



UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II

itee_{PhD}
information technology
electrical engineering



DIE
TI

UNI
NA



PON
RICERCA
E INNOVAZIONE
2014 - 2020

PhD Maria Teresa Verde

“Smart Farm in Buffalo Farm”

PON Dottorati di ricerca su tematiche dell'innovazione e
green - Azione IV.5 (Green)

Tutor: Prof. Leopoldo Angrisani
co-Tutor: Prof. Francesco Bonavolontà

Cycle: XXXVII

Year: 2022

My background

- **MSc Degree in Veterinary Medicine**
- Bachelor's Degree in **Technologies of Animal Production**
- **Qualified Zootechnical Veterinary Doctor**
- Research Grant at Department of Veterinary Medicine and Animal Production (Prof. Luigi Esposito, Scientific director)
- PhD start date – 01/01/2021

Research field of interest

Precision Livestock Farming (PLF) is define as the efficient management of livestock farming through the use of principles and engineering technologies.

PLF systems usually consist of sensors that may be attached to or implanted inside the animals such as
or placed in the barn

Cameras, microphones, temperature loggers



Smart Collar



Ear Tag



Research field of interest

By collecting data with sensors and analyzing them, PLF enables:

- Efficient utilization of food and nutrients;
- The early detection of health issue;

Food and nutrients



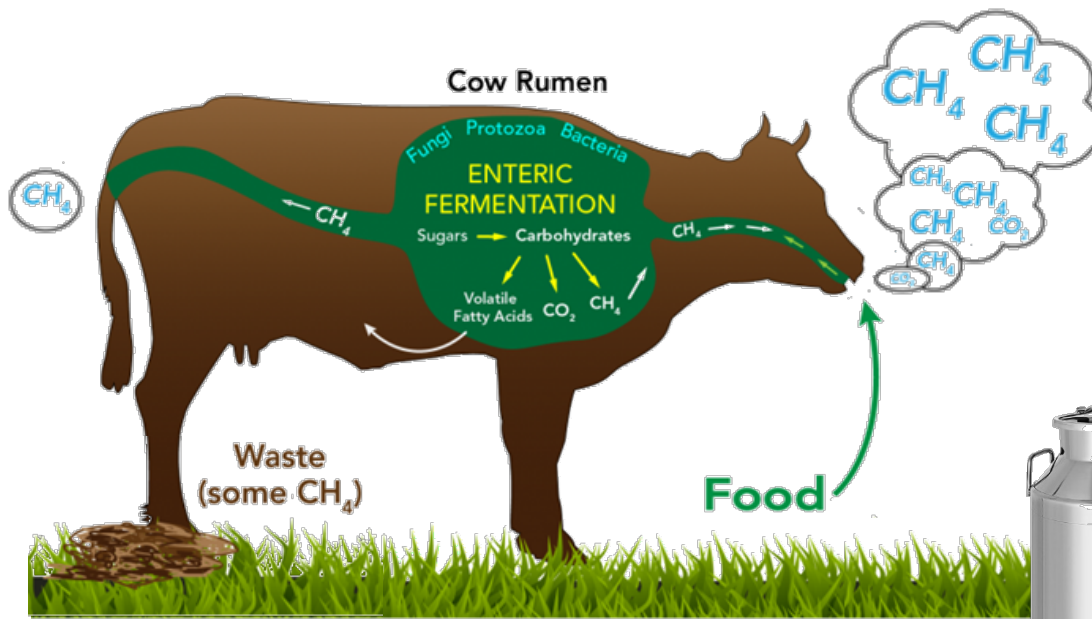
Health issue



Research field of interest

By collecting data with sensors and analyzing them, PLF enables:

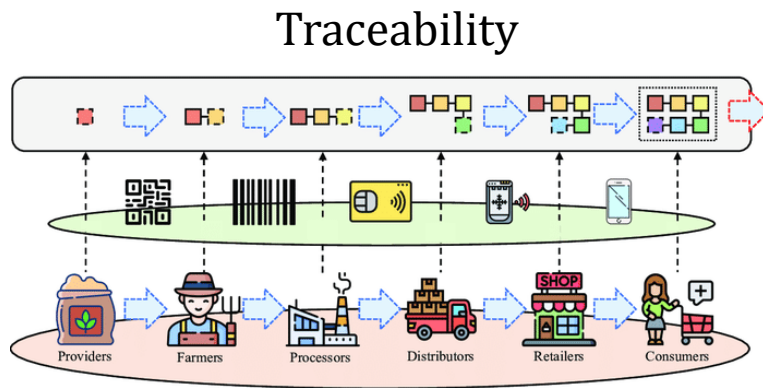
- Environmental sustainability (Reduction of Methane and Ammonia emissions);
- Increasing quantity and quality of animal production



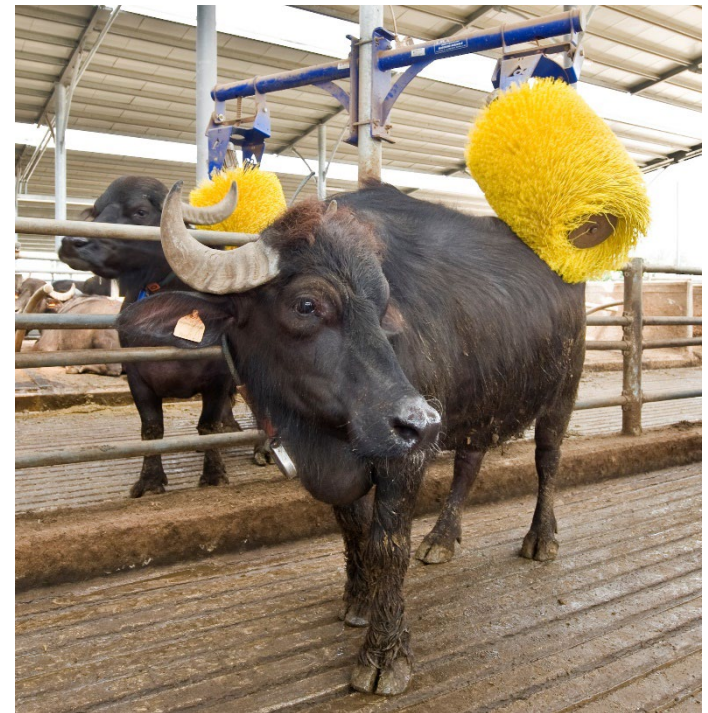
Research field of interest

By collecting data with sensors and analyzing them, PLF enables:

- Improving Animal Welfare;
- Full traceability of the entire supply chain.



Animal Welfare



Summary of Study Activities

In the following table, educational and research credits, acquired during the first year, are reported:

	BM1	BM2	BM3	BM4	BM5	BM6	TOT
Ad hoc course			5				5
Other course/Ph.D. Schools		6	18	6			30
Seminars		2,6	2	3		0,5	8,1
Research	3	3	3	3	6		18

The minimum number required for each item is reached

Summary of Study Activities

Courses:

Activity	Credits
Corso di dottorato in Ingegneria Industriale “Federico II”: Piattaforme di misura e monitoraggio basate su Internet of Things. Prof. Schiano Lo Moriello.28/04/2022	6
Big Data Architecture and Analytics. Prof. Sperli. 29/06/2022	5
Sensori e Trasduttori di Misura. LM Ing. Elettronica. Prof. D. Grillo.29/06/2022	9
Sensori e Smart Metering. LM Ing. Elettrica. Prof. F. Bonavolontà. 20/06/2022	9
Intelligenza Artificiale. Prof. Flora Amato 7/7/2022.	6
	35

Seminars:

“La termografia come strumento di precisione nell'allevamento degli animali da reddito.” Leonardo Nanni Costa, Università di Bologna, Veronica Redaelli, Università di Milano Fabio Luzi Università di Milano. 02/03/2022.	“Running towards Car Electrification, ST MICROELETTRONICS”, S. Cannavacciuolo, V. D’Angelo, F. Bonavolontà, 16/05/2022.
“Transdairy Living Lab’s Open Day ICT & Bio Nanotechnology”, Prof. L. Zeni, A. Mandolini, A. Anastasio, A. Minardo, F. Bonavolontà, N. Cennamo, A.Varriale, S. Sarkis, 31/03/2022.	“Artificial Intelligence @ The Deep Edge” 2/06/2022.
“Picariello Lectures on Data Science – II Cycle Ethics and Politics of A.I, Prof Mark Coekelbergh”, 11/04/2022.	“Augmented reality for remote use of measurement Instrumentation” Prof. Liccardo. 24/05/2022.
“Picariello Lectures on Data Science – II Cycle Can a Text-to-Speech Engine Generate Human Sentiments?”, Prof. Vijay K. Gurbani. 28/02/2022	Power Electronics: control and architecture. A mini Campus. 4/5 Luglio 2022 presso STMicroelectronics.
“Protozoi Intestinali come ospiti sgraditi: Giardiasi e Trichomoniasi nella pratica clinic”, Prof. Tommaso Furlanello. 2/03/2022	Seminar title Il futuro della medicina alla luce dell’applicazione dell’intelligenza artificiale e della robotica Seminar date 15/11/2022 Lecturer Bruno Siciliano , Agostino Sibillo
“Elementi di Automazione e Introduzione al concetto di domotica. Smart Building e vantaggi del sistema nelle strutture ricettive. I sistemi di comunicazione e la connessione tra i dispositivi. Il concetto di attuatore e di cavo bus.” Prof. Francesco Bonavolontà. 7/03/2022	

Research activity: Overview

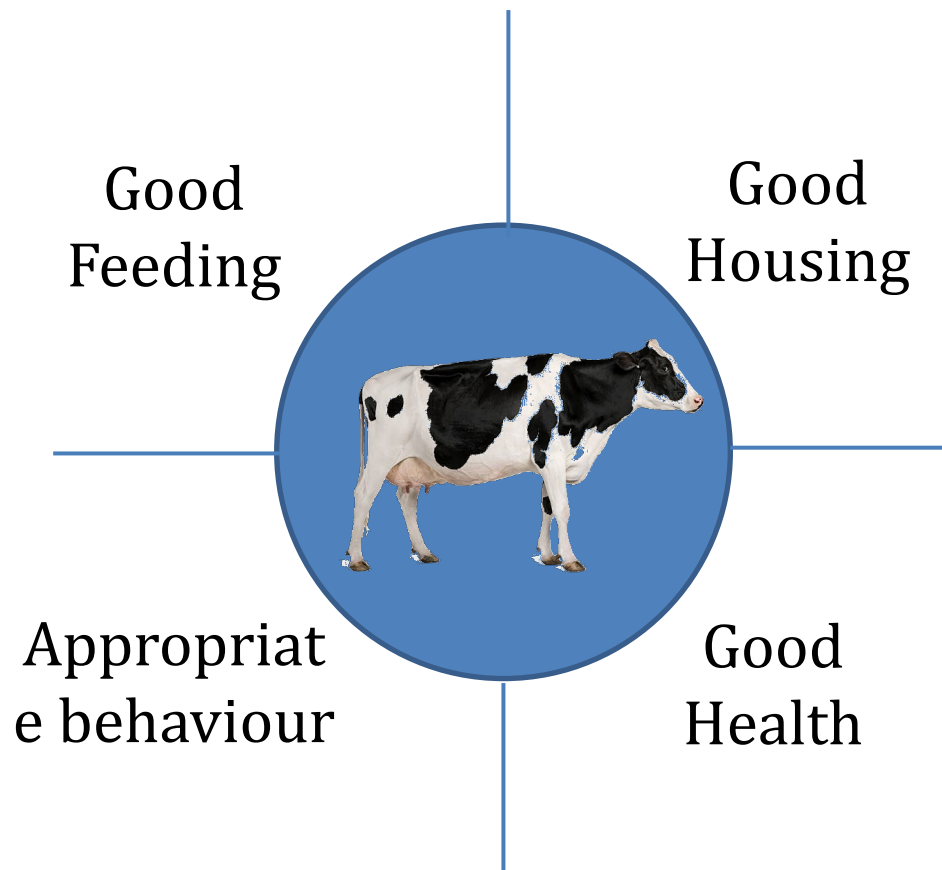
The goal of the Ph.D., entitled "*Smart farm in buffalo farm*", is to study and develop new measurement sensors and instruments for PLF applications.

Specifically, during the first year, the activity focused on:

- the study and identification of parameters of interest, knowledge of which is useful in establishing Mediterranean buffalo welfare and breeding sustainability;
- The study and design of innovative measurement systems to measure parameters of interest.

Research activity: Overview

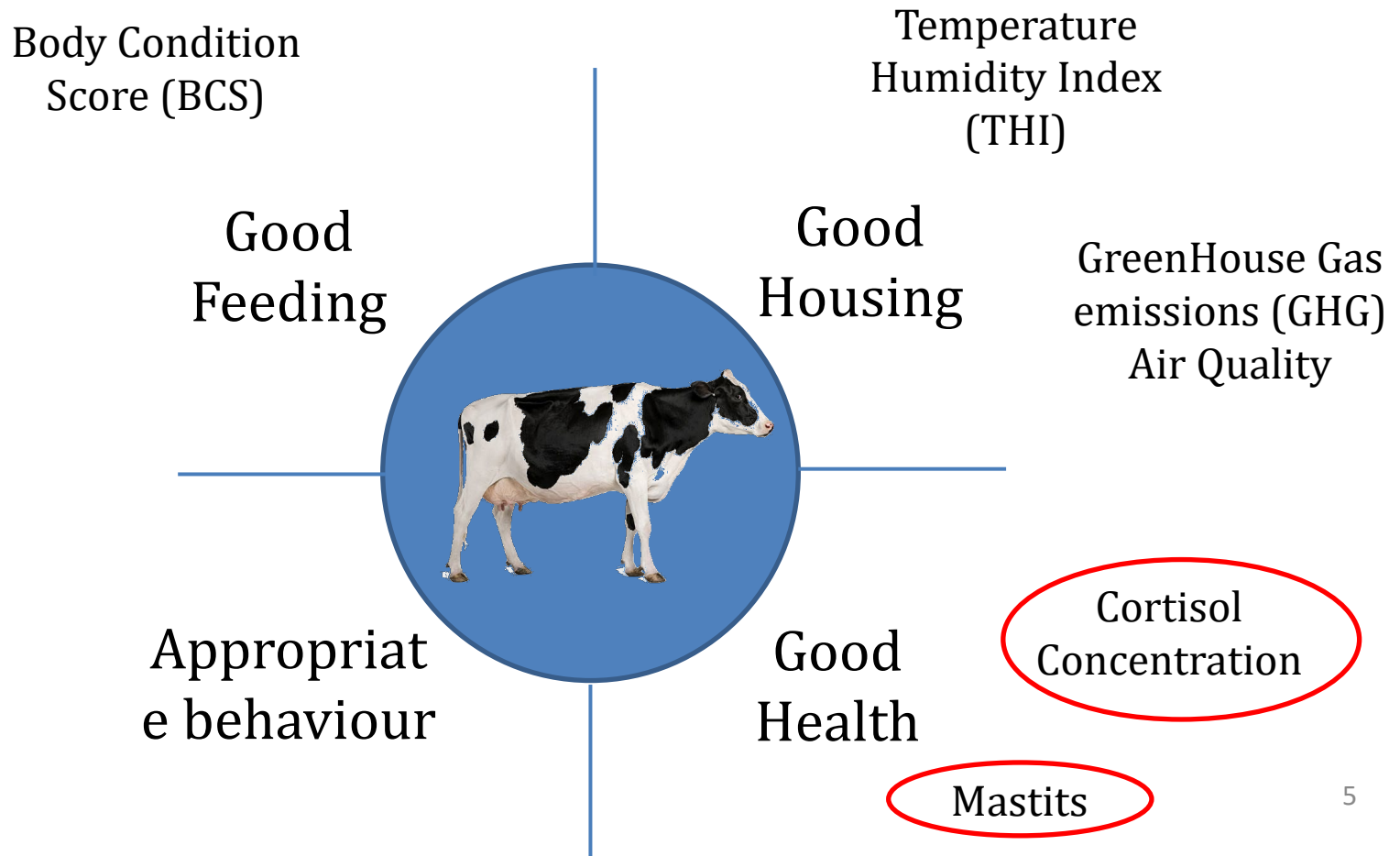
Animal welfare assessment take into account several multi-dimensional aspects



Research activity: Overview

For each aspect, there are several criteria to be evaluated in order to obtain a comprehensive information on animal welfare, production, and environmental sustainability.

For the time being, the focus has been on:



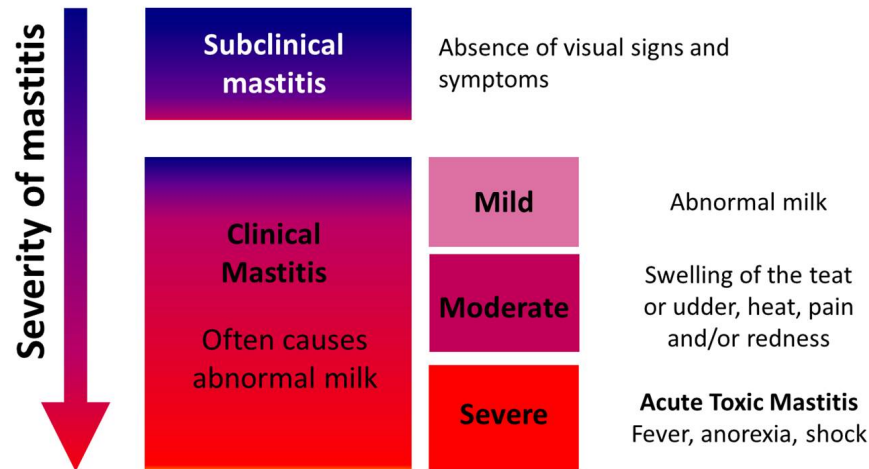
Research activity: Overview

Mastitis

Mastitis is generally defined as the inflammation of the mammary gland

Mastitis reduces the number and activity of milk producing epithelial cells and contributes to decreased milk production, reduced milk quality, decline in animal health and welfare, and added cost of treatment

Mastitis Infections



Mastitis



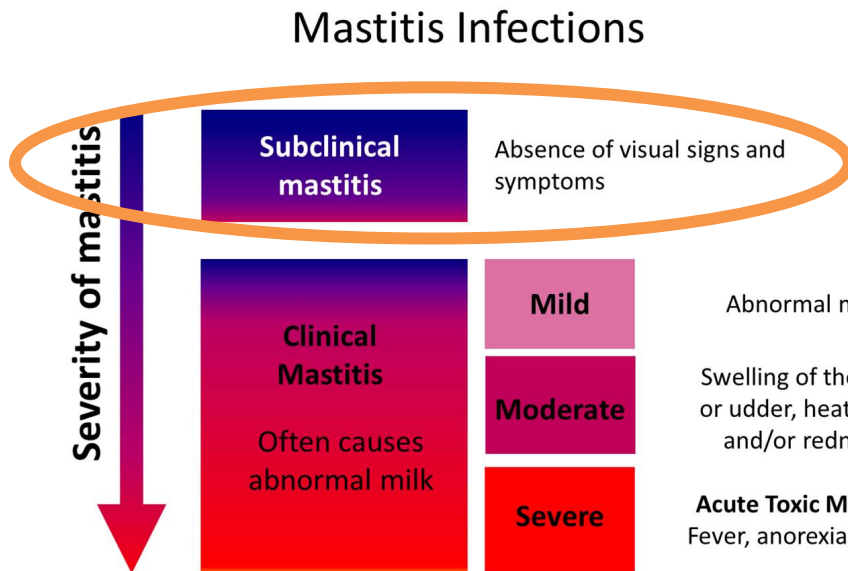
Grossly abnormal milk

Research activity: Overview

It is important to detect mastitis early, even in the absence of visual signs and symptoms. However, with traditional techniques, problems are often detected too late, when mastitis has already caused abnormal milk.

The aim of the research activity is to develop, fine-tune, and validate an innovative **rapid** and **contactless** measurement method for early detection of subclinical mastitis.

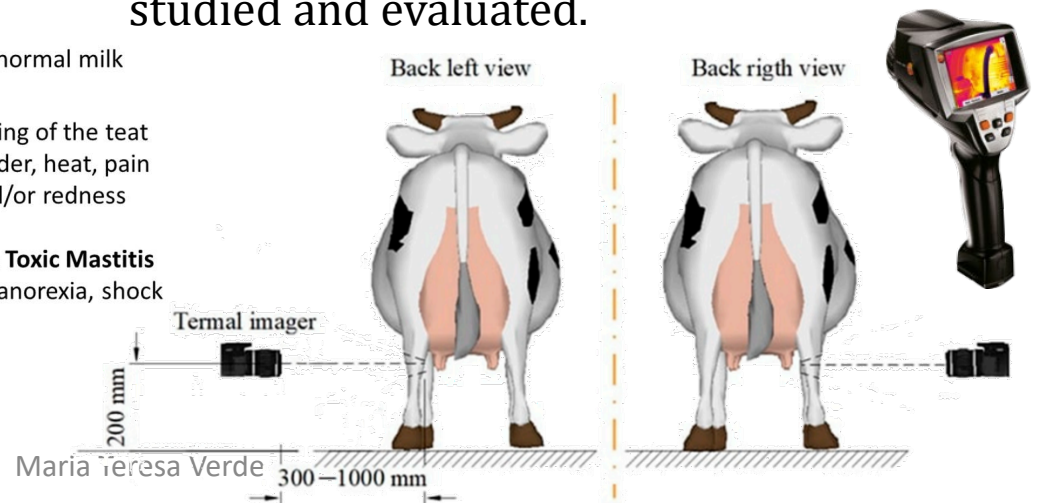
Take into account that udder surface temperature increases at the onset of inflammation, the use of **Infrared Thermography** for **Early Detection of Mastitis** (Subclinical Mastitis), has been studied and evaluated.



Abnormal milk

Swelling of the teat or udder, heat, pain and/or redness

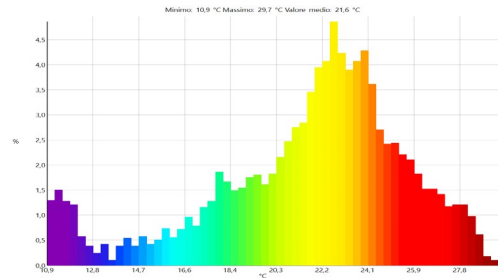
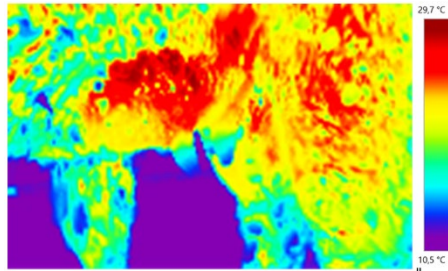
Acute Toxic Mastitis
Fever, anorexia, shock



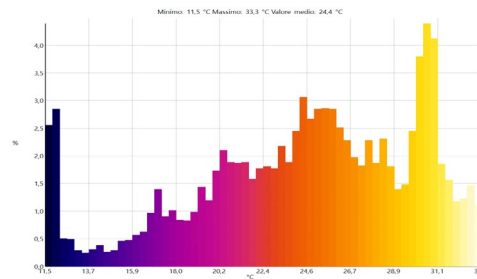
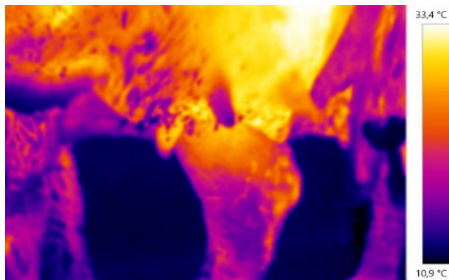
Research activity: Preliminary Results

Preliminary results highlights the feasibility of the proposed measurement method

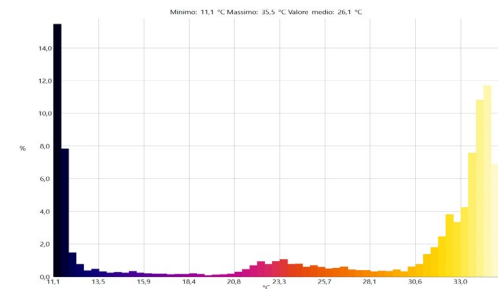
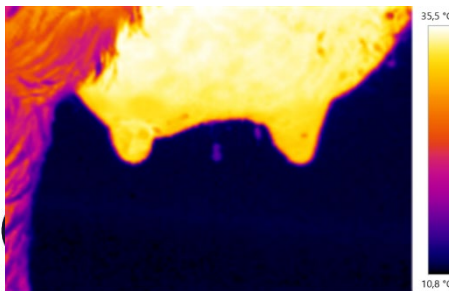
The average temperature increases with the severity of inflammation.



Control group
 $29 \pm 1^\circ$



Pathological group 1
(subclinical mastitis)
 $33 \pm 1^\circ$



Pathological group 2
(clinical mastitis)
 $35 \pm 1^\circ$



Research activity: Overview

Cortisol concentration

The assessment of cortisol concentration in biological samples is one of the main tools to evaluate the stress in animals.

The study on cortisol concentration has allowed to validate a reliable radioimmunoassay method to assess cortisol concentration in buffalo milk in order to provide a preliminary data for the calibration of future biosensing technologies for non-invasive assessment of cortisol to be integrated in milking parlour systems.

The results of the research are detailed in the following paper:



Validation of a radioimmunoassay method for cortisol in buffalo milk whey. A preparatory step for future sensor technology

Alessio Cotticelli , Maria Teresa Verde, Roberta Matera , Isabella Pividori , Alberto Prandi , Gianluca Neglia  & Tanja Peric 

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 Download citation  <https://doi.org/10.1080/1828051X.2022.2147868>

 Check for updates

Italian Journal of Animal Science

- **2.552 (2021)** Impact Factor
- **Q1** Impact Factor Best Quartile

Maria Teresa Verde

Produces

[P1]	<i>Alessio Cotticelli, <u>Maria Teresa Verde</u>, Roberta Matera, Isabella Pividori, Alberto Prandi, Gianluca Neglia & Tanja Peric (2022) Validation of a radioimmunoassay method for cortisol in buffalo milk whey. A preparatory step for future sensor technology, Italian Journal of Animal Science, 21:1, 1622-1631, DOI: 10.1080/1828051X.2022.2147868</i>
[P2]	
...	

Future Steps

As future step the following activities have been planned:

- **Organization of the Special Session “IOT-BASED INNOVATIVE TECHNOLOGIES FOR PRECISION LIVESTOCK FARMING”** at the conference 2023 IEEE International Workshop on Measurements and Applications in Veterinary and Animal Sciences, Naples, Italy, April 26-28, 2023
- Development of new sensors based on edge artificial intelligence for:
 - early detection of subclinical mastitis using infrared thermography,
 - methane emission estimation,
 - body conditioning score monitoring,and analysis of data collected from automatic milking systems.
- **Patent Submission of an innovative “Cage trap for capturing wild boar”**
- **Submissions of new journal and conference papers**

Thank You for your Attention