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Dairy Farms – *Current and Future Challenges*

**Evolution of structures**
- Increase in herd size
- Increase in labor required

**Change in the economic context**
- Price volatility
- Timely decisions
- Traceability of livestock products

**Change in rearing conditions**
- Animal welfare
- Increased risk of diseases (increased surveillance)

**Blow up of Information and Communications Technologies**
- Advances of electronic systems (portable, autonomous, ...)
- Sensors and data management (DSS, Artificial Intelligence, ...)

*Development of AUTOMATION In Livestock Farming*
Automation in Livestock Farming

The trends to higher automation in livestock farming supports the development of systems for:

- **EFFICIENCY**: more efficient use of resources and reduction of emissions per unit of product.
- **WORKLOAD**: reduction of work-load and labor costs.
- **PREVENTION**: improvement of management in livestock housing (cow welfare)
- **CERTIFICATION**: traceability of actions, events and product quality (sanitary, nutritive, ...).
The application of automation is a growing trend in the dairy industry:

- **1970**: Automatic concentrate feeder
- **1980**: Automatic Milking System
- **1990**: Automatic Feeding
- **2000**: Feed Pusher
- **2010**: Robotic Scrapers
- **2020**: On-farm dairy processing
Automatic Milking Systems (AMS)

- One of the most significant technological changes in the dairy industry
- Well-established technology
- Maximise milk production and animals’ welfare, thanks to the voluntary milking access
- Increase the resource efficiency and environmental sustainability of dairy farms.
The present study:

• Assesses the state of the art of research on AMS through a systematic review of patent trends in the last two decades (2000-2019) in order to identify research tendencies and critical gaps.

• Patents of the last 20-years were extracted from the EspaceNet database. Terms appearing in title and abstract of a total of 154 patents were processed by text mining approach.
Data Collection and Analysis

- Patents were searched using a custom script including different synonyms used to define the AMS ("automatic milking" OR "milking robot" OR "robotic milking" OR "automated milking" OR "automatically milking")


- "Title" and "Abstract" were processed with the text mining process through MS Excel and GraphPad Prism 8.0.0

- Words included in the dataset were grouped into four clusters: "Animal", "Process", "Sensors" and "Components".
Clusters Analysis - Trends

The text mining process allowed to identify the following main clusters: Components (30%), Sensors (29%), Process (25%) and Animal (16%).

In the last 10 years, the development of sensors has been incorporated in the improvement of the process efficiency. Meanwhile, the target of the patents moved towards the components.
Clusters Analysis – Words Frequencies

**ANIMAL**

*Animal body condition/weight*: +249% from 2000 to 2019

*Animal health*: +391% from 2000 to 2019

**SENSORS**

*Imaging techniques*: topic with the highest increase!


**PROCESS**


*Pulsation technologies*: +65% from 2000 to 2019.

**COMPONENTES**

*Teat cups*: -44% from 2000 to 2019.

*Milking arm*: +51% from 2000 to 2019.
CONCLUSIONS

• This study analysed the AMS patents trend over the last two decades.

• Cluster analysis showed that the AMS industry is focused on the implementation of more efficient and sustainable systems.

• The evolution of components, sensors and technologies complies both with high-quality products and ensure animal welfare.

• Topics related to the animal aspect are still underdeveloped, but their increasing trend allows to expect a progressive evolution in the animal welfare issue.
THANK YOU FOR YOUR ATTENTION!

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