World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

Productive and reproductive characteristics of Tarentaise cattle in the southern mediterranean region

M'Naouer Djemali * and Ilhem Barkia

Animal Genetic Resources and Feed Research Lab., INAT, 43 Av. Charles Nicole 1080 Mahrajène Tunis Tunisia.

World Journal of Advanced Research and Reviews, 2024, 21(01), 482–488

Publication history: Received on 26 November 2023; revised on 01 January 2024; accepted on 05 January 2024

Article DOI: https://doi.org/10.30574/wjarr.2024.21.1.0035

Abstract

The Tarentaise breed in Tunisia is gaining prominence, yet comprehensive field studies on it are limited. This research aimed to delineate the breed's unique production and reproductive characteristics in Tunisia, assess non-genetic influences on milk production, and evaluate genetic progress under current management. Analyzing 345 lactations from two herds, we identified the main sources of variation in milk traits. Average milk yield, fat percent, protein percent and days in milk were 3022 kg ± 1532 kg, 3.52 ± 0.51, 3.50 ± 0.59, and 214.69 d ± 111 d, respectively. The average daily milk production was 14 kg ± 6 kg. Key findings revealed significant advantages in winter calvings and highlighted that some cows peak in performance by their sixth lactation, suggesting untapped potential. There was more than 700 kg between cows that calved in January and if the same cow calved in summer season, in favor of winter calvings. Alarmingly, both herds showed a reliance on sires with negative milk breeding values, potentially hampering genetic milk traits. Introducing tailored adjustment factors for the Tarentaise breed, our study underscores the need for optimized management to harness its full milk-producing prowess in Tunisia.

Keywords: Tarentaise; Milk; Fat; Protein; Genetics

1. Introduction

Originating from the Savoie region in France, particularly the Tarentaise Valley nestled within the French Alpine mountains, the Tarentaise breed boasts a lineage dating back to 1859 [1]. Recognized as a highly adaptable dual-purpose breed, the Tarentaise is primarily utilized in contemporary times by the French for milk production, essential for producing the esteemed Beaufort cheese, reminiscent of Gruyere.The breed has been exported to various countries, including Algeria, Morocco, Tunisia, India, Canada, and the USA [1].

In response to the escalating demand for animal-derived products spurred by rapid population growth, the North Africa region has strategically embraced the importation of high-yielding breeds since the seventies, with a particular emphasis on dairy cattle [2]. The primary breeds chosen for this purpose included Friesians (Holsteins), Brown Swiss, and Tarentaise. Simultaneously, the expansion of cereal and fruit tree cultivation has led to a reduction in range land areas and their biomass outputs, causing a significant transformation in production systems and practices [3]. This transformation has resulted in a decline in pastoralism, the traditional livestock production system.The pivotal change in livestock feeding systems has been characterized by a shift to the consistent use of cereals (concentrates) as a standard practice in daily feeding routines [3].

The introduction of the Tarentaise breed in Tunisia aimed to enhance the generally low native bovine population's productivity, in mountain areas, in terms of both milk and meat yields. In 1993, a private breeder resumed the importation of purebred Tarentaise animals and semen. The Tarentaise Breeders Group (GERT), affiliated with the

* Corresponding author: M'Naouer Djemali

« Tunisian Union of Agriculture and Fisheries" UTAP, was established in 2005 to promote the breed in the country and limit the influence of one purpose high yielding dairy cattle. Presently, the Tarentaise breed has its Tunisian breed association (GERT), the sole one dedicated to dairy cattle in Tunisia [4]. According to studies conducted in 2010 by the Office of Livestock and Pastures (MOA-OEP), the total population of Tarentaise cows in Tunisia was estimated to be 17,800 heads, comprising 770 purebred cows, 3,550 cows crossed at 75%, and 13,500 cows crossed at 50% [5].

The Tarentaise breed in Tunisia has garnered some attention in previous studies [4,6,7]. However, these studies largely lacked comprehensive field data on the breed. This paper endeavors to bridge this gap by pursuing the following objectives: 1) Characterization of the production and reproduction attributes specific to the Tarentaise breed in Tunisia ; 2) Investigate the influence of non-genetic factors on the breed's milk production and 3) estimate the genetic progress made under the prevailing management practices. Through this research, we aim to provide a holistic understanding of the Tarentaise breed's performance and potential in the Tunisian context.

2. Materials and methods

In this study, data from 422 complete lactations, sourced from two herds participating in the breed's milk recording program, were employed. The original dataset underwent refinement, retaining only records within the range of the milk average plus and minus two standard deviations. Following this editing process, the dataset comprised a total of 345 lactations for further analyses.

Data were analyzed by the linear model (1) using GLM of SAS software.

$$Y_{ijklm} = \mu + H_i + M_j + L_k + A_l + b_1 * DIM + b_2 * DIM*2 + e_{ijklm} \quad (1)$$

where,

Yijklm: Milk yield, fat percent, and protein percent for a specific observation.
μ: Population mean.
H_i: Herd effect for the i-th herd.
M_j: Calving month effect for the j-th month.
L_k: Lactation number effect for the k-th lactation.
A_l: Age at calving effect for the l-th age.
b_1 and b_2: Regression coefficients.
DIM: Days in milk.
e_{ijklm}: Residual random error.

Least Square Solutions obtained from model (1) for month and lactation number effects were used to derive adjustment factors using the Shaeffer formula (8). Furthermore, the regression coefficients $b1$ and $b2$ from model (1) were utilized to standardize raw milk data into a 305-day milk yield, accounting for lactation length. This comprehensive approach ensures that observed data were appropriately adjusted and standardized, allowing accurate predictions and evaluations within the context of our study. The adjusted milk yields were employed in predicting Breeding Values through the application of the Best Linear Unbiased Prediction (BLUP) animal model (8).

3. Results and discussion

3.1. Milk production means and variation

Average milk yield, fat percent and protein percent and their variations are in table (1). A Tarentaise cow produces on average, under Tunisia environmental condtions 3022 kg ± 1532 kg, 3.52 ± 0.51 and 3.50 ± 0.59 of milk, % fat and % Protein, respectively. The average DIM was 214.69 d ± 111 d allowing 14 kg ± 6 kg of daily milk production. The MOA-OEP reported in 2021 for Tarentaise herds enrolled in the national milk recording system an average milk production of 4237 kg in 348 days [9].

Table 1 Means and variation of milk traits of the Tarentaise breed (Tunisia)

Trait	Lactation	Mean	SD
Milk yield (kg)	345	3021.96	1532
Daily milk	251	13.74	6
Days in milk (d)	345	214.69	111
Protein %	345	3.52	0.51
Fat %	345	3,5	0.59

In France, the Tarentaise produced, in 2017, 4473 kg in 305 d, with 3.6 % fat and 3.2 % protein [10]. The latter source reported for Prim'holsteins 9042 kg in 305 d with 3.9 % fat and 3.1 % protein.

3.2. Sources of variation

Main sources of variation of milk yield, percent fat and percent protein are in table (2). Factors such as herd, calving year, calving month, and days in milk were found to be highly significant ($p < 0.01$) in influencing the milk yield of the Tarentaise breed in Tunisia. This study marks a pioneering effort in revealing the various factors affecting milk production traits within the Tarentaise breed in Tunisia. It underscores the significance for farmers to recognize that factors beyond a cow's genetic composition can substantially impact the breed's milk performance.

Table 2 Sources of variation of milk yield, protein and fat percent

Source	ddl	Milk yield	% Protein	% Fat
Herd	1	**	**	Ns
Calving year	7	**	**	0.02
Calving month	11	**	0.09	ns
Lactation number	8	**	ns	ns
Age at calving	10	ns	**	0.03
DIM	1	**	ns	0.08
DIM^2	1	**	ns	0.04
Residual error		267	264	264
R^2 (%)		83	39.5	19.6

*p<0.01 ; ns : non significant

3.3. Month of calving

The Least Square Solutions for the calving month effect, derived from model (1), are illustrated in Figure (1), using December as the reference month. This result indicates that the optimal period for Tarentaise cows to calve, given Tunisian conditions, spans from December to March. The impact of the calving month on milk yield is quantified as the difference between the whole lactation milk yield for a specific calving month and the complete lactation milk yield associated with December calving. This study presents groundbreaking findings on how the calving month influences milk production in Tarentaise cows within the context of the South Mediterranean climate. Notably, there's a significant difference in milk production, with a range of 700 kg to 750 kg observed between cows calving in January compared to those calving in August or September. It's crucial to share these insights with Tarentaise producers, enabling them to strategically optimize milk production by aligning with the specific environmental and climatic conditions their cows face. Monthly trends, favoring cows calving in January over those calving in August were reported by [11] for Holteins in Tunisia.

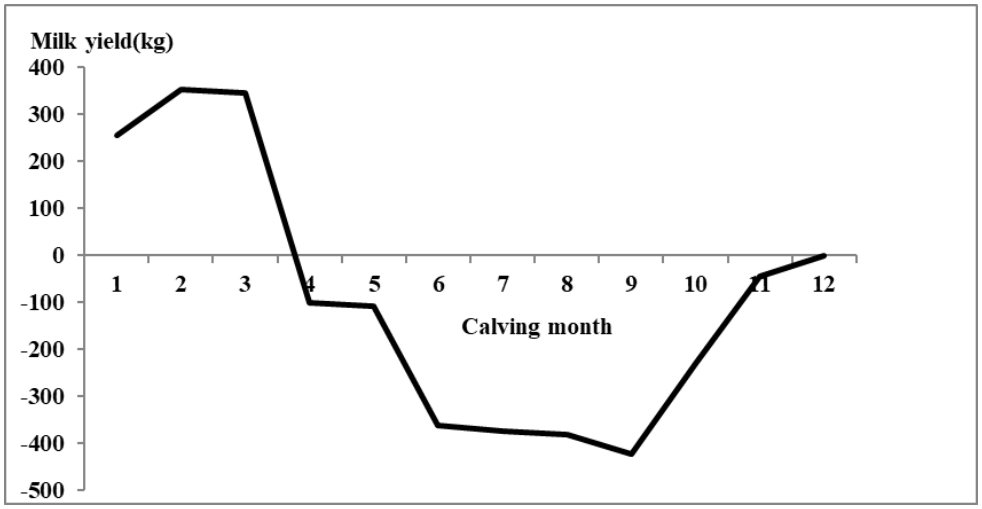

Figure 1 The effect of calving month on milk yield of tarentaise cows

Upon examination of calving frequencies (as shown in Figure (2), it's evident that a greater number of cows calve during the summer months. This suggests that farmers may be missing out on potential profits by not strategically timing calving to optimize milk production.

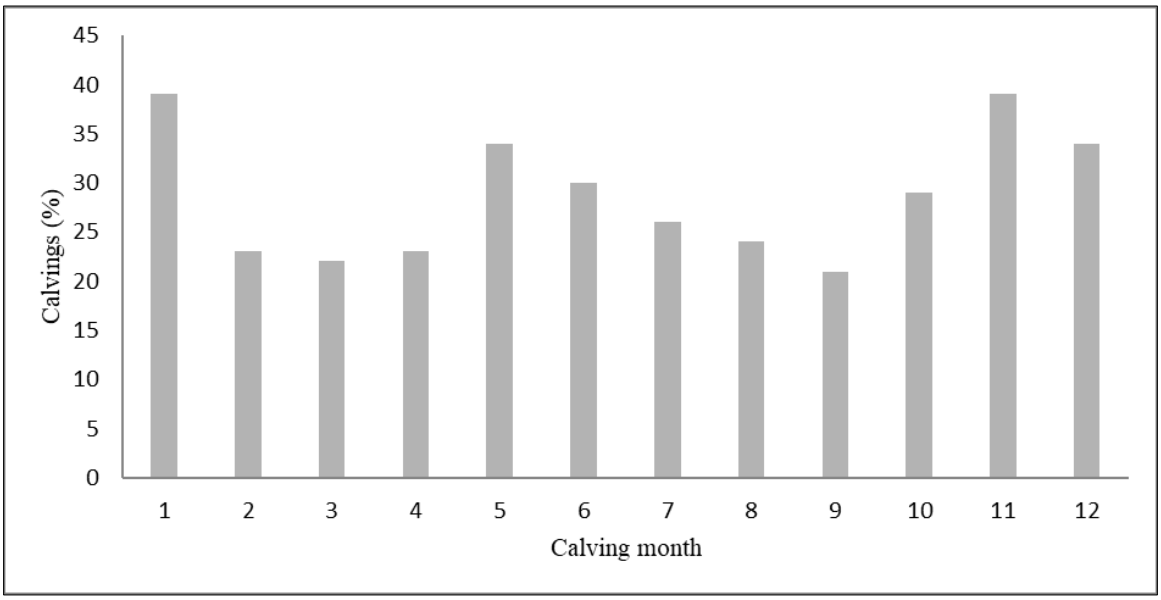

Figure 2 Calving frequencies by month

3.4. Lactation number

The effect of lactation number on milk yield is shown in figure (3). As reported, cows are retained for up to their 9th lactation. However, the analyzed field data indicated that peak milk production is achieved during the 4th lactation, which typically occurs when the cow is 6 years old. Retaining cows for extended periods could hinder Tarentaise breed owners from capitalizing on the global advancements in genetic progress.

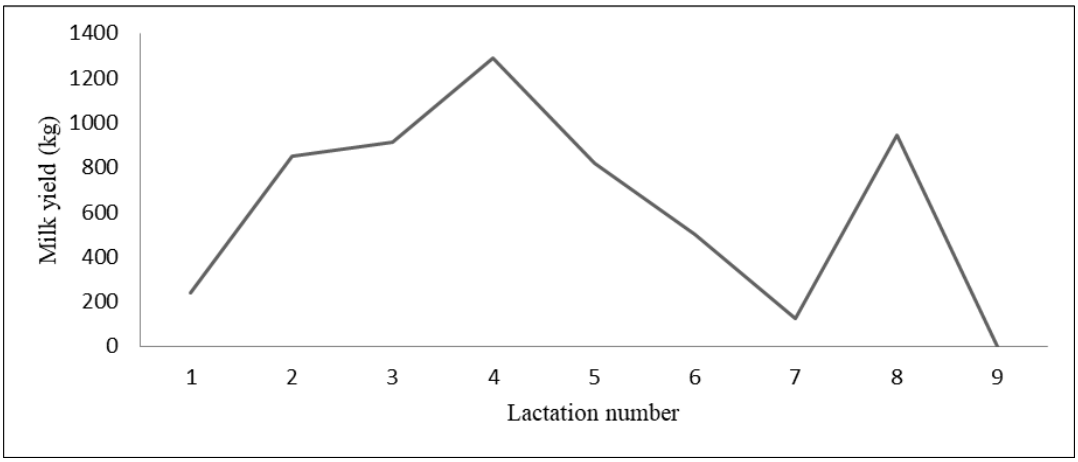

Figure 3 Effect of lactation number on milk yield

Adjustment factors for calving month and lactation number are derived in table (4).

Table 3 Adjustment Factors for calving month and lactation number

Calving month	Adjustment factor	Lactation number	Adjustment factor
1	0.92	1	0.93
2	0.9	2	0.78
3	0.9	3	0.77
4	1.03	4	0.7
5	1.04	5	0.79
6	1.13	6	0.86
7	1.14	7	0.96
8	0.96	8	0.76
9	1.16	9	1
10	1.05		
11	1.01		
12	1		

Equations (2 and 3) were formulated to account for days in milk for both primiparous cows and those in their subsequent lactations. Recommended adjustment, for the Tarentaise breed, to standardize milk yield for DIM under climatic conditions in Tunisia are for first lactation:

$$\textbf{Milk 305d} = \textbf{milk yield} + 16.63*(305-DIM) - 0.01*(305-DIM)^2 \quad (2)$$

For all lactations after the first :

$$\textbf{Milk 305d} = \textbf{milk yield} + 22.15*(305-DIM) - 0.024*(305-DIM)^2 \quad (3)$$

These findings hold significant implications for dairy producers not only in Tunisia but also across the broader southern Mediterranean region. They underscore that factors beyond the genetic composition of the dairy cow play a pivotal role in influencing milk yield, fat yield, and fat percentage. Adjusted milk yield to 305 DIM and for calving months and lactations number gave an estimate of 3782kg ± 869kg.

3.5. Genetic progress

The Average BLUP Breeding Values, categorized by the birth year of the assessed animals, are presented in Figure (4). The data indicated that neither herd demonstrated a positive trend in genetic progress for milk yield. Notably, of the five bulls utilized across both herds, the one with the negative Breeding Value (BV_milk (kg) was predominantly used by both.

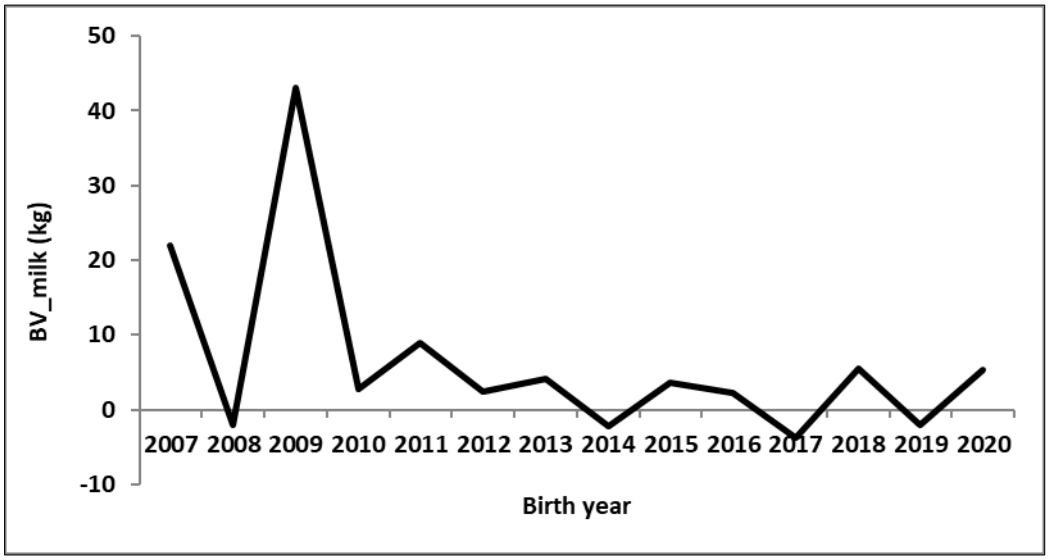

Figure 4 Genetic trend

The findings presented represent a pioneering effort in assessing the impact of calving months, lactation number, and DIM on milk production in Tarentaise cows within Tunisia. A specific optimal calving period was pinpointed for enhanced milk yield. Interestingly, certain cows remain in herds for up to nine lactations, yet their peak milk production is observed during the sixth lactation. It's noteworthy that the genetic progress trajectory has decelerated since 2010, largely attributed to the frequent utilization of genetically inferior sires.

4. Conclusions

Tunisia aims to achieve again its self-sufficiency in milk production on a national scale since 2010. This study marks the inaugural attempt to detail the yield and reproductive outcomes of the Tarentaise breed in the country. We consider this research a foundational step towards gaining deeper insights into the Tarentaise cow and its ecological context.

For effective management of within-herd breeding initiatives, it's crucial to refine records by accounting for non-genetic variables. Specifically, adjustments considering age at calving, lactation duration, and calving season are paramount. This research has now equipped Tunisian dairy producers breed association (GERT) with the tools to make these critical record refinements.

By consistently improving the accuracy in identifying both sires and cows over extended durations, the GERT can fortify the foundation of genetic improvement programs, ensuring they are built on solid and reliable data for lasting impact.

Compliance with ethical standards

Acknowledgments

The authors extend their gratitude to Dr karim Daoud and Mr. Bejaoui Mouhamed (GERT) for their support and guidance and appreciate the warm reception from Mrs. Amina Najjar Baccouri and Mrs. Claire Daoud at their farms.

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] The Cattle Site, 2022. www.ansi.okstate.edu

[2] M'Naouer Djemali, 2023. Unlocking animal genetic resources for enhanced productivity: The power lies in the genes. World Journal of Advanced Research and Reviews, 2023, 20(03), 631–637

[3] Abdelguerfi A., Laouar M. 2000. Consequences of changes on the genetic resources of the Maghreb in Bourbouze A. (ed.), Qarro M. (ed.). Disruption: new issues, new functions, new image of range breeding, Montpellier: CIHEAM. Mediterranean Options: Series A. Mediterranean Seminars; not. 39:77-87

[4] Givlait, 2007. Tarentaise study definitive version. www.givlait.com.tn

[5] Barki Ilhem. 2023. Genetic evaluation of Tarentaise breed herds registered for milk recording. PFE, INAT.

[6] M. Belhaj and J. L. Tisserand, 1990. Genetic improvement of cattle in southern Mediterranean climates (EAAP Publication No 47). © Center for Agricultural Publishing and Documentation, (Pudoc) Wageningen, Netherlands.

[7] Rahma Bellagi, 2017. Study of the adaptation of the Tarentaise breed to heat stress conditions in Tunisia. https://www.researchgate.net/publication/324886171.

[8] M'Naouer Djemali, 2017. Animal Genetics (Book), ISBN: 978-9938-00256-0. Chapter 7.

[9] MOA-OEP, 2021. Livestock Technical Indicators.

[10] Web-Agri, 2017. Disparate but constantly increasing inter-race productivity. https://www.web-agri.fr/vaches-laitieres/article/136895/une-productivite-inter-race-disparate-mais-qui-ne-cesse-d-entreprises.

[11] M. Djemali and P. J. Berger, 1992. Yield and Reproduction Characteristics of Friesian Cattle Under North African Conditions. J Dairy Sci 75:3568-3575.