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Greenhouse gas emission intensity of milk production in three Slovenian goat breeds

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Introduction

- Livestock production contributes to anthropogenic greenhouse gas (GHG) emissions
- Small ruminant production contributes 6.5% of all emissions in livestock production
- Major GHG produced by small ruminants are **CH_4** (methane) and **N_2O** (nitrous oxide)
- One of strategies to reduce GHG emissions: a selection for production traits
- In terms of efforts to reduce GHG emissions of livestock production goats seems to be superior to other ruminants

more efficient in converting natural sources into meat and milk

Objective

- to determine the intensity of GHG emissions from milk production of three goat breeds in Slovenia

- to determine the main impacts on the GHG emissions

- to identify GHG emission intensity trends in the study period

Material: Breeds

Slovenian Saanen goat (SA)

- Traditional breed
- Milk production
- Population size = 600 animals

Slovenian Alpine goat (SR)

- Traditional breed
- Milk production
- Population size = 1.100 animals

Drežnica goat (DR)

- Local breed
- Milk and meat production
- Population size = 1.000 animals

Material: Data

- Central Database for Small Ruminants in Slovenia
  - date of kidding and end of lactation
  - litter size and parity
  - records about milk recording (total milk yield, % of protein and fat)

- 9,890 lactations included after records control

- From the year 2008 to 2021

Methods I

- CH_4 emissions from **enteric fermentation** were calculated based on the **net energy** requirements (IPCC, 2019)

-maintenance
-activity
-lactation
-pregnancy

estimation of **GE** intake

$$EF = \frac{GE * \left(\frac{Ym}{100}\right) * 365}{55.65}$$

Where:

EF = emission factor (kg CH_4/animal/year)

GE = gross energy intake (MJ/animal/day)

$\mathbf{Y_m}$= CH_4 conversion factor, % GE in feed converted to CH_4

The factor **55.65** (MJ/kg CH_4) is the energy content of CH_4

Methods II

- **CH_4** emissions from **manure management:** based on the amount of daily volatile solid excreted, maximum CH_4 producing capacity for manure produced and CH_4 conversion factors for each manure management system

- The estimation of **direct** and **indirect N_2O** emissions used only to estimate full GHG emissions in dairy goats (EMEP, 2019)

- GHG emissions expressed in **CO_2 eq**
  - CH_4 emissions X GWP_{100} factor **28**
  - N_2O emissions X GWP_{100} factor **265**

- GHG emission **intensity**: quantity of GHG emissions / total milk yield

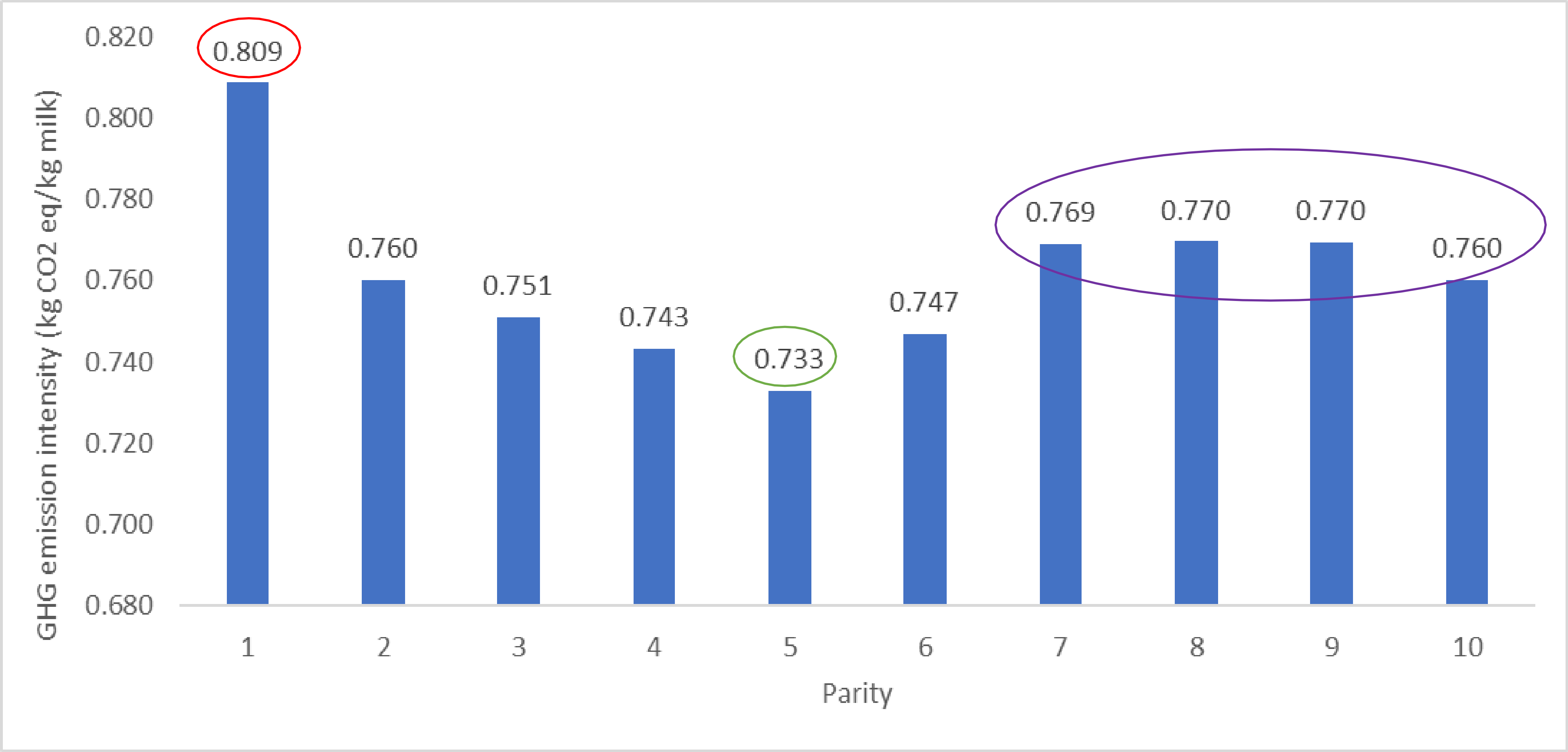
Results: GHG emissions by breed

Parameter		Breed		
		Slovenian Saanen	Slovenian Alpine	Drežnica
GHG emissions ($kg\ CO_2\ eq/year$)	Enteric methane	325.5	307.6	264.2
	Methane from manure stores	6.4	6.0	5.2
	Nitrous oxide from manure stores	16.6	16.6	16.6
	Indirect nitrous oxide	2.3	2.3	2.3
	Total	**350.7**	**332.5**	**288.2**
GHG emission intensity ($kg\ CO_2\ eq/kg$ milk)	Enteric methane	0.701	0.683	0.798
	Methane from manure stores	0.014	0.013	0.016
	Nitrous oxide from manure stores	0.037	0.038	0.052
	Indirect nitrous oxide	0.005	0.005	0.007
	Total	**0.756**	**0.740**	**0.873**

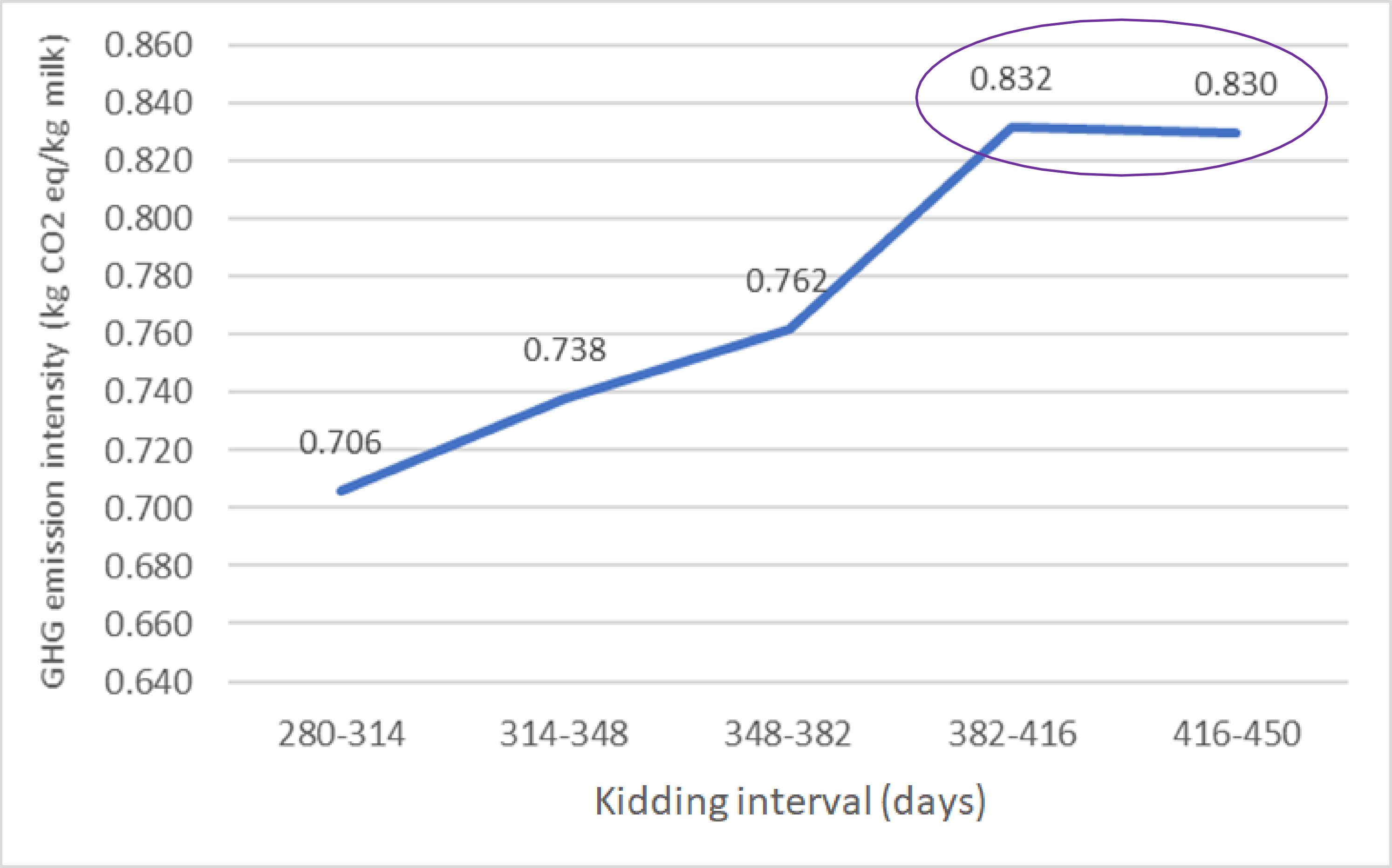
Results: GHG emissions by litter size

Parameter		Litter size		
		Single	Twins	Triplets
GHG emissions ($kg\ CO_2\ eq/year$)	Enteric methane	296.3	313.3	324.0
	Methane from manure stores	5.8	6.1	6.3
	Nitrous oxide from manure stores	16.6	16.6	16.6
	Indirect nitrous oxide	2.3	2.3	2.3
	Total	**320.9**	**338.3**	**349.3**
GHG emission intensity ($kg\ CO_2\ eq/kg\ milk$)	Enteric methane	0.747	0.671	0.630
	Methane from manure stores	0.015	0.013	0.012
	Nitrous oxide from manure stores	0.043	0.037	0.034
	Indirect nitrous oxide	0.006	0.005	0.005
	Total	**0.811**	**0.726**	**0.680**

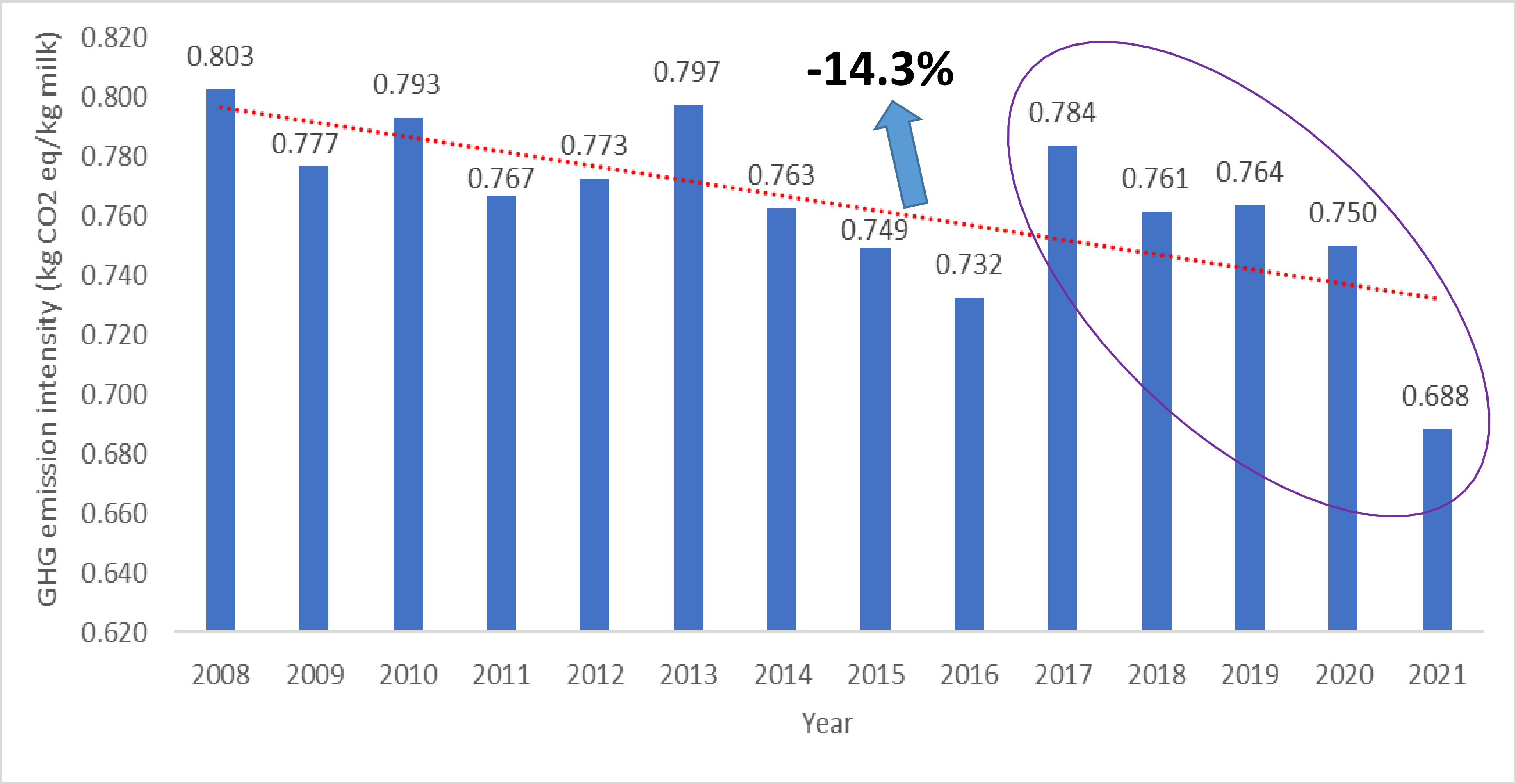
Results: Intensity of GHG emissions by parity



Results: Intensity of GHG emissions related to kidding interval



Results: Intensity of GHG emissions by year



Conclusion

- Selection for high milk production of dairy goats could be a useful tool to reduce the intensity of GHG emissions

- Some fertility traits such as kidding interval, parity, and litter size are correlated with milk production and consequently with the intensity of GHG emissions as well

- In particular, relatively short kidding interval could significantly reduce the intensity of GHG emissions

Thank you for your attention!