Genomics, EPDs and their application to beef herds in Florida

Raluca Mateescu | Associate Professor of Quantitative Genetics & Genomics

(raluca@ufl.edu)

UF UNIVERSITY of FLORIDA

Department of Animal Sciences

Outline

- Revisiting some basic genetic concepts
- Beef cattle – traditional selection
- Genomic selection - practical questions
  - Dairy Industry as a genomic selection success story
  - Beef Industry as an “opportunity for improvement”
- What genomic tests are available?
- What do the results mean?
- Current and future status of this technology

Basic Selection Principles

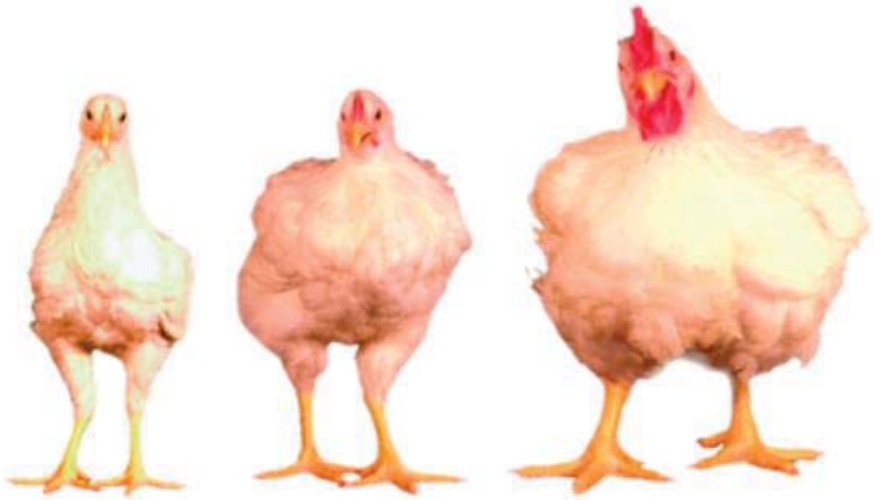
Selection and Prediction

- Genetic change - use animals better than the average as parents of the next generation
- Key to genetic change: selection
  - Estimate **genetic merit** for animals in a population
  - Select **superior animals** as parents of future generations

EBV, EPD

Traditional Animal Breeding

- Selective breeding for economically important traits
- Traditionally based on phenotypic recording
  - Estimation of breeding values from phenotypic records and pedigrees
  - Knowledge of heritability of each trait
- Successful
  - but slow process especially for certain traits



Fed identical diets, kept in similar conditions for 56 days.

Strains:	1957	1978	2005
56-d weight:	905g	1,808g	4,202g

Impact of innovation in US

1977

7 cows today yield the beef of 10 cows in 1977

Today

Mid 1940's

Cows yield 4 times the milk of cows in the mid 1940s

Today

1. J.L. Capper. "The environmental impact of beef production in the United States: 1977 compared with 2007." Journal of Animal Science. 2011

2. J.L. Capper, R.A. Cady, and D.E. Bauman. "The environmental impact of dairy production: 1944 compared with 2007." Journal of Animal Science. 2009

Slow/Difficult to improve traits

- Traits measured in **only one sex** (milk yield)
  - Need phenotypic records on relatives (progeny)
- Traits measured **late** in life (longevity) or **after death** (meat quality)
- Measuring the traits is **expensive** or **difficult** (feed efficiency, disease resistance)

Rate of genetic change

- Depends on 4 factors:
  - Selection **intensity**
    - How choosy we are in selecting individuals as parents
    - Can improve (increase) through management
  - **Accuracy** of genetic prediction
    - How close the EBV is to the true BV
    - Can improve (increase) through more/better records
  - **Generation interval**
    - Time between 2 generations
    - Can improve (decrease) through management or genomic selection
  - Amount of **genetic variation** in the trait
    - Genetic variation in a population (constant over short period of time)

How to achieve high accuracy?

Historically:

- Number of records: large number of animals and high-quality phenotypic records
- Trait is highly heritable

Slow/Difficult to improve traits

- Traits measured in **only one sex** (milk yield)
  - Need phenotypic records on relatives (progeny)
- Traits measured **late** in life (longevity) or **after death** (meat quality)
- Measuring the traits is **expensive** or **difficult** (feed efficiency, disease resistance)

MAS – marker assisted selection

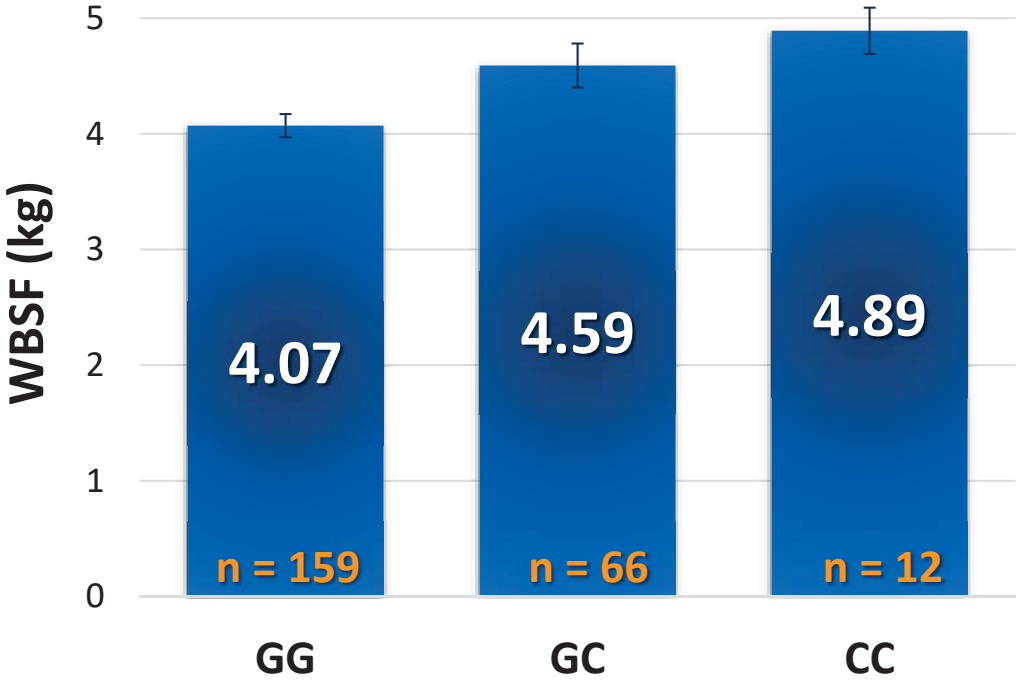
- Since 1990s – DNA information can increase the rate of genetic improvement.
- Challenges:
  - The effect of individual markers (QTLs) on complex traits is small
  - A large number of markers (QTLs) are necessary to explain the genetic variation
  - Marker information in outbreeding species is limited – linkage phase between marker and QTL (gene) must be established for every population

Tenderness – calpain

GAGTGGAACG **G** CGTGGACCCT
GAGTGGAACG **C** CGTGGACCCT

- CAPN1-316 = marker for tenderness
- One of the SNPs in the **GeneStar** Tenderness test
  - **GG** was **1.10** kg **tougher** than GC *(Pinto et al., 2010)*
  - **GG** was **0.36** kg **tougher** than GC *(Curi et al., 2010)*
  - **CC** is **1.23** kg **tougher** than CG *(UF multibreed pop., Casas et al., 2010)*

	Bos taurus	*Bos indicus*
GG	tougher	
GC		
CC		tougher



Potential Benefits of Genomics

- Benefits are greatest for economically important traits that:
  - Are difficult or expensive to measure
  - Measured late in life or after death
  - Not currently selected for because are not routinely measured
  - Have lower heritability
- Benefits:
  - Determine the value of animal at birth
  - Increase accuracy of selection
  - Reduce generation interval
  - Increase selection intensity
  - Increase rate of genetic gain