Recording Individual Real Yield in Mozzarella Cheese in the Italian Mediterranean Buffalo population

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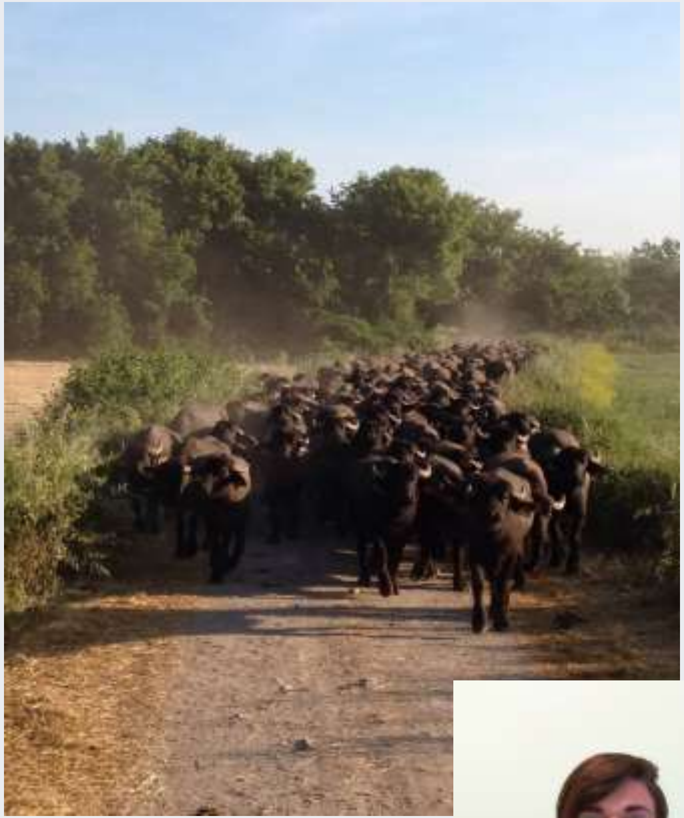
Objective:

The objective of this study was to develop **a new protocol to recording individual yield in curd in the buffalo** population to be used in selection program for increasing yield in mozzarella cheese

Introduction

Buffalo species

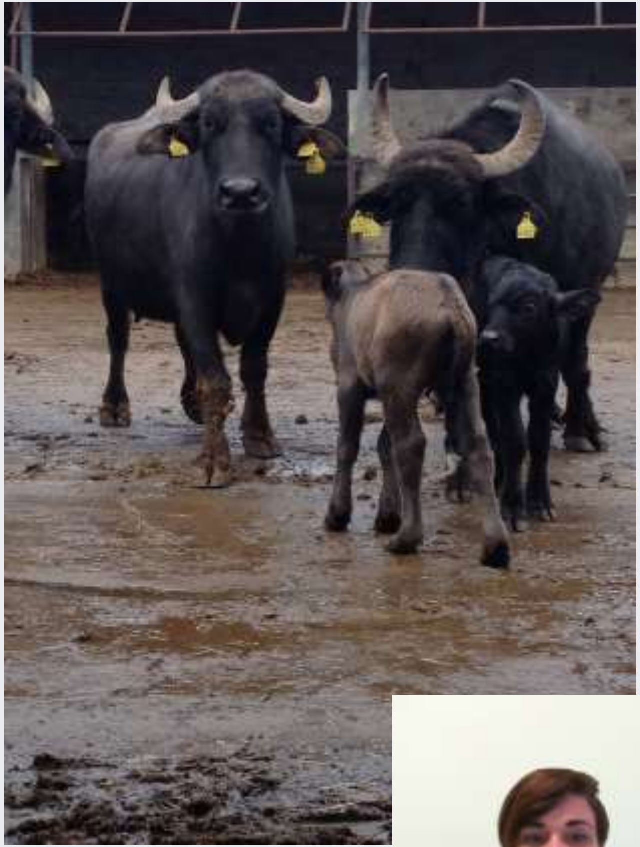
- From 1980 to 2019 the number of Italian Mediterranean buffalo in Italy is increased from 81,000 to 402,290 (FAOSTAT, 2021)
- High market demand for the buffalo mozzarella cheese
- Price for buffalo's milk is more than three times higher than the price of cow's milk



Introduction cont’s

Buffalo’s milk *vs* Cow’s milk

- ✓ Buffalo milk is richer in fat, crude protein, total solids, vitamins and minerals
- ✓ High dry matter content
- ✓ To produce 1 kg of mozzarella cheese are required 8 kg of cow’s milk, but only 4 kg of buffalo’s milk
- ✓ Buffalo milk is primarily paid by its yield in mozzarella cheese and by its unique flavor



Introduction cont's

Buffalo mozzarella cheese estimation:

PKM (Kilos of mozzarella production) (Altiero *et al.*, 1989)

$$\text{PKM} = \text{milk yield, kg} * \frac{3.5*(PP)+1.23*(FP)-0.88}{100}$$

- However, the yield of mozzarella cheese does not only depend on the percentage of protein (PP) in the milk, but also on the type and proportion of the different protein variants (Zicarelli L. et al., 2020).

- The selection of the PP in the milk does not guarantee the selection for a higher yield in mozzarella (Zicarelli L. et al., 2020)

- In fact, buffalo were found in the population with the same percentage of proteins in milk, but different yield in mozzarella cheese (Zicarelli L. et al., 2020)

Introduction cont's

Buffalo mozzarella cheese estimation cont's

APKM (Adjusted PKM) (Parlato E., and Zicarelli L., 2015)

APKM=PKM*c

where:

PKM= milk yield, kg * $\frac{3.5*(PP)+1.23*(FP)-0.88}{100}$;

c = $\frac{EY}{MEY}$;

EY=[3.5*(PP)+1.23*(FP)-0.88];

MEY is the average milk yield of the year the lactation refers to.

Introduction cont's

APKM vs PKM

PKM is largely correlated with milk yield, and it tends to under-estimate the high-yielding buffalo (Parlato E., and Zicarelli L., 2015)

Therefore, by selecting through the actual PKM, one risk is to increasing the number of animals in the population that will produce more milk, which is not always suitable for producing mozzarella cheese.

APKM might give a better estimation of the individual yield in mozzarella cheese.

In fact, the APKM is lower correlated to the milk yield than the actual PKM, and tended to increase ranking of the sire with positive EBVs for protein and fat percentage (Parlato E., and Zicarelli L., 2015).

Introduction cont's

DMYC (Dry Matter Yield in Curd)

Recording the **Yield in Curd** might be more accurate than the APKM to measuring the individual yield in mozzarella cheese in buffalo

Material and Methods

Data:

- 499 milk samples of 1 kg
- from 89 buffalo distributed
- in 8 farms of
- 2 provinces (Caserta and Salerno) of the Campania region (Italy)
- from year 2005 to year 2010

Material and Methods cont’s

Data cont’s:

- Milk samples were collected from 3 to 6 times during a single lactation,
- at intervals of about 40- 45 days from 30 to 270 days in milk (DIM)
- The day of calving was set equal to 0
- From the same samples an addition of 500 ml of milk was collected for the analysis of Percentage of Crude Protein (PP) and Percentage of Fat (FP) by CombiFoss using the dilution method.

Material and Methods cont's

Protocol to obtain individual Dry Matter Yield in Curd (DMYC)

The Real Yield in Curd (RYC) was first calculated by the micro-cheese making technique according to the following protocol (Zicarelli *et al.*, 2001; Zicarelli *et al.* 2020):

- Liquid rennet (80% Chymosin) with a concentration of 160 IMCU mL^{-1} (International Milk-Clotting Units, mL^{-1}) was added to the milk sample (1 mL Kg^{-1}) and heated to 37 °C. Since coagulation was performed with the maximum amount of rennet, the curdling and the curd formation were faster than that observed in the cheese factories

Material and Methods cont's

Protocol to obtain individual DMYC cont's

- To facilitate the complete syneresis, the coagulum was cut first into a large piece then into small pieces, and then pressed to remove the residual whey. The curd was put in plastic tray containers, refrigerated (4 °C) and weighted after 24 hours. The measured weight represented the yield of the curd per kg of milk after 24 h (**RYC24**)

- After 24 hours at 4°C, 50 g of curd were used to determine the percentage of dry matter by drying the yield in curd at 103°C; Dry Matter Yield in Curd (**DMYC**) was obtained by multiplying the weight of the coagulum from 1 kg of milk sample by the DM times 0.01

$$DMYC = RYC24 * DM * 0.01$$

Material and Methods cont's

Statistical analysis

- To evaluate the effectiveness of using the DMYC as estimator of the individual **RYC**, correlation analysis among **DMYC**, **RYC24**, **PKM**, and **APKM** was performed by PROC CORR procedure of SAS (2005)

- Moreover, to detect the possibility of using only one sample per animal, as representative of the whole lactation, correlation analysis of the average DMYC per lactation with the DMYC per each DIM interval was also evaluated

Results

Table 1. Overall unadjusted means and standard deviations of weights for Dry Matter Yield in Curd (DMYC), Real Yield In Curd after 24 hours (RYC24), PKM, and adjusted PKM (APKM), in grams, of 499 individual milk samples at different DIM of 89 animals

Trait	Mean	Std.Dv
DMYC	113.75	14.85
RYC24	260.19	29.32
PKM	263.98	22.15
APKM	264.33	32.33

Results cont's

Table 2. Coefficients of correlation* (above and below the diagonal) among DMYC, RYC24, PKM and APKM

	DMYC	RYC24	PKM	APKM
DMYC	1.00	0.85	0.52	0.65
RYC24	0.85	1.00	0.56	0.58
PKM	0.52	0.56	1.00	0.90
APKM	0.65	0.58	0.90	1.00

* : $P \leq 0.0001$

Results cont's

Table 3. Coefficients of correlation, r* for the unadjusted mean of DMYC overall DIM intervals and DMYC at each DIM interval of 89 buffalo

DIM	r
30 -60	0.71
61-90	0.68
91-120	0.70
121-150	0.65
151-180	0.59
181-210	**0.79**
211-270	0.72

* : $P \leq 0.0001$

Conclusions

- Using the DMYC as estimator of the real yield in mozzarella cheese, instead of the RYC24, might be more accurate because the weight of RYC24 could be biased, for instance, by the intensity of the pressure made on the curd to obtain the coagulum
- Whereas, by weighting the dry matter (DMYC) of the coagulum would give results more accurate, avoiding any bias due to the process by which the RYC24 is obtained
- Since there was a large correlation between the overall average DMYC and the DMYC at DIM interval of 181-210 days, DMYC might be evaluated per animal, per lactation only one time at DIM interval of 181-210 days

Conclusions cont's

- Selecting for DMYC will improve in the population the number of high-yielding buffalo that will produce more mozzarella cheese than more milk (Zicarelli, 2020)

- Moreover, selection on DMYC will help to keep the characteristics flavor of the buffalo milk. Animals with larger yield in mozzarella cheese but less milk production are desirable to avoid flavor dilution in the milk (Zicarelli, 2020)

- Yield in mozzarella cheese and flavor are the most important traits for improving the profit of the buffalo farm (Zicarelli, 2020)

References

- Altiero, V., Moio, L., & Addeo, F. 1989. Previsione della resa in mozzarella sulla base del contenuto in grasso e proteine del latte di bufala. Scienza Tecnica Lattiero-Casearia, 40(6), 425–433
- Zicarelli, L., Potena, A., De Filippo, C., Di Palo, R., & Campanile, G. 2001. Confronto tra bufale con differente resa alla caseificazione. Atti I Congresso Nazionale sull'allevamento del bufalo, 3–5 ottobre, Eboli. 241–246.
- Parlato E, Zicarelli L. 2015. Genetic Parameters and Sire Ranking for the Adjusted Estimate of Mozzarella Cheese Production in Italian Mediterranean Buffalo. J Adv. Dairy Res. 3: 148. doi:10.4172/2329-888X.1000148
- Zicarelli L., Di Palo R., Napolano R., Tonhati U., De Carlo E., Gagliardi R., Di Luccia A., La Gatta B. Influence of alphas1-CN and kappa CN polymorphism on the curd yield of the Italian Mediterranean buffalo (Bubalus bubalis) milk. 2020. Int. Dairy J. 100 (2020) 104559

Thank you for your attention!

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