

Developing a new selection index for the Italian Mediterranean Buffalo (*Bubalus bubalis*)

Riccardo Negrini¹, **Stefano Biffani**², Mauro Fioretti¹, Roberta Cimmino³ and Maria Gómez³



¹ *Italian National Breeders Association (AIA), Rome, Italy*

² *Consiglio Nazionale delle Ricerche (CNR), Istituto di biologia e biotecnologia agraria (IBBA) 20133 Milano, Italy*

³ *Italian National Association of Buffalo Breeders, Caserta, Italy*



Background

- World Buffalo population :
 - > 234 million individuals
 - ~ 15 % of total milk production
- **Italy:**
 - > 90 % of the European population
 - Large census increase over the last 10 years (Mozzarella di Bufala Campana cheese)
 - ANASB data base (2020):
 - > 35k lactating buffaloes officially registered
 - > 650k lactation records
 - > 10000 type traits evaluations



Background

- Late 1990's:
 - first selection scheme based on a BLUP animal model
 - main breeding objectives = kg of milk and kg of Mozzarella (PKM)
 - Aprox 18 male calves/year

- PKM:

$$\text{mozzarella (kg)} = (\text{milk, kg}) * [3.5 * (\text{protein, \%}) + 1.23 * (\text{fat, \%}) - 0.88] / 100$$



Background

- PKM pros and cons

–Pros:

- Mozzarella was the breeding objective
- Easy to estimate/calculate
- Easy to understand
- Positive relationship with milk kg



Background

- PKM pros and cons
 - **Cons**
 - **Rosati et al.:** The breeding values for mozzarella production can be considered as a kind of selection index because all available information about the individual is used.
 - Not completely true: the genetic correlations among traits or among criterion and objectives are not taken into account
 - No health-related traits



The need

- **Reverse** the unfavorable observed genetic trend for contents (prot & fat %)
- Start considering **functional traits** (e.g udder morphology and feet & legs)
- **Change** the farmer's habit of looking at only 1 trait



New Breeding Objectives

Breeding Objective	Selection Criterion
$\text{Mozzarella Yield} = 117 + 2.015 * (\text{Prot \%} * \text{Fat \%}) + 2.928 (\text{Prot \%}^2) -$ (Di Palo, Campanile <i>et al.</i>)	Milk kg
	Fat %
Milk Yield (kg)	Prot %
Functionality (Udder + Feet & Legs)	Feet & Legs
	Udder



How we did it?

1. Estimate (co)variance components among/within traits in the breeding objective and traits in the selection criterion
 - Data & model
 - 7.199 buffalo cows
 - 19.574 pedigree
 - Multi-trait animal model



How we did it?

2. Define 3 different Scenarios (emphasis %)

Breeding goal	Scenario 1	Scenario 2	Scenario 3
Milk kg	5	30	45
Mozzarella	45	35	45
Feet & Legs	30	15	5
Udder	20	20	5

Extreme

Middle

Balanced



How we did it?

3. Look at Genetic Response

$$GR_j = \frac{\mathbf{b}' \mathbf{G}_j}{\sqrt{\mathbf{b}' \mathbf{P} \mathbf{b}}}$$



Results

- Genetic Correlation:

Traits	Mozzarella yield
Feet & Legs	0,25
Udder	-0,01
Milk kg	-0,54
Fat %	0,87
Protein %	0,96



Results

- Response to selection (genetic sd):

Traits	Extreme 1	Middle 2	Balanced 3
Udder	0,13	0,22	0,20
Feet & Legs	0,14	0,16	0,14
Fat %	0,32	0,15	0,12
Milk kg	-0,24	0,03	0,11
Protein %	0,42	0,25	0,21
Mozzarella	0,05	0,03	0,02



Results

- Scenario 3 maximizes the overall breeding goal (Milk Kg, Cheese production, functionality): **IBMI**

Selection Criteria	Relative Weights
Feet & Legs	24
Udder	20
Milk Kg	21
Fat %	15
Protein %	20



Final considerations

- PKM vs IBMI
 - Different ranking
 - PROS:
 - IBMI is a more comprehensive selection tool
 - CONS:
 - The farmer's habit of looking at only 1 trait



Final considerations

- What can we do more?
 - individual mozzarella yields
 - On-going project
- Genomic selection



Italian Journal of Animal Science



ISSN: (Print) (Online) Journal homepage: <https://www.tandfonline.com/loi/tjas20>

Genomic investigation of milk production in Italian buffalo

Alberto Cesarani, Stefano Biffani, Andre Garcia, Daniela Lourenco, Giacomo Bertolini, Gianluca Neglia, Ignacy Misztal & Nicolo Pietro Paolo Macciotta

To cite this article: Alberto Cesarani, Stefano Biffani, Andre Garcia, Daniela Lourenco, Giacomo Bertolini, Gianluca Neglia, Ignacy Misztal & Nicolo Pietro Paolo Macciotta (2021) Genomic investigation of milk production in Italian buffalo, Italian Journal of Animal Science, 20:1, 539-547, DOI: [10.1080/1828051X.2021.1902404](https://doi.org/10.1080/1828051X.2021.1902404)





Thank you for the
attention

