Predicted methane emission a new breeding value for Italian Holstein

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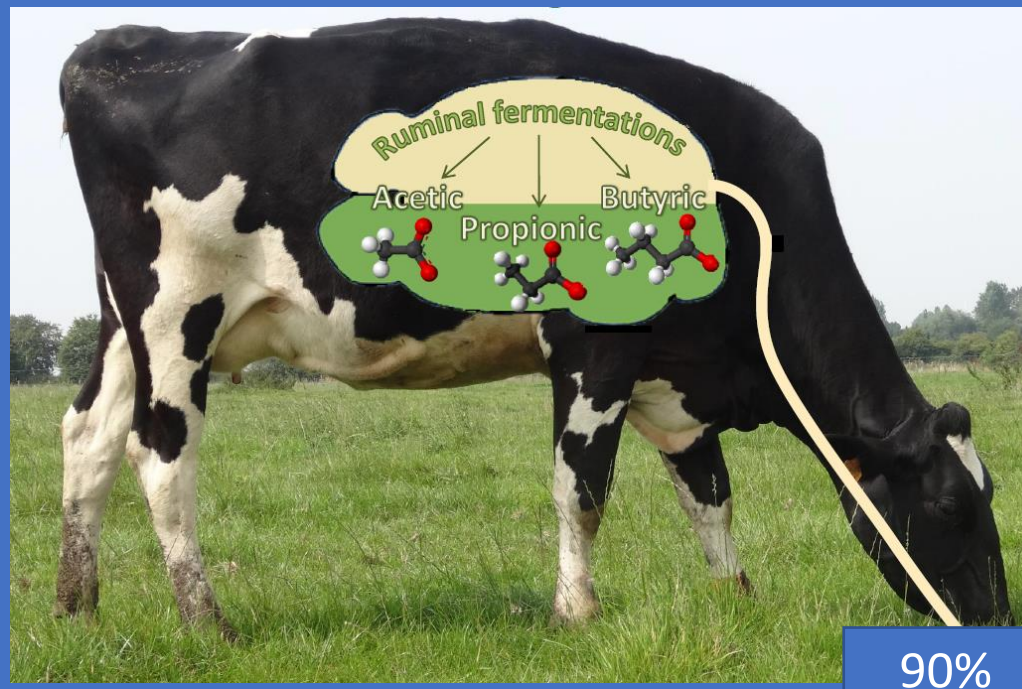
Università degli Studi di Padova

25th Congress
ASPA2023
Animal Production Science: innovations and sustainability for future generations
Monopoli (Bari, Italy), June 13-16, 2023

Introduction

- **Livestock farming** is indirectly linked to GHG emissions, mainly due to enteric fermentation,
- **Methane and carbon dioxide** from cattle emissions are heritable, providing the basis for applying genetic selection for their reduction,
- **Several countries** are working in this direction and some had already published breeding value for this "trait"



90%

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Global emissions from Livestock

Alfaro & Mejias (2022) from FAO 2016

Strategies to lower emissions intensity and gross emissions in ruminants

- Managing herd life and replacements bred
- Nutrition (e.g. lipids, concentrates) and inhibitors (e.g. 3-NOP)
- Vaccines and early life programming
- Feed efficiency
- Fertiliser optimisation
- On-farm energy savings
- Selecting for low CH4 production directly
- Breeding for higher producing cows (reducing emissions per kg product)

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The role of genetics in creating a sustainable future

Pryce & Richardson Herd'23 Bendigo (AU) 13-16 march 2023

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Reducing greenhouse gas emissions through genetic selection in the Australian dairy industry

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AIM

Set up a methane emission (CH4) breeding value for the Italian Holstein population

How to define the trait

- Direct phenotype – Labour and costly
- Derive phenotype – Proxies – Economic

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Direct traits and Proxies

- **Data collection –** phenotype collected at the Genetic Center (FedANA session Thursday afternoon)
- **MID-Infrared Spectrum** → Practically free data, but need a representative reference population with lots of variation
- **Microbiome Profile** → Less expensive, but still labour intensive and invasive
- **Literature formula** → derive trait making use of National routine data – Economic

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CH4:Predicted Phenotype

Predicted body weight (Finocchiaro et al, 2017)

Predicted DMI

FIRST STEP

1. **Daily ch4 produced $_{(Mj/d)}$= 3,23 + 0,809 *pDMI (Ellis et al, 2010)**

2. **Ch4 produced / FPCM $_{kg/d}$**

SECOND STEP

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Material and Methods

✓Data-editing

- ✓ Parameter estimation has been estimated on a subset (250 herds) of the Italian Holstein population randomly extracted; procedure was repeated 3 times,
- ✓ HTD at least 5 contemporary groups
- ✓ At least 5 daughters per sire in 3 herds
- ✓ Final data-set was on average **632,840 repeated records from 39,574 cows and 1,434 sires**, Pedigree (**76,268 animals**) included individuals with records and their ancestors **up to 6 generations back,**

$$Y = HTD + YC + DIMclass * parity + age(parity) * YC * Season\_calving + a + pe + e$$

Results

	Mean ± SD	h^2
Milk (kg/d)	32,21±8,97	0,31
Fat (kg/d)	1,2±0,38	0,29
Protein (kg/d)	1,07±0,28	0,30
Fat (%)	3,77±0,77	0,50
Protein (%)	3,36±0,37	0,50
Fat-protein corrected milk (kg/d)	30,85±8,37	-
Predicted body weight in 1° parity cows (kg)	602,17±39,91	0,30
Metabolic body weight (kg)	126,78±8,61	-

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Results

	Mean ± SD	h^2
Dry Matter Intake (kg/d)	23.73±3.42	0.14
Predicted feed efficiency pFE (kg/d)	1,26 ± 0,18	0.25
Predicted Ch4 intensity pCH4 (MJ/kg)	0.76±0.17	0,21

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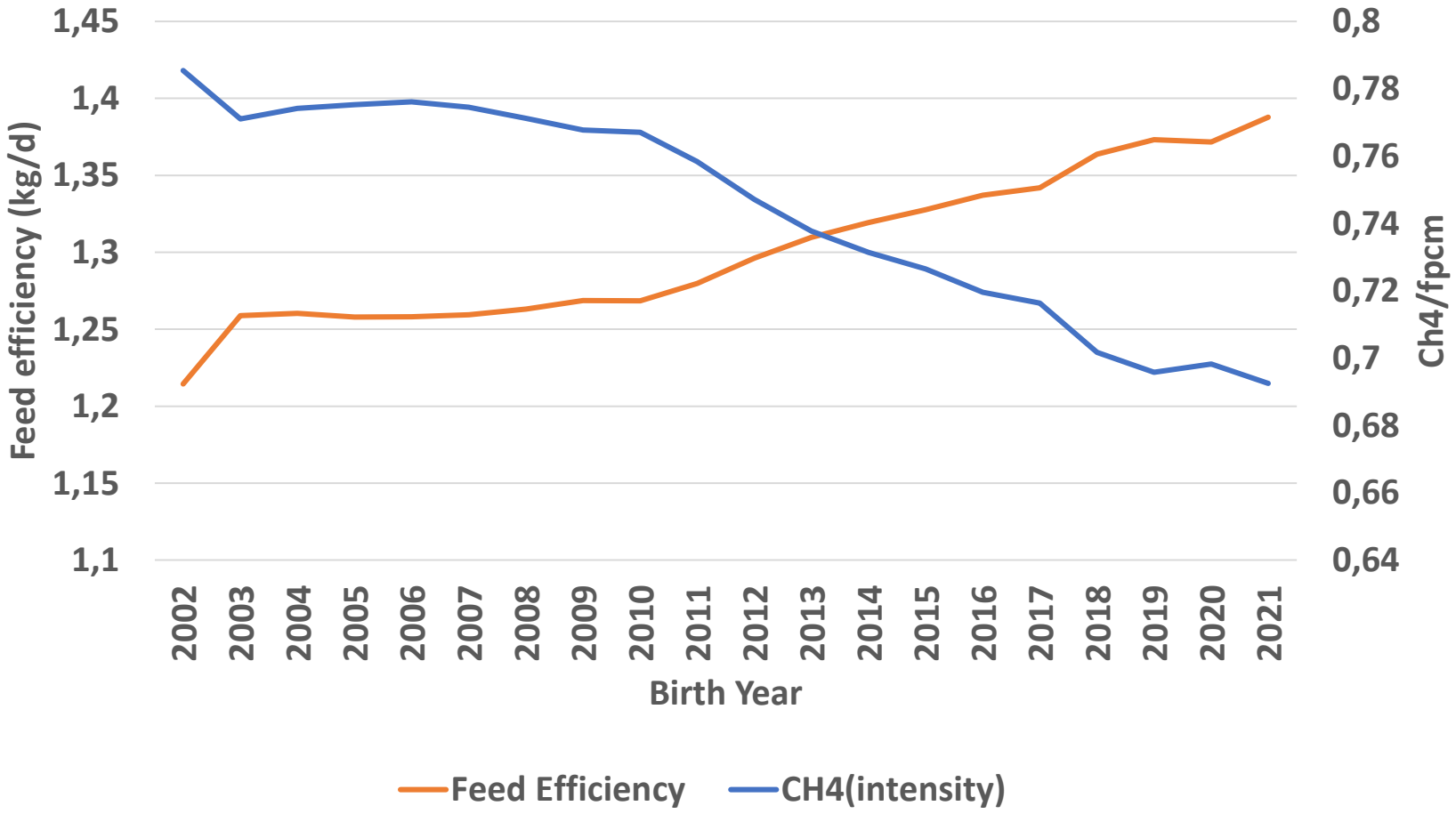
Birth Year trend for feed efficiency and Ch4 produced per kg of milk energy



$$pFE = \frac{FPCM}{pDMI}$$

$$pCH4 = \frac{CH4}{FPCM,}$$

Ch4 intensity by stage of lactation and parity

FPCM	Average ch4 production	Ch4/FPCM ratio
34	23	0,66
33		0,68
32		0,70
29		0,78

- ✓ Increasing stage of lactation increases the ratio between methane produced and useful energy
- ✓ Production decreases: cows have more energy to invest in the production of methane

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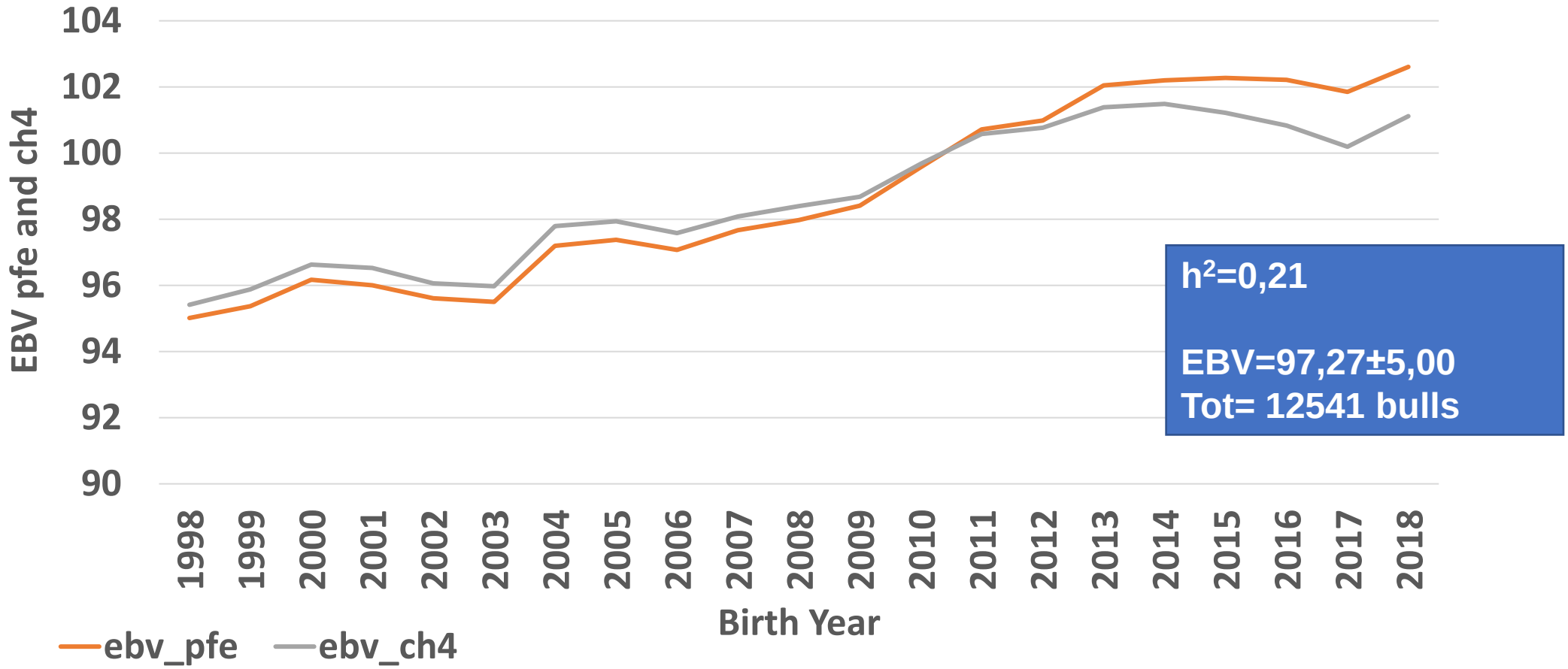
Bull's EBV trend per year of birth



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Conclusions

- ✓EBV for pCH4 has been developed and integrated within the Italian Holstein system
- ✓Genomic Breeding value is under development
- ✓This new index will be first published next december 2023
- ✓EBV pCH4 will be included in a more complete Sustainability index which is already underdevelopment.

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