

Introductory notes to the Thematic issue on Measurements and Applications in Veterinary and Animal Sciences – part 2

Leopoldo Angrisani¹, Francesco Lamonaca^{2,3}, Gianluca Neglia⁴

¹ Department of Information Technology and Electrical Engineering, University of Napoli Federico II, Naples, Italy

² Department of Computer Engineering, Modeling, Electronics and Systems Engineering, 87036 Arcavacata di Rende, Italy

³ National Research Council of Italy, Institute of Nanotechnology (CNR-NANOTEC), Rende, Italy

⁴ Dept. of Veterinary Medicine and Animal Productions, University of Napoli Federico II, Via F. Delpino 1, 80137 Naples, Italy

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Corresponding author: Leopoldo Angrisani, e-mail: angrisan@unina.it

Dear Readers,

This thematic issue continues the previous one published in Acta IMEKO Vol. 12, No. 4. The number and quality of papers included in both issues highlight the significant and authoritative contribution of the metrology Community to the field of veterinary and animal science.

It is our pleasure to provide you with a brief introduction to the papers in this new issue. We hope you will find interesting solutions and ideas that will further stimulate research in the field and foster the creation of a network of scientists from different disciplines to address the numerous challenges of this research field.

In [1], the Authors highlight the importance of reference intervals (RIs) in clinical pathology. RIs are a necessary metrological practice in veterinary clinical pathology to provide a database to compare results obtained from healthy versus diseased animals. Data are obtained from laboratory measurements and are typically processed through statistical tests to define the RIs. It is frequently challenging to have a large number of healthy individuals to establish de novo RIs, especially for wild and exotic animals. In the paper, drawbacks, influencing factors, and main methods for their determination are considered.

The most widely used predictor to assess the incidence of thermal stress in livestock is THI, the temperature humidity index. However, it is an indicator that disregards the individual animal and the specific farm conditions. The review presented in [2] aims to list and summarise other thermal stress predictor factors, by using non-invasive and cost-effective strategies, in particular with the aid of Precision Livestock Farming technologies.

The growing sensitivity of consumers about animal welfare and the awareness of its impact on food security and safety recently influenced international policies and the legal scenario. To face these needs, in 2018 the Italian Ministry of Health commissioned the development of a system named ClassyFarm able to categorise the level of risk arising from farm animal welfare. The aim of the study presented in [3] is to measure welfare conditions in cattle herds reared in the Aosta Valley through the ClassyFarm checklist for tie-stall dairy cattle.

Being able to obtain objective and repeatable measurements of stress levels from a single subject represents a primary issue in animal welfare science, especially in relation to cattle farming. In [4], the Authors developed and tested the reliability of salivary cortisol as a marker for the assessment of animal welfare. The aim is to develop an on-field use Lateral Flow Immunoassay (LFIA) for the evaluation of acute stress in bovines.

The paper in [5] deals with the prediction and, consequently, the control of oxidative phenomena, a big challenge for meat industry. Since colour modifications and volatile compounds synthesis are processes closely linked to the oxidative reactions occurring in meat, oxidation could be measured through colorimetric parameters or some volatile compounds. A Spearman's correlation analysis of oxidative parameters and enzymatic activity with colorimetric parameters and volatile profile was performed on horse steaks subjected to short (14 days) and long aging time (56 days).

Monitoring the health status of broilers and the early detection of any health problem is of great importance in intensive farming, especially nowadays as antibiotics are drastically reduced. Precision Livestock Farming (PLF), through the combination of cheap technologies and specific algorithms, can provide valuable information for farmers starting from the huge amount of data collected in real time at farm level. The

study in [6] is aimed to the application of a PLF diagnostic tool, sensible to the variation of volatile organic compounds, to promptly recognise enteric problems.

The paper in [7] deals with the determination of sulfonamides in muscle as a metrological tool for food safety. Indeed, sulfonamides represent a wide class of synthetic drugs commonly used in veterinary therapy for the treatment of several bacterial and protozoan infections in cattle, swine and poultry. The use of these drugs in farming can lead to the possibility of having their residues in animal products intended for human consumption.

Also the paper in [8] deals with food safety. It is devoted to detecting common adulterants in bulk bovine milk by using Fourier transformed mid-infrared spectroscopy and Partial least squares – discriminant analysis. The presence of adulterants in bovine milk represents a risk for dairy industries and public health and it needs to be faced with new approaches, like those offered by PLS-DA.

The study in [9] seeks to evaluate a prototype effectiveness in safeguarding livestock against wolf attacks. With an increasing imperative to protect livestock from predation, the prototype's performance was systematically assessed under different conditions. The study primarily aimed at assessing the prototype's ability to detect wolf attacks by analyzing noise variations inherent to predator assaults. Simultaneously, the prototype aimed to mitigate livestock casualties and foster coexistence between wolves and livestock.

Texture of meat is a critical parameter of consumer's acceptability. In this regard, aging technology has become essential to enhance meat tenderness and flavor. The study in [10] evaluated the effect of dry-aging on the rheological properties of cooked and raw meat using objective instrumental measurements: colorimeter, texture profile analysis and Warner Bratzler shear force test. Results showed that aging time and cooking tended to decrease the hardness and shear force implying more tender meat for the consumer.

The study in [11] aimed to investigate the phenotypic factors affecting the variability of the milkability traits measured in Italian dairy goats through a portable milkmeter in commercial herds. Milkability descriptors combine either milk production, milking time, or milk flow, and are important to consider for reasons related to udder health, e.g., they can be exploited for large or small-scale monitoring of mechanical milking stress. Monitoring milking ability of goats through milkmeters in the field can be a strategy to evaluate milking procedures of farmers and could thereby boost the implementation and effectiveness of udder health improvement schemes with positive implications on milk quality, animal welfare and farm profitability.

The aim of the study presented in [12] is the characterization of eight mixed forages preserved as hays produced in four agricultural and livestock farms located in four Provinces (Avellino, Benevento, Campobasso, and Potenza) of Southern Italy, different for environmental conditions. Nutritive values including methane production were determined. The little differences observed between sampling areas highlighted that the forage produced in Avellino area is the most interesting in terms of chemical composition, nutritive value, in vitro characteristics, and environmental impact. Data obtained allow having more information about hays produced in the study area, useful for farmers to make balanced rations, to maintain animal health and guarantee high quality of production.

The Authors of [13] propose a study to evaluate the effect of beneficial fungal microbes as novel eco-sustainable tools for forage crops. Traditional approaches to protect agricultural crops

are based on the use of chemical pesticides. Nevertheless, these products are costly, contaminate the environment and are harmful to animals and humans. Reduction or elimination of chemical applications in agriculture is extremely important, and the application of biostimulants and biological control agents is an efficient alternative for an eco-sustainable agriculture. This study demonstrated that formulations based on fungi belonging to *Trichoderma* genus had beneficial effects on forage crops and significantly affected plant metabolome.

Monitoring daily behavioral activities of cows in livestock farms is strategic for improving the herd management. For this reason, IoT techniques and smart sensors are becoming the most common technological support in barns. The aim of the study presented in [14] is to validate the use of predefined accelerometer thresholds in timely detecting cow behavioral activities through the statistical analysis of the data acquired from accelerometers housed in collars.

The work in [15] aimed to collect and analyse data obtained from the routine post-mortem veterinary inspection of bovine viscera and to evaluate the reliability of remote veterinary meat inspections. A comparative study was conducted on viscera belonging to 30 bovines. For each bovine, findings were recorded simultaneously by two veterinarians, one conducting an on-site post-mortem inspection and another performing the remote inspection through a tablet. In an overall 73.33 % of bovines, the findings recorded by the veterinarian who conducted the on-site post-mortem inspection and those recorded by the veterinarian performing the remote inspection were overlapping.

Anaerobic digestion can provide a valuable aid to manure management while producing renewable energy. Biogas production is highly dependent on the size and composition of livestock farms, and the availability of fresh manure can vary throughout the year, limiting reliable assessment of potential production. The aim of the study in [16] is to develop an affordable GIS-based analysis to support manure management, based on a highly detailed livestock farm database.

Exercise tests are indicated for the evaluation of a horse physical condition and for the analysis of poor athletic performance, often associated with discomfort during training or competition that creates excessive stress in the animal. In order to understand the different biological mechanisms of adaptation to exercise-induced stress, a large amount of data need to be collected in real time, to obtain what is called "deep phenotyping" (DEPH) that opens the way to the full exploitation of omics techniques. The aim of the study in [17] is the configuration of innovative low-cost sensors for real time detection of crucial stress parameters that will allow early identification of metabolic dysfunctions preserving the horse's welfare.

The technological features of milk are essential for cheese manufacturing. This is particularly true for Italy, where most of the milk produced by sheep is intended for cheese production. The possibility to evaluate technological characteristics and coagulation aptitude of milk in advance, before any treatment, is crucial for decision-making at industry level. In the study presented in [18], the Authors tested the ability of mid-infrared spectroscopy for prediction of coagulation traits (rennet coagulation time and curd firmness) by using more than 4000 bulk milk samples of 344 sheep herds. The models developed with a partial least square regression showed that spectral data points can be successfully used to predict the two traits.

In the last years, the livestock sector has been moving towards a more sustainable animal-based industry, mitigating the environmental impact of livestock while meeting the demand for high-quality food. To achieve these goals, farms are using a more technological approach, adopting algorithms to manipulate the vast amount of data from sensors and routine operations. In this context, machine learning can be successfully employed. The brief review reported in [19] gives an overview of the current state of the art of the most popular applications for dairy science and the most widely used and best-performing algorithms, highlighting the challenges and obstacles for a broad acceptance of these techniques in the dairy sector.

The measurement of behaviour in extensively managed livestock for the assessment of welfare remains a challenge. Bio-logging devices offer the opportunity to collect continuous behavioural data over long periods while animals are in their normal physical environment. Using collar-measured acceleration from 84 ewes over 28 days in a commercial flock, the Authors of [20] built two-component daily phenotypic profiles with data-driven analysis techniques not reliant on human observations. The reported results in relation to previous work, showed that the proposed methods of measurement and analysis are capable of revealing the daily patterns of behaviour in sheep and how these are influenced by the physical environment and genetics.

In recent years, the role of the microbiota has proved to be extremely important in medicine as one of the most important aspects for the characterization of living beings in both healthy and pathological conditions. In veterinary sciences, microbiome studies have seen applications not only in medicine in the strict sense (e.g. diagnosis) but also, for example, in food inspection (quality, fraud, etc.) and in animal feed preparation itself. In [21], the Authors present, as a case study, a critical discussion about the large number of metrics and their impact in the statistical comparisons among groups.

We hope you will enjoy your reading.

Leopoldo Angrisani
 Francesco Lamonaca
 Gianluca Neglia
 Section Editors

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