator | Prevalence of lameness observed on a sample of cows (Nfin1) on the day of the visit | Cows are observed when walking on a surface on which they normally walk. The cows gait score is assessed using this scale:  0: Not lame: timing of steps and weight-bearing equal on all four feet  1: Moderately lame: imperfect temporal rhythm in stride creating a limp  2: Severely lame: Strong reluctance to bear weight on one limb, or more than one limb affected |
| Integument alterations | Animal-based indicator | Prevalence of integument altera-tions observed on a sample of cows (Nfin1) on the day of the visit | Observation of five body regions of cows (neck/ shoulder/ back, hindquarter, tarsus, ﬂank/ side/ udder, carpus) on one side of the animal. On each region, the number of hairless patches and lesions/ swellings of a minimum diameter of 2 cm are recorded |
| Nasal discharge | Animal-based indicator | Prevalence of nasal discharge observed on a sample of cows (Nfin1) on the day of the visit | Animal is observed without being touched. Assessed using this scale:  0: No evidence  1: Evidence of clearly visible ﬂow/ discharge from the nostrils; transparent to yellow/ green and often of thick consistency |
| Ocular discharge | Animal-based indicator | Prevalence of ocular discharge observed on a sample of cows (Nfin1) on the day of the visit | Animal is observed without being touched. Assessed using this scale:  0: No evidence  1: Evidence of clearly visible ﬂow/ discharge (wet or dry) from the eye, at least 3 cm long |
| Diarrhea | Animal-based indicator | Prevalence of diarrhea observed on a sample of cows (Nfin1) on the day of the visit | Animal is observed without being touched. Assessed using this scale:  0: No evidence  1: Evidence of loose watery manure on both sides of the tail. Area affected at least the size of a hand |
| Coughing | Animal-based indicator | Mean number of coughs expressed per cow per 15 min | Recording using continuous behavior sampling of sudden and noisy expulsion of air from the lungs of cows during a total period of 120 minutes |
| Vulvar discharge | Animal-based indicator | Prevalence of vulvar discharge observed on a sample of cows (Nfin1) on the day of the visit | Animal is observed without being touched. Assessed using this scale:  0: No evidence  1: Evidence of purulent efﬂuent from the vulva or on the bottom side of the tail |
| Mortality | Farm records | Annual cumulative incidence of mortality | Deﬁned as the percentage of dairy cows which died or were euthanized due to disease or accidents or were emergency slaughtered during the last 12 months |
| Milk somatic cell count | Farm records | Prevalence of cows with subclinical mastitis within the last 3 months | Cow milk somatic cell counts are obtained from individual milk records and assessed using this scale:  0: Somatic cell count below 400 000 cell/ml for the last 3 months  1: Somatic cell count of 400 000 cell/ml or above at least once within the last 3 months |
| Downer cows | Farm records | Annual cumulative incidence of downer cows | Deﬁned as the percentage of cases of downer cows in the herd during the last 12 months |
| Dystocia | Farm records | Annual incidence of dystocia | Deﬁned as the percentage of calvings where major assistance was required in the herd during the last 12 months |
| Hampered respiration | Animal-based indicator | Prevalence of hampered respiration observed on a sample of cows (Nfin1) on the day of the visit | Animal is observed without being touched. Assessed using this scale:  0: No evidence  1: Evidence of deep and labored respiration. Expiration mostly accompanied by pronounced sound |
| Disbudding/ dehorning | Questionnaire | --- | The farmer is asked about his or her management practices for disbudding/ dehorning (procedures, use of anesthetics/analgesics) |
| Tail docking | --- | --- | Not practiced in Germany except an emergency case |
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| Principle Appropriate Behavior | | | |
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| Agonistic behavior | Animal-based indicator | Observed in repre-sentative segments of the barn/ pasture on the day of the visit | Recording of agonistic behavior using continuous behavior sampling during a total period of 120 minutes: Number of head butts, displacements, chasing (-up) and fightings |
| Outdoor loafing area or pasture | Questionnaire | --- | Access to outdoor loafing area and/ or pasture:  0: yes  2: no |
| Avoidance distance | Animal-based indicator | Observed on a sample of cows (Nfin1) on the day of the visit | Starting at 2 m in front of the cow at the feed bunk, the observer approached the animal with an extended hand. If the cow showed withdrawal, the avoidance distance was estimated between the hand and the muzzle of the cow at the moment of first sign of retraction, noted in 10 cm intervals |
| Qualitative behavior assessment (QBA) | Animal-based indicator | Observed in repre-sentative segments of the barn/ pasture on the day of the visit | Equal distributed segments observed for 20 minutes overall. The herd was valued for a tendency to be active, relaxed, fearful, agitated, calm, content, indifferent, frustrated, friendly, bored, playful, positively occupied, lively, inquisitive, irritable, uneasy, sociable, apathetic, happy or distressed |

1 with Ninf = 96.04 and N = herd size.