

Comparison of energy expenditure and energetic efficiency between Holstein-Friesian and relatively low yielding cows

L. F. Dong^{*†}, T. Yan^{*}, C. P. Ferris^{*}, A. F. Carson^{*} and D. A. McDowell[†]

^{*} Agri-Food and Biosciences Institute, Hillsborough, UK

[†] Faculty of Life and Health Sciences, University of Ulster, UK

Introduction

- ❖ Until recently, there are two breeding programmes for dairy cows
 - 1) Milk production orientated breeding programme (Holstein-Friesian (HF)):
 - Mainly based on milk production
 - Consequently resulted in high milk production but poor health, fertility, and longevity
 - 2) Comprehensive breeding programme (e.g., Jersey, Norwegian):
 - Based on milk production and other functional traits (health, fertility, longevity, etc.)
 - Consequently resulted in relatively low milk production but better health, fertility, and longevity
- ❖ Crossbred programme (e.g., Jersey × HF or Norwegian × HF)

Pursuing the combination of advantages from high milk production and functional performance of dairy cows
- ❖ However, there is little information on the meta-analysis for the effect of crossbred on energy expenditure and energetic efficiency using calorimeter data

Objectives

To evaluate the effect of crossbreeding of HF cows on energy expenditure and energetic efficiency parameters using meta-analysis of calorimeter data



AFBI calorimeter data

❖ Data collation

- **32** respiration calorimeter chamber studies were undertaken at this institute



935 observations { **823** lactating HF cows
112 other dairy cows { **50** Norwegian
46 Jersey × HF
16 Norwegian × HF

- Animals were offered with forage only diets and mixed diets of concentrates and forage

Forage were mainly grass silage, with other forage including maize silage, whole crop wheat, straw, fresh grass, dried grass and lucerne

Statistical Analysis

❖ Meta-analysis

To evaluate if there was any significant difference in maintenance energy requirement and energetic efficiencies between HF and other genotype dairy cows using a range of linear relationships between energy intake and energy output parameters

For example, to compare if there was any significant difference in coefficients (with a common constant) in the linear regression of milk energy output adjusted for zero energy balance ($E_{1(0)}$, MJ/kg^{0.75}) against ME intake (MJ/kg^{0.75}) between HF and other dairy cows

Genotype	Equations	
	Coefficient	Constant
HF cows	$a_1 \times \text{ME intake}$	b
Other dairy cows	$a_2 \times \text{ME intake}$	

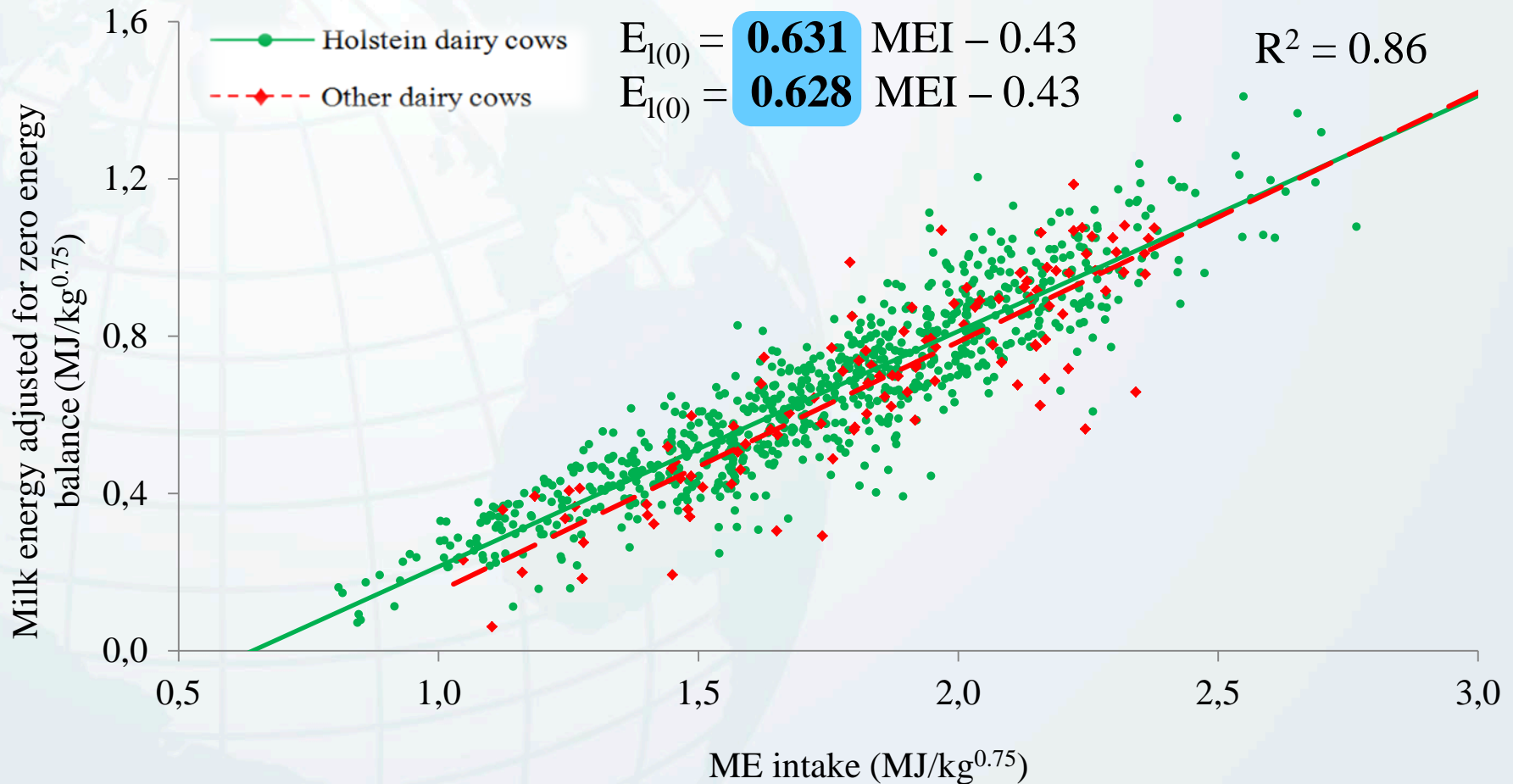
Animal performance dataset

	Holstein-Friesian cows (n = 823)	Other dairy cows (n = 112)	s. e.	<i>P</i> -value
Live weight (kg)	558	550	7.2	0.240
Body condition score	2.50 ^a	2.75 ^b	0.567	< 0.001
Forage proportion (kg/kg DM)	0.56	0.55	0.036	0.830
Milk yield (kg/d)	21.5 ^a	19.8 ^b	1.18	0.013
DM intake (kg/d)	16.5	16.5	0.50	0.940
ME intake (MJ/d)	200	205	6.8	0.800

Energy efficiencies dataset

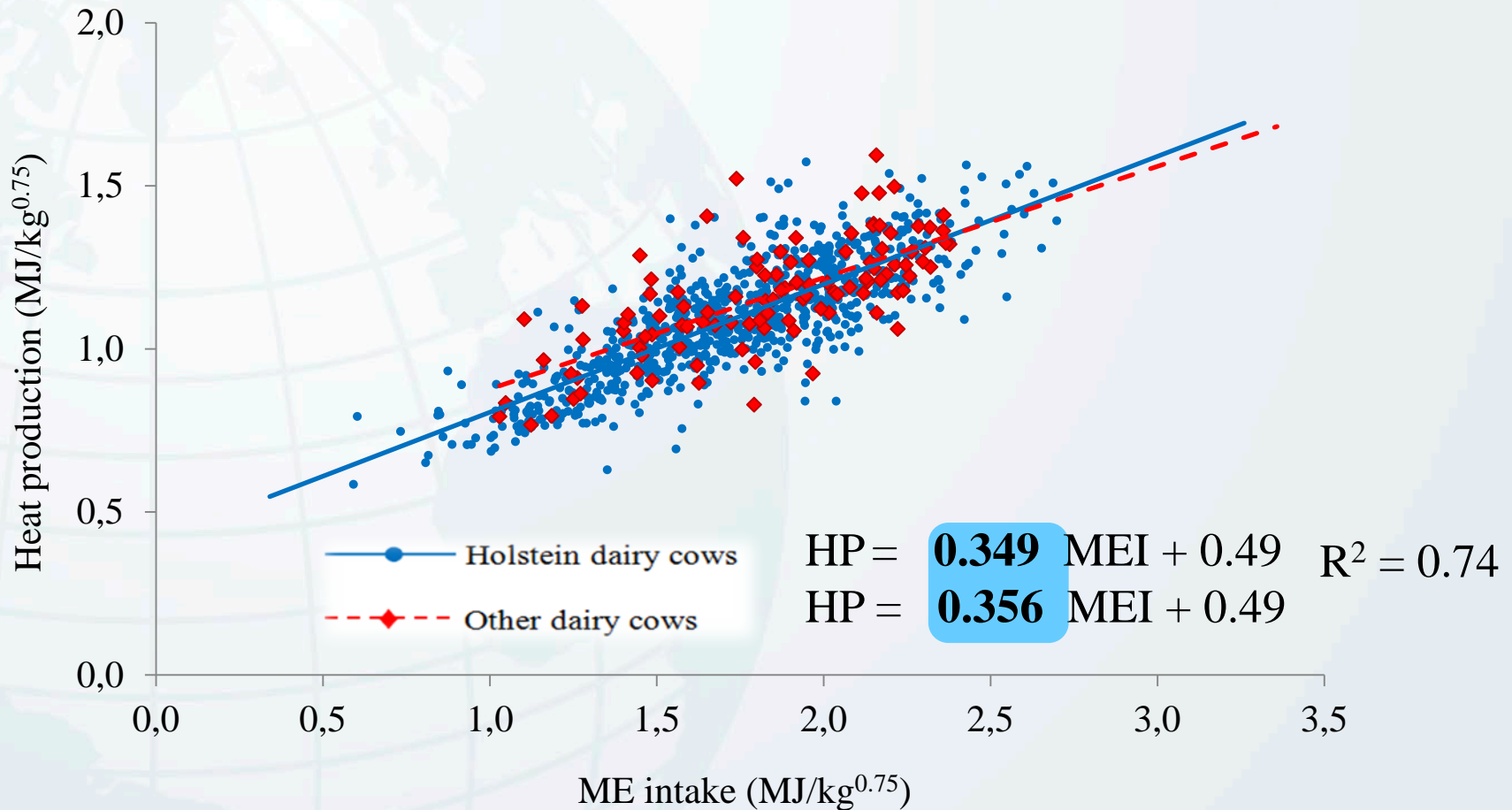
	Holstein-Friesian cows (n = 823)	Other dairy cows (n = 112)	s. e.	<i>P</i> -value
DE/GE	0.741	0.763	0.0054	0.240
ME/GE	0.639	0.657	0.0088	0.650
Heat production/ME intake	0.645	0.648	0.0118	0.625
Milk energy/ME intake	0.354	0.328	0.0119	0.109

Holstein-Friesian vs. other dairy cows (1)



- ❖ With a common constant, there was no significant difference in the coefficients in the above relationships between HF and other dairy cows (Norwegian, Jersey × HF, and Norwegian × HF)

Holstein-Friesian vs. other dairy cows (2)



- ❖ With a common constant, there was no significant difference in the coefficients in the above relationships between HF and other dairy cows (Norwegian, Jersey × HF, and Norwegian × HF)

Holstein-Friesian vs. other dairy cows (3)

Animal		Coefficient	Constant	R ²
Holstein cows	ME _m * =	0.119 ME intake	0.48	0.38
Other dairy cows		0.123 ME intake		
Holstein cows	ME _m /MEI =	-0.176 ME intake	0.72	0.51
Other dairy cows		-0.172 ME intake		
Holstein cows	HP/MEI =	-0.192 ME intake	0.98	0.55
Other dairy cows		-0.186 ME intake		

*The ME_m (MJ/kg^{0.75}) was calculated from heat production minus energy losses from the inefficiencies of ME use for lactation, tissue change and pregnancy

- ❖ There was no significant difference in coefficients in any relationship between HF and other dairy cows in each comparison when using a common constant
- ❖ These results indicated that cow genotype had no significant effect on ME_m (MJ/kg^{0.75}), ME_m/ME intake, or heat production/ME intake

Conclusions

- ❖ There is no significant difference between Holstein-Friesian and other dairy cows (Norwegian, Jersey × HF, and Norwegian × HF) in the energy expenditure and energetic efficiencies
- ❖ Maintenance energy requirement (ME_m , $MJ/kg^{0.75}$) is not a constant value but increased with increasing feed intake

Acknowledgements

- ❖ Colleagues in Agri-Food and Biosciences Institutes, Hillsborough
- ❖ This study was funded by European FP7 - Project No 266367 Sustainable Organic and Low Input Dairying (SOLID).