DGAT1 affects milk yield in Sudanese Butana x Holstein crossbred cattle

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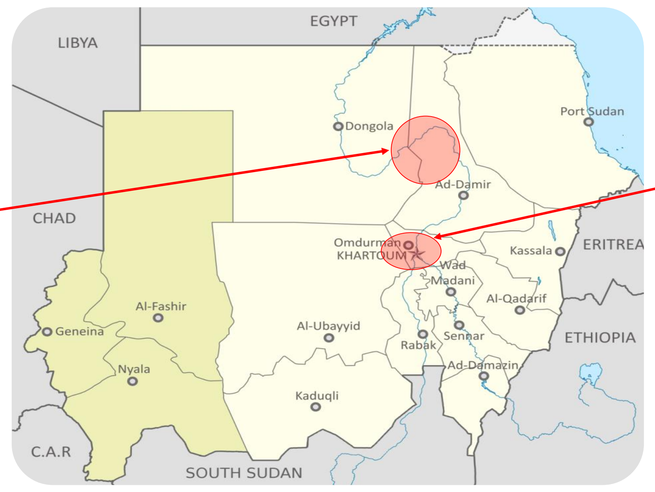
Introduction

- **Butana:**
  - Indigenous *Bos indicus* dairy cattle breed in Sudan
  - Well adapted to harsh environmental conditions
  - High milk fat content and low milk yield
- **Butana x Holstein crossbred cattle:**
  - Butana was crossed with Holstein for higher milk yield
  - Crossbreed is as robust as Butana
- **Problem:**
  - Increasing demand for milk and dairy products in Sudan
- **Possible solution:**
  - Genetic selection for higher milk yield using K232A polymorphism (*DGAT1* gene)
  - Protein variant with lysine: associated with higher fat and protein content and lower protein and milk yields

Objectives

- Estimating allele frequencies of K232A polymorphism in Sudanese cattle
- Association analysis of *DGAT1* marker with milk production traits

Butana



Sampling locations animals in Sudan

Butana x Holstein

Material and Methods

Samples

- 93 purebred Butana cattle
- 203 Butana x Holstein crossbred cows

Traits

- Daily milkings at monthly sample dates in the years 2017-2018 Milk yield (MY) and composition: Fat content (FC), protein content (PC) and lactose content (LC), fat yield (FY), protein yield (PY) and lactose yield (LY)
- Outliers were defined as values outside the mean ± 3 SD

Genotyping

- K232A polymorphism of *DGAT1* using the marker rs109234250 (14:611,019 G/A)
- Allele A of *DGAT1* marker corresponds to the protein variant with lysine

Association analysis

- Linear mixed model implemented in R language for statistical computing version 3.5.3

  $Y = X\beta + DGAT1 + (1|animal) + error,$

  β: vector of estimated fixed effects including farm, birth year, birth season, age at first calving, lactation number, calving season and milk yield, *DGAT1*: Genotypes of *DGAT1* marker, animal included as random effect, error: residual error

Results and discussion

Allele frequencies of DGAT1 marker and mean values of production traits

Butana:

- High fat, protein, and lactose content in milk
- Allele A almost fixed → corresponding to higher FC and PC → may explain high milk fat content and lower milk yield of Butana cattle

Butana x Holstein crossbred cattle:

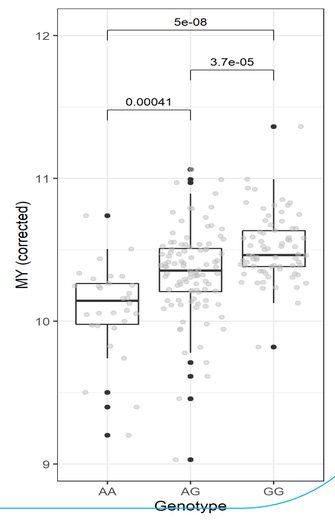
- High milk, fat, protein, and lactose yield in milk
- Allele A frequency much lower than in Butana → higher allele G frequency corresponds to higher MY and PY

Breed	Farm	Allele A freq	MY (SD)	FY (SD)	PY (SD)	LY (SD)	FC (SD)	PC (SD)	LC (SD)
Butana	Atbara Station	0.96	4.15 (1.40)	0.25 (0.08)	0.22 (0.05)	0.21 (0.07)	6.01 (0.65)	3.74 (0.11)	5.03 (0.19)
Butana x Holstein	Five farms	0.39	10.12 (1.10)	0.43 (0.20)	0.36 (0.10)	0.49 (0.20)	4.30 (0.50)	3.59 (0.20)	4.84 (0.30)

Associations with milk production traits in Butana x Holstein crossbred

- No significant associations with fat, protein and lactose content
- Significant effect of *DGAT1* marker on milk, fat, protein, and lactose yield
- Direction of effects:
  - Allele A associated with lower MY and PY → same as in literature
  - Allele A associated with lower FY → opposite to literature

Traits	β_A	SE(β_A)	P- values
MY	-1.740	0.170	**7.60E-20**
FY	-0.080	0.009	**2.20E-17**
PY	-0.063	0.006	**2.00E-19**
LY	-0.084	0.009	**4.00E-18**
FC	-0.046	0.051	0.370
PC	0.004	0.015	0.812
LC	-0.023	0.026	0.386



Conclusions

- Well described K232A polymorphism of *DGAT1* gene could be used in order to increase milk yield in Sudanese Butana x Holstein crossbred cattle
- Higher sample sizes and further analysis needed for purebred Butana cattle

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