

# Data on Gastrointestinal and Claw Disorders as Possible Predictive Factors in Beef Cattle and Veal Calves' Health and Welfare

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**Abstract:** Today, consumers have a growing concern about the welfare of beef cattle, and specific schemes have been proposed to assess their wellbeing during the fattening. On-farm assessments can be integrated and partially replaced by animal-based measures recorded *postmortem* at the abattoir. *Postmortem* organ inspection data are of value, as several lesions can be reflective of subclinical diseases not easily detected in the live animal. The present data collection aimed to evaluate the slaughterhouse prevalence and location of hoof, gastric, hepatic, and liver lesions in beef cattle and veal calves and retrospectively associated this information with the animals' housing and feeding management systems. Individual data on gastrointestinal and claw disorders of beef cattle (bulls and heifers) and veal calves were collected through a *postmortem* inspection by trained veterinarians directly at the slaughter line. Around 15 animals/batch, belonging to 97 batches of young bulls, 56 batches of beef heifers, and 41 batches of veal calves were inspected in three slaughterhouses located in Northern Italy during 30 sampling days, and information on the animals' rearing systems were gathered *a posteriori* from farmer interviews. The implementation of this recording system should promote a continuous improvement of beef cattle management from a health and welfare perspective.



**Citation:** Magrin, L.; Contiero, B.; Cozzi, G.; Gottardo, F. Data on Gastrointestinal and Claw Disorders as Possible Predictive Factors in Beef Cattle and Veal Calves' Health and Welfare. *Data* **2022**, *7*, 43. <https://doi.org/10.3390/data7040043>

Academic Editor: Flavio Licciulli

Received: 8 March 2022

Accepted: 5 April 2022

Published: 6 April 2022

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**Dataset:** DOI:10.25430/researchdata.cab.unipd.it.00000589; Direct URL to data: <http://researchdata.cab.unipd.it/id/eprint/589>.

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**Keywords:** beef cattle; veal calves; claw disorders; gastrointestinal disorders; intensive fattening system

## 1. Summary

In recent decades, research into methods of assessing the welfare status of farm animals has intensified. However, on-farm assessments using animal-based measurements is rather complicated, expensive, and time-consuming. For these reasons, in meat-producing species, there is a growing interest in developing welfare monitoring schemes that consider animal-based measures recorded at the slaughterhouse, possibly during routine veterinary inspections [1]. Lameness events in finishing beef cattle are becoming more and more a relevant health issue since they are shown to impair animal welfare with negative consequences on beef farm economies [2]. The health and integrity of the rumen wall and abomasal mucosa is a further welfare issue for beef cattle and veal calves due to intensive feeding plans during their fattening [3,4]. Specific damages to the rumen mucosa and some laminitis-related disorders may both develop in response to subacute or acute ruminal acidosis conditions [5]. The main aims of the present data collection were to evaluate at the slaughterhouse the prevalence and location of claw and gastric lesions in beef cattle [6–9]

and veal calves [10,11], investigate the potential correlations among different lesions detected on the same organ or different organs, and retrospectively associate this information with the housing, feeding, and management systems of the animals during the fattening period. This paper presents data on gastrointestinal and claw disorders of 194 batches of veal calves and beef cattle (bulls and heifers) collected through a *postmortem* inspection at the slaughterhouse and information on the animals' rearing systems gathered *a posteriori* from farmer interviews. This work was supported by the University of Padova (Italy) within PRAT [CPDA158107] research project titled 'Use of animal-based measures taken at the slaughterhouse as indicators of welfare at the farm: a retrospective approach'. Potential benefits of publicly releasing these data are:

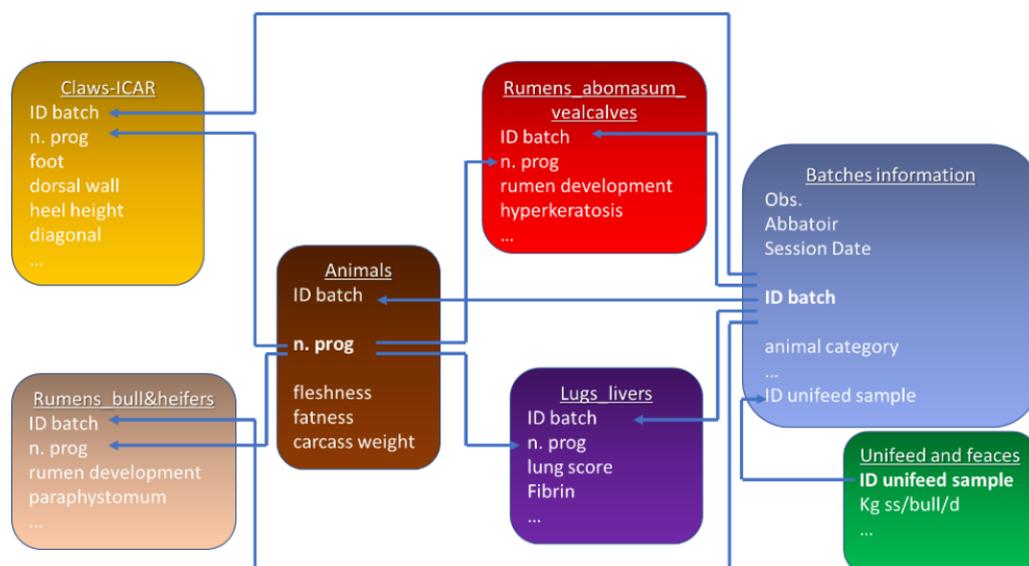
- To present an overview of the occurrence of specific rumen, abomasum, lung, liver, and claw disorders for different cattle categories (beef bulls, beef heifers, and veal calves) intensively reared for meat production;
- To provide an overview of the current housing systems, feeding plans, and farm management used for the fattening of veal calves and beef cattle in Italy;
- To allow the development of benchmarking systems to identify critical batches with a prevalence above an alarm threshold for a given lesion;
- To help the farmer and the farm veterinarian to identify and correct critical factors such as the feeding plan or the flooring system that impair animal welfare in the production system;
- To be used for comparative studies with other international beef production systems (i.e., feedlot, grass-fed, etc.).

## 2. Data Description

The dataset is provided in a single Excel file with eight sheets (one sheet containing data legend, and seven sheets with data storage) whose description can be summarised as follows:

- The sheet 'Legend\_dataset' reports the complete structure of the other sheets: the names of the recorded variables, a brief explanation of the meaning of each variable, the type of data, the unit, the number, and the pick list of the levels for discrete variables;
- The sheet 'Batches information' reports the data regarding the 194 batches inspected at the slaughterhouse and the data about the origin farm (collected using the survey Supplementary Material questionnaires S1 and S2). The 'ID batch' field is a key that allows the information content of this sheet to be linked to the information content of the other sheets;
- The sheet 'Animals' reports for each controlled animal (N = 2798), inside each batch, the carcass weight, carcass conformation, and fatness scores. 'n.prog' is the unique key field (inside each batch) that allows the information content of this sheet to be linked to the information content of the other sheets (claws and gastrointestinal organs sheets);
- The sheet 'Claws\_ICAR' includes for each foot of each animal inside each batch the information regarding specific claw dimensions measured and disorders detected on the sole following the protocol of the International Committee for Animal Recording (ICAR) Claw Health Atlas [12] (N = 5544);
- The sheet 'Rumens\_bulls&heifers' reports scores and characteristics of the gastro-ruminal apparatus of the checked bulls and heifers (N = 2161);
- The sheet 'Rumens\_Abomasum\_vealcalves' reports scores and characteristics of the gastro-ruminal apparatus of the checked veal calves (N = 670);
- The sheet 'Lungs\_livers' includes scores and characteristics of lungs and livers of the checked animals (N = 2666);
- The sheet 'Unifeed and faeces' reports the chemical and physical analyses of the total mixed ration (TMR) used and the faeces collected for some batches (N = 53). The 'ID sample' field is the key that allows the information content of this sheet to be linked to the information content of the 'Batches information' sheet.

The structure of the seven sheets used for data storage is shown in Figure 1.



**Figure 1.** Structure of the dataset. The direction of the arrows indicates a one-to-many relationships. Key fields are indicated in bold type inside the tables where they are unique.

### 2.1. Batches' Information

The sheet, which collected the information regarding all the recorded batches, was divided into nine sections:

- Data of the inspected batches at the slaughterhouse, including the identifier of the abattoir, the session date, and the animal category;
- Data about the farm of origin;
- Type of Supplementary Material questionnaire (bulls/heifers S1 or calves S2);
- Barn characteristics;
- Health status of each batch;
- Other information regarding the farm management;
- Characteristics of the liquid fraction of the diet;
- Characteristics of the solid feed;
- Identifier for TMR and faeces samples.

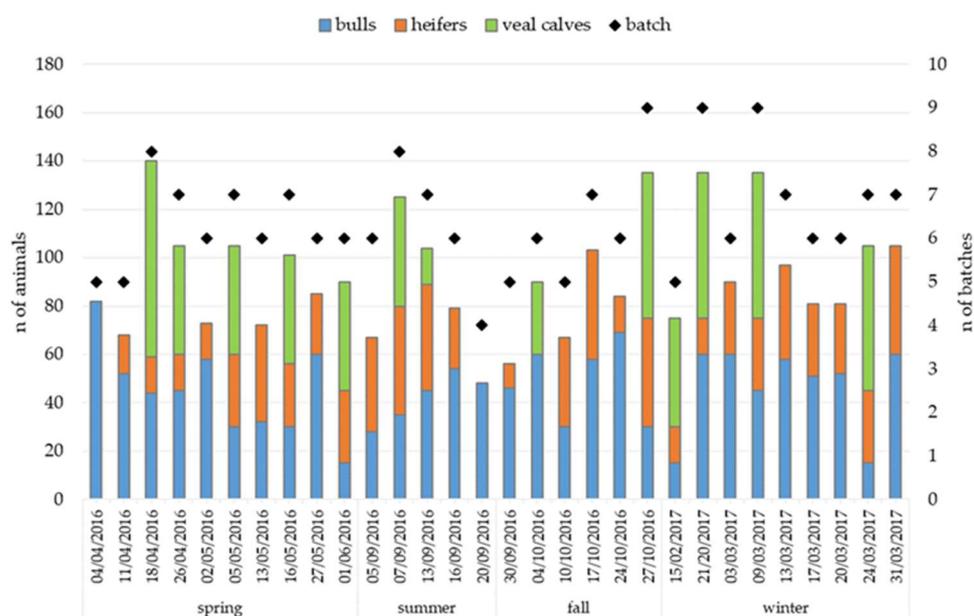
### 2.2. Animals

The sheet “Animals” reported the following information regarding the inspected animals gathered from the slaughter records:

- Identifier for ID batch;
- Progressive number for each animal inspected within the ID batch;
- Individual carcass conformation according to the SEUROP grading scheme;
- Individual fatness score;
- Individual carcass weight;
- The numbers of animals and batches of bulls, heifers, and veal calves inspected at slaughter in each of the 30 sampling days are shown in Figure 2.

### 2.3. Claws Disorders

Claw health conditions were codified according to [12] (Table 1). The position of disorders on the sole was recorded considering seven zones: codes from 1 to 6 for digital position and 10 for the interdigital one [13]. Code 9 was associated with the coronet area. Each disorder in a specific zone of the claw was recorded as a binary measure (presence/absence).



**Figure 2.** Numbers of animals and batches of bulls, heifers, and veal calves inspected for the 30 sampling days, grouped according to the season.

**Table 1.** Abbreviations used in the dataset, ICAR system abbreviation, and corresponding pathologies and position on the claw.

Abbreviation	ICAR System Abbreviation [12]	Pathology	Position
D	DD	Digital dermatitis	lateral, medial, interdigital
E	HHE	Heel erosion	lateral, medial, interdigital
I	ID	Interdigital dermatitis	interdigital
F	IP	Phlegmon, foot rot	interdigital
H	SH	Sole haemorrhage	lateral, medial
C	CC	Corkscrew claw	lateral, medial
W	WL	White line lesions	lateral, medial
U	SU	Sole ulcer	lateral, medial
Z	TS	Thin sole	lateral, medial
T	TU	Toe ulcer	lateral, medial
SW	SW	Swelling of the coronet	coronet

## 2.4. Gastrointestinal Disorders

### 2.4.1. Rumens of Bulls and Heifers

Rumen mucosa development was graded according to the 4-point scale described in detail by [4]: 1 = hairless; 2 = few and little papillae; 3 = papillae < 2 mm; 4 = leaflet shaped papillae. Macroscopic alterations (e.g., hyperkeratosis, signs of ruminitis, ulcers, star scars, etc.) were registered as binary measures (present/absent), following the methods reported in [9]. Whenever there was the presence of rumen parasites (*Paramphistomum*), it was also recorded as binary (presence/absence). A global lesions score was calculated as a weighted linear combination of the recorded alterations:

$$(1 \times \text{redness\_of\_mucosa} + 2 \times \text{hyperkeratosis} + 3 \times (\text{stars\_lesion} + \text{sign\_of\_acidosis})), \quad (1)$$

The value of the global lesion score is between 0 and 9.

### 2.4.2. Rumens and Abomasa of Veal Calves

Rumens disorders were codified as for beef cattle. Regarding abomasa inspection, the presence of any kind of lesions on the mucosa of the torus pylorus was evaluated as a

binary variable (yes/no). Lesions in the pyloric region were counted from zero (no lesions) to a censored maximum of four (presence of four or more lesions) within three size classes: small lesions with a diameter  $< 0.5 \text{ cm}^2$  (ulcer1), medium lesions with a size between 0.5 and  $1 \text{ cm}^2$  (ulcer2), and large lesions  $> 1 \text{ cm}^2$  (ulcer3) [4,14]. A global abomasal score was calculated as a weighted linear combination of the three types of ulcers:

$$(1 \times \text{ulcer1} + 2 \times \text{ulcer2} + 3 \times \text{ulcer3}), \quad (2)$$

The value of the abomasal score is between 0 and 24.

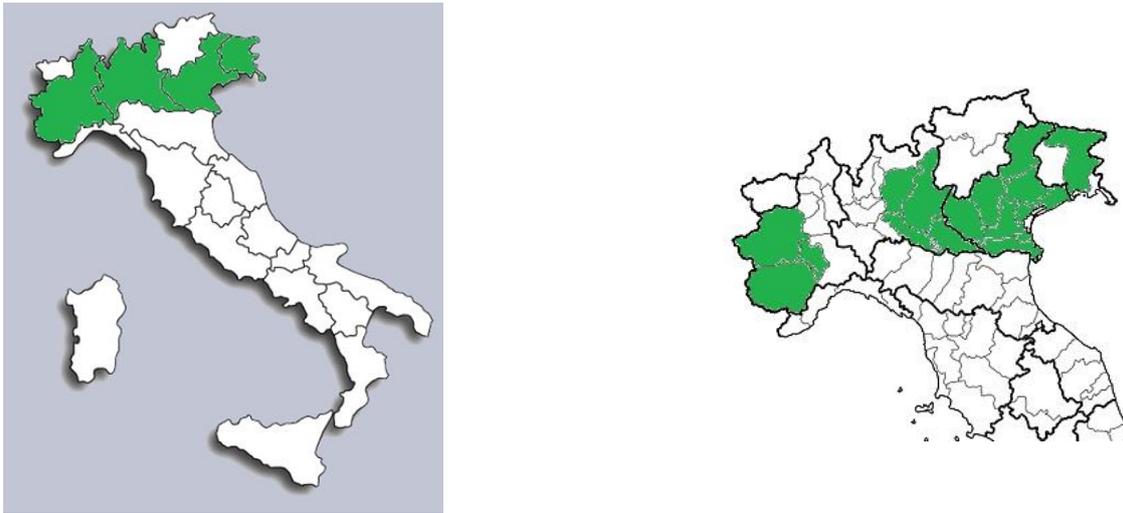
#### 2.4.3. Lungs and Livers

Lungs were scored using the signs of pneumonia from 0 to 3: 0 = healthy; 1 = spot; 2 = < of one lobe or little spots; and 3 = > of 1 lobe or abscess. The presence of fibrin or pleuritis was also recorded. At the liver level, signs of lipidosis and the presence of abscesses and/or adhesions were recorded as binary codes.

### 3. Methods

Data collection was carried out in 3 commercial cattle slaughterhouses located in Northern Italy from April 2016 to March 2017. The Po Valley is the core area of intensive beef cattle and veal calves' production that accounts for 70–75% of the total animals in Italy [15]. One hundred and four fattening farms located in the lowland area of four regions (Piemonte, Lombardia, Veneto, and Friuli Venezia Giulia, Figure 3) were involved. Three different assessments were carried out: the first assessment was made from April to June 2016 (10 sampling days), the second from September to October 2016 (11 sampling days), and the third from February to March 2017 (9 sampling days). *Post-mortem* evaluations were carried out by three veterinarians during 30 sampling days on batches of cattle that were regularly slaughtered according to ordinary slaughterhouse planning. Each observation day lasted from 06:00 h to 13:00 h with a target of inspecting at least six batches per day. *Postmortem* inspections of individual animals belonging to 97 batches of young bulls, 56 batches of beef heifers, and 41 batches of veal calves were acquired. A batch was considered a homogeneous group of cattle of the same breed and category (bulls or heifers or calves) coming from the same farm and belonging to the same slaughter group (during loading, transport, unloading, lairage time, and slaughtering phases). It was set to inspect the claws and organs of at least the first 15 animals per batch for batches larger than 15 animals and of all the animals in the case of smaller batches. In total, 2798 animals were assessed. The veterinarians were located in different areas of the slaughter line (dispatch, tripery, and skins areas), allowing the tracing and inspection of different organs belonging to the same animal. Rumen, lungs, liver, and claws were examined for each animal, plus the abomasum for each veal calf. A prerequisite of the assessment was to use a set of quick measures (1 min/head) that could be applied without interfering with the regular working of the slaughter line. Individual carcass weights were obtained from the slaughterhouse records. After each observation day, information about the farm of origin of each inspected batch were obtained *a posteriori* by the slaughterhouse personnel. A trained assessor visited the farm of each inspected batch (on average  $6.61 \pm 6.2$  (mean  $\pm$  SD) days after the slaughter sessions) to interview the stockman face-to-face with a standardised questionnaire gathering information regarding features of the rearing facilities and health management during the finishing period (Supplementary Material S1 and S2 survey questionnaires for beef cattle and veal calves, respectively). Both beef cattle and veal calves in the farms of origin were intensively reared indoors and housed in multiple pens with fully slatted or deep littered floors and provided high-concentrate diets [7,14,16]. A fresh TMR sample of the fattening diet and a pool of faeces belonging to their peers still present at the farm was also collected after ensuring that breed, gender, finishing period, TMR, and rearing facilities were the same as for the animals inspected at the slaughterhouse. After collection, TMR and faeces samples were chemically assayed and physically analysed for their particle-size distribution. The protocol of the study did not consider any *in vivo* cattle manipulations

that would require specific approval by an ethical board. The assessments of carcasses performed *postmortem* did not require the approval of the animal welfare committee. An input validation of data was assumed to preserve the integrity and consistency of the information stored in the dataset [17]. A white-list validation was adopted that stated by definition exactly what was authorised to be entered. The length, type, minimum, maximum, or the pick list of possible levels of the input data were defined a priori. The white list was reported in the 'Legend\_dataset' sheet of the database.



**Figure 3.** Four Italian regions and 15 provinces where the batches of beef cattle and veal calves were reared.

**Supplementary Materials:** The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/data7040043/s1>, Supplementary Material S1: Copy of questionnaire provided to the farmers of finishing beef cattle; Supplementary Material S2: Copy of questionnaire provided to the farmers of veal calves.

**Author Contributions:** Conceptualisation, supervision, funding acquisition, project administration: F.G.; methodology: F.G., L.M., G.C.; data curation, writing—original draft preparation: L.M., B.C.; software, formal analysis: B.C.; writing—reviewing and editing: all authors. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research was funded by the University of Padova, Italy, grant number PRAT project [CPDA158107].

**Institutional Review Board Statement:** Not applicable. The protocol of the study did not consider any in vivo cattle manipulations that would require a specific approval by an ethical board.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** The data presented in this study are openly available at Research Data Unipd, the open-source repository of databases at the University of Padova <http://researchdata.cab.unipd.it/id/eprint/589> (accessed on 7 March 2022).

**Acknowledgments:** We thank the AZOVE beef cattle producers' association, their veterinarians for the support, the official veterinary inspectors, and all personnel of the slaughterhouses involved (Colomberotto S.p.A., Pellizzari Carni dei Fratelli Pellizzari Snc, and Macello Piemonte Nord Srl) for hosting the research group for data collection.

**Conflicts of Interest:** The authors declare no conflict of interest.

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