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Selection for the price of young calves in Italian Simmental breed

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Italian Simmental (IS)

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- IS is a dual-purpose cattle breed mainly reared in small farms (< 20 heads)
- 57% of the farms located in the mountainous area of North-East Italy
- Average lactation (2023) = 7434 kg milk, 3.90 fat %, 3.42 protein %
- High fertility, low somatic cells, good beef performances
- Managed by the Italian Simmental Breeders Association (ANAPRI)

IS breeding program

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- Milk and meat weights are 33% and 20%, with a ratio of 2/1
- For meat production we consider:
  - muscularity of cows (6%)
  - weight of bulls at 12 months (4%)
  - weight gain of bulls (4%)
  - muscularity of bulls (4%)
  - feed efficiency (2%)
- IS farmers want to keep the beef characteristics of the breed

Auctions

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- The sale of calves is an important revenue for farmers
- Farmers can sell their calves through auctions or directly to the market or other farmers
- Auction is the most common method of cattle sale in northeast Italy
- IS calves show better price than other breeds

Auctions

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- The prices offered by the fattening centers are based on:
  - a visual inspection of the animals
  - their guess on the future performances of calves at the end of the fattening cycle

Aim of this study

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- There is a lack of information on the phenotypic and genetic factors influencing the cost of the animals
- The **aim** was to analyze phenotypic and genetic background of traits recorded during auctions

M&M: data

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- 51,825 Simmental calves coming from 2,180 herds
- Calves sold in 898 auctions held in the period 2004-2023
- Average age of 26±7 days and average weight of 70.16±8.98 kg
- Two traits:
  - **price per kg** (€/kg)
  - **total selling price** (€/kg * weight)

M&M: analysis

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- The traits were analyzed with the following linear model:

$$y = auction + herd + sex + ageDam + ageCalf$$

- For the genetic analysis we included the animal and maternal random effects
- Variance components were estimated using blupf90+ (Misztal et al. 2014)
- Breeding values were estimated using blup90iod2 (Misztal et al. 2014)
- Factor analysis on EBV using SAS software

Results: phenotypic analysis

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- All effects were highly significant
- Both prices were higher in males than females
  - price per kg: 5.13€ for males and 4.34€ for females
  - total selling prices: 400€ and 309€, respectively

Results: evolution during years

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- The weight at auction increased by around 0.14 kg per year
- Both prices fluctuated during the years, but they were constantly higher for males

Results: phenotypic analysis

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- The total selling price increased as the age of the dam increased
- A no clear pattern was observed for the price per kg

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Results: phenotypic correlations

- Price per kg was not correlated with the weight and the age of the calves
- The weight of the calf was positively and highly correlated with the total selling price

Females	Calf age	Calf weight	Price per kg	Total selling price
Calf age		0.21	-0.11	0.04
Calf weight	***		0.15	0.68
Price per kg	***	***		0.82
Total selling price	***	***	***	
Males	**Calf age**	**Calf weight**	**Price per kg**	**Total selling price**
Calf age		0.24	-0.17	0.04
Calf weight	***		0.01	0.69
Price per kg	***	***		0.72
Total selling price	***	***	***	

Results: genetic analysis

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- Direct heritabilities were 0.21±0.01 for price per kg and 0.12±0.01 for total selling price
- The maternal heritabilities were very low: 0.02±0.01 and 0.08±0.01
- The genetic correlations between additive and maternal effects were not significant

	Price per kg		Total selling price	
	Mean	SD	Mean	SD
Additive component	0.049	0.004	349.28	38.16
Maternal component	0.005	0.001	223.84	30.39
Covariance additive-maternal	0.000	0.002	-0.02	27.59
Residual component	0.184	0.003	2394.50	29.81
Direct heritability	0.205	0.018	0.12	0.01
Maternal heritability	0.022	0.006	0.08	0.01
Genetic correlation additive-maternal	0.035	0.121	-0.01	0.10

Results: genetic analysis

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- EBV of prices were positively and moderately correlated:
  - 0.64 (Pearson) and 0.60 (Spearman)
- The new traits were lowly correlated with the other considered official breeding values
- Largest correlation with muscularity of bulls
- Lowest correlations with:
  - Feet and legs of cows
  - Size of the bulls

	Price per kg	Total price
Milk, kg	0.00	0.03
Fat, kg	-0.02	0.00
Protein, kg	0.01	0.02
Somatic cells	0.03	0.02
Udder	-0.06	-0.05
Persistency	0.01	0.00
Size, cows	-0.07	0.11
Muscularity, cows	0.16	0.10
Feet and legs, cows	-0.01	**-0.06**
Average daily gain	0.05	0.13
Size, bulls	**-0.11**	0.07
Feet and legs, bulls	0.14	0.08
Muscularity, bulls	**0.24**	**0.18**

Factor analysis

- F1 included milk, fat, and protein yields
- The two prices clustered alone in F6
- For this factor, all the other traits had low values

Trait	F1	F2	F3	F4	F5	F6
Milk, kg	**0.87**	0.26	-0.04	0.11	-0.37	0.03
Fat, kg	**0.88**	0.21	-0.04	0.09	0.30	-0.02
Protein, kg	**0.88**	0.31	-0.05	0.13	0.03	0.04
Somatic cells	0.04	**0.70**	0.00	0.21	0.12	0.08
Lactation persistency	0.19	**0.57**	-0.02	-0.09	-0.13	0.12
Udder	0.21	**0.69**	-0.12	0.19	0.09	-0.14
Feet and legs, cows	0.15	**0.68**	0.12	-0.10	-0.02	-0.17
Size, cows	0.06	0.29	-0.09	**0.74**	0.06	0.04
Muscularity, cows	-0.48	0.14	0.53	0.19	0.09	0.20
Average daily gain, bulls	0.21	-0.09	0.58	**0.60**	0.00	0.00
Size, bulls	0.05	-0.05	0.10	**0.82**	-0.03	-0.06
Feet and legs, bulls	-0.04	0.07	**0.77**	-0.16	-0.07	-0.05
Muscularity, bulls	-0.09	-0.13	**0.81**	0.19	0.03	0.22
Price per kg	0.00	0.00	0.16	-0.20	-0.01	**0.87**
Total selling price	0.01	-0.06	0.02	0.15	-0.04	**0.88**

Discussion I

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- In Italy, the overall average market price (considering all cattle breeds) registered in March 2024 was 3.83€ per kg (ISMEA) → lower than the value of IS
- Several studies reported larger prices for males compared to females (Bittante et al., 2020; Danielce et al., 2020; Zanon et al., 2023)
- Heritabilities were in line with those reported in literature (Schierenbeck et al., 2009; Penasa et al., 2012)
- As expected, maternal heritabilities were lower than direct ones (Penasa et al., 2012)

Discussion II

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- Females are usually used for veal production, whereas the males are fattened for the meat production (Dal Zotto et al., 2009)
- Buyers are willing to pay on average 15% more for males
- The higher price may be related to the greater weight gain during rearing and fattening, and to the greater final value at slaughter because of better yield and carcass dressing

Conclusions

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- The genetic analysis highlighted a higher heritability for the price per kg that suggests its possible consideration as a breeding goal to be included in the selection index of the IS
- Relationships with beef traits considered in the breeding program of the IS are rather low

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