ANIMAL BREEDING SUSTAINABILITY: THE ITALIAN HOLSTEIN EXPERIENCE

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ICAR 2022 MONTRÉAL CANADA
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May 30 – June 3, 2022

INTRODUCTION

•Dairy cattle is known to have impact on greenhouse gasses (GHG) emissions for over **10% of the emissions from livestock sector globally (*Gerber et. Al., 2013*)**;

•Methane (CH_4) and carbon dioxide (CO_2) emissions are heritable, providing the basis for applying genetic selection for their reduction (*Cassandro et al., 2010*);

•National breeding programs can provide relevant contribution to reduce GHG emissions;

•Since 2018 ANAFIBJ has started to record methane emissions at Genetic Center on young bulls Italian Holstein (candidates to the artificial insemination in Italy)

INTRODUCTION

Livestock Production Science, 32 (1992) 189–202
Elsevier Science Publishers B.V., Amsterdam

Genetic relationships between feed intake, efficiency and production traits in growing bulls, growing heifers and lactating heifers

G.J. Nieuwhof, J.A.M. van Arendonk, H. Vos and S. Korver
Department of Animal Breeding, Wageningen Agricultural University, Wageningen, Netherlands

(Accepted 27 January 1992)

ITALIAN HOLSTEIN OBJECTIVE

- Set up routine recording system at the Genetic Center of GHG emissions ;
  - Implementation of experimental protocols to be applied in experimental farms;
  - Implementation of experimental protocols to be applied in commercial farms;
  - Evaluate microbial contribution to CH_4 emissions;
  - Evaluate the reliability of feces and buccal swabs as a proxy of rumen sample.

MATERIAL AND METHODS

Animals:

Ongoing experiment:

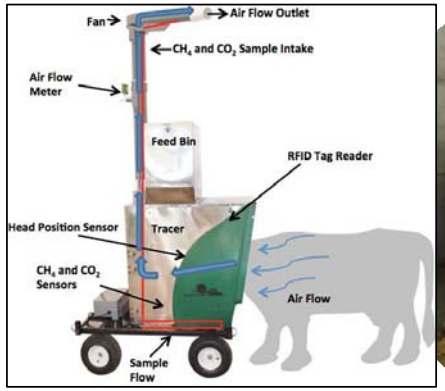
- 221 genotyped Italian Holstein young bulls using GreenFeed system;

•Future planning

- 3,000 genotyped Italian Holstein dairy cows (few daughters or sib of ANAFIBJ young bulls) in 100 commercial farms using Laser Methane Detector Mini (LMD);

- Ruminal fluid, buccal swabs and feces samples on Italian Holstein young bulls for metagenomic analysis.

MATERIAL AND METHODS



Equipment:

- Automated Head-Chamber System (AHCS; GreenFeed C-Lock Inc.,Rapid City, SD,USA);
- Laser Methane Detector Mini (LMD, Crowcon, Abingdon, UK);
- Flora Rumen Scoop (Profs Products).

MATERIAL AND METHODS

Data from animals:

- Body weight (WEI);
- Body Condition Score (BCS);
- Heart girth (HG);
- Height (HEI).

Data from GreenFeed:

- Number of visits (NVG);
- Carbon-dioxide daily emissions (CO_2);
- Methane daily emission (CH_4);
- Average airflow (AIR);
- Average time (ATG).

Data from Laser Methane Detector Mini:

- Mean of CH_4 peaks (P_MEAN).

Data from metagenomic analysis:

- Relative abundance of OTU (ABU).

MATERIAL AND METHODS

EXPERIMENTAL PROTOCOL – GREENFEED SYSTEM

FACTORS	FREQUENCY
Animals per box	Max. 20 animals/day
Feed unloading time	40 s
Quantity of feed per unloading	≈ 60 g
Feeding interval	21,600 s = 6 hours
Feed unloading frequency	Max. 6 time / access
Daily access limit	Max. 24 times / day

MATERIAL AND METHODS

EXPERIMENTAL PROTOCOL – LASER METHANE DETECTOR MINI

FACTORS - Measuring livestock CH_4 emissions with the LMD: a review (Sorg, 2021)	
Distance between animals	2 m
Distance to the animal	1,5 m
Duration of recording	300 s
Measurement interval	0,5 s
Total number of repeats per animal	28 (in 10 days)
Number of consecutive days per measurement	5 (mon-fri)
Time of day	8:00 am, 12:00 am, 3:00 pm;
Animal activity	Standing
Pointing angle	180° (front of the animal)

MATERIAL AND METHODS

EXPERIMENTAL PROTOCOL – RUMINAL FLUID / BUCCAL SWABS / FECES

FACTORS	FREQUENCY
Position of the animal	Standing with head locked
Frequency of sampling	2 times in 100 days
Interval between sampling	≈ 80 days
Storage condition	- 80°C
Strumental analysis	Shotgun Metagenomic Sequencing 16SrRNA

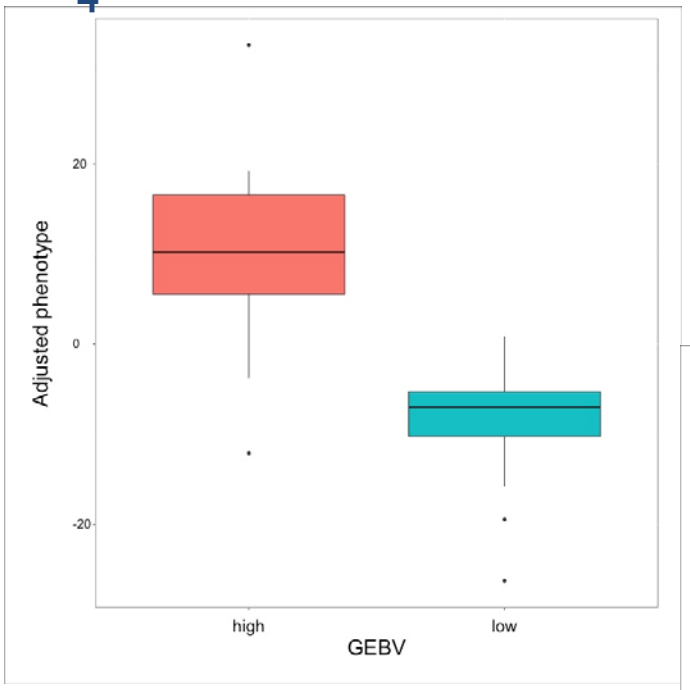
Descriptive statistics

Trait	Metric	N	Mean	SD
WEI	kg	885	309.3	77.5
BCS	score	849	3.0	0.3
HG	cm	715	157.3	14.2
HEI	cm	714	125.5	7.7
«GREEN TRAITS»				
NVG	count	2,817	3.9	1.7
CO_2	g/d	2,817	6198.2	1103.9
CH_4	g/d	2,817	223.6	51.8
AIR	L/s	2,817	29.2	4.0
ATG	s	2,817	329.3	87.5

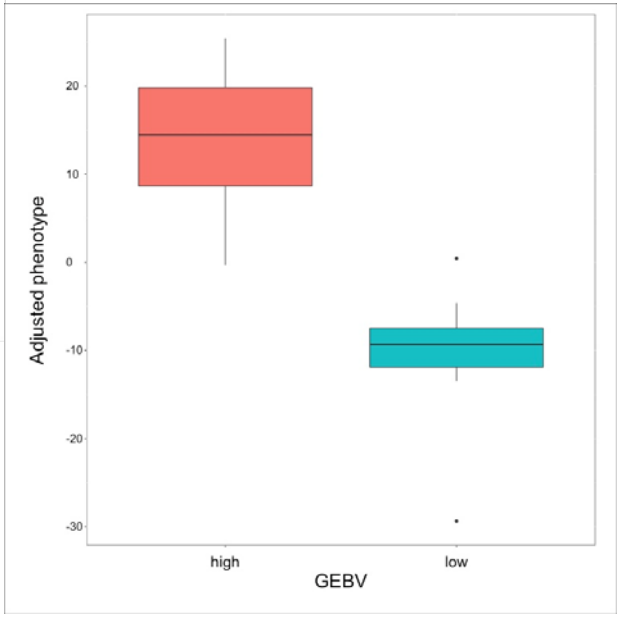
Trait	h^2
WEI	0.45 (0.24)
BCS	0.51 (0.20)
HG	0.44 (0.25)
HEI	0.39 (0.23)

NVG	0.36 (0.11)
CO_2	0.48 (0.21)
CH_4	0.40 (0.17)
AIR	0.45 (0.09)
ATG	0.24 (0.11)

CH_4



CO_2



CONCLUSION

- Selection indices could be built in order to reduce GHG emissions without compromising growth, BCS, stature and feed intake;
- We are testing several protocols and our genetic center is turning in a «LIVING LAB»
- We will produce a «green certificate» for our bulls i
- Lot's work still has to be done

MANAGING GENETIC DIVERSITY IN DAIRY CATTLE

WORKSHOP

thursday 14th of July 2022

REGISTRATION DEADLINE JUNE 30th

HYBRID MEETING

ON-SITE attendance:
ANAFIBJ - CREMONA - ITALY
via Bergamo, 292
REGISTRATION FEE 80€
&
ON-LINE attendance:
REGISTRATION FEE 50€

attendance certificate

info and registration please contact clararapazzoli@anafi.it

PROGRAM

10:00 **Prof. Martino Cassandro** *General Manager ANAFIBJ - ITALY*
THE EVOLUTION OF ARTIFICIAL INSEMINATION (AI) IN ITALY

10:40 **Prof. Christian Maltecca** *North Carolina State University - USA*
LIVESTOCK INBREEDING IN THE GENOMIC ERA

11:20 **Mr. Emmanuel Lozada Soto** *North Carolina State University - USA*
GENETIC DIVERSITY IN FIVE NORTHERN AMERICAN DAIRY BREEDS

12:00 **Dr. Michela Ablondi** *Università di Parma - ITALY*
GENOME-WIDE SCAN REVEALS GENETIC DIVERGENCE IN ITALIAN HOLSTEIN COWS BRED WITHIN PDO CHEESE PRODUCTION CHAINS

12:40 / 14:00 LUNCH BREAK

14:00 **Dr. Christian Persichilli** *Università del Molise - ITALY*
EXPLORING GENOME-WIDE DIFFERENTIATION AND SIGNATURES OF SELECTION IN ITALIAN AND NORTH AMERICAN HOLSTEIN POPULATIONS

14:40 **Dr. Jan-Thijs van Kaam** *ANAFIBJ - ITALY*
HOLSTEIN EFFECTIVE POPULATION SIZE REDUCING

15:00 **Dr. Saija Tenhunen** *Arhus University and VikingGenetics - DENMARK*
INBREEDING MANAGEMENT IN NORDIC HOLSTEIN

15:40 / 16:00 **Prof. Martino Cassandro** *General Manager ANAFIBJ - ITALY*
Conclusions

THANKS FOR THE ATTENTION!