Feeding teff *(Eragrostis tef)* to lactating dairy sheep: a forage option in the Mediterranean basin

Riccardo Primi[1]*, Pier Paolo Danieli[1], Gloria Bernabucci[1], Michele Ferri[1], Francesca Cellitti[1], Irene Bottoni[1], Francesco Napoli[2], Carlo Boselli[2], Raffaello Spina[1], Bruno Ronchi[1]

[1]Università degli Studi della Tuscia, DAFNE, Via San Camillo del Lellis, snc, 01100, Viterbo, ITALY

[2]Istituto Zooprofilattico Sperimentale del Lazio e della Toscana "M. Aleandri", National Reference Centre for Ovine and Caprine Milk and Dairy Products Quality (C.Re.L.D.O.C.), via Appia Nuova, 1411, 00178, Roma, ITALY

primi@unitus.it

UNIVERSITÀ DEGLI STUDI DELLA TUSCIA
DIPARTIMENTO DI SCIENZE AGRARIE E FORESTALI

Istituto Zooprofilattico Sperimentale del Lazio e della Toscana *M. Aleandri*

INTRODUCTION

Teff [*Eragrostis tef* (Zucc.) Trotter] is a promising forage crop for **Mediterranean livestock systems** due to its adaptability under **climate stress** [1]. Despite growing interest, its role in **dairy sheep diets** remains underexplored. This study compares **milk yield** and **composition** in dairy sheep grazing on **teff** (T) with those grazing on **sorghum** (*Sorghum sudanense*) **grass** (S), used as control.

MATERIAL and METHODS

In **May 2024**, two forage crops were sown, without fertiliser or irrigation, on a commercial farm in central Italy:

- **Forage teff** (Moxie, coated blend composed by 37% Tiffany + 63% CW0604, Barenbrug, The Netherlands)
- **Forage sorghum** (var. Piper, Pacific Seed Company, California, U.S.A.)

Thirty-two primiparous Sarda ewes were selected (BCS 2.7±0.2; days in milking 150±10; milk yield 0.9±0.2 kg/day) and randomly assigned to the **groups**:

- **G1** (sorghum grazing ewes, n=16);
- **G2** (teff grazing ewes, n=16).

In **July 2024**, ewes grazed **5 h/day** and were supplemented with:

- Clover-ryegrass hay, *ad libitum*;
- Pelleted feed, 0.5 kg/day, at milking.

Sample collection and analysis (5-week sampling: from T0 to T4)

- **Feed and pasture:** analysed for dry matter (DM), ash, ether extract (EE), crude protein (CP), ash [2], crude fiber (CF) and fibre fractions (aNDFom, ADF, ADL) [3].
- **Milk yield:** recorded weekly and pre-trial using lactometers.
- **Milk samples:** analysed at the IZSLT laboratory using a Milkoscan FT device (Foss Electric), to determine fat (%), protein (%), lactose (%), freezing point (m°C), urea (mg/dL), and total casein (%).
- **Milk correction:** yields adjusted to 6.5% fat and 5.8% protein (FCM6.5%; FPCM6.5%,5.8%) using the equation proposed by [4].

Statistical analysis

Repeated measures ANOVA was performed, including diet, time, and their interaction as fixed effects, and animal as a random effect. Significance was declared at $p<0.05$. Analysis were performed using XLSTAT 2024.2.2. The Cornell Net Carbohydrate and Protein System (CNCPS) were used to evaluate the prediction of DMI (NDS Professional software, R.U.M.&N sas, Italy).

RESULTS and DISCUSSION

Dry matter increased (S: 29.45–41.72%, T: 42.72–56.21%) while CP declined (S: 5.97–3.61%, T: 7.36–4.89%) during the trial due to maturation (T0 to T4). **Fiber** components (**aNDFom**: 64.99–70.84% in S, 67.7–70.44% in T; **ADF**: 37.49–48.62% in S, 29.69–44.6% in T; **ADL**: 4.62–5.65% in S, 4.19–3.89% in T) and **EE** (S: 1.37–6.59%, T: 1.42–1.71%) generally increased. **Non-structural carbohydrates** (NSC) declined in S (21.62–18.16%) but remained relatively stable in T (17.38–18.97%) across sampling periods. Significant main effects of diet were observed for **milk fat** and **urea** content ($p<0.0001$). G1 produced a comparable **milk yield** (0.87 ± 0.12 kg/day) to G2 (0.81 ± 0.15 kg/day, p = 0.3), yet G1 displayed a higher milk fat content from T1 to T4 (7.19 ± 0.3% vs. 5.68 ± 0.8%, $p<0.001$) (Fig. A). The lower milk fat content in G2 may be due to reduced pasture **dry matter intake** (DMI) (G2: 1.72 vs G1: 2.48 kg/day) and a possible unfavorable interaction of teff with **ruminal microbial populations**. The protein content did not differ between groups but increased over time, with a significant rise in G2 at T4 (6.19 ± 0.82% vs 5.12 ± 0.51%; $p<0.0001$) (Fig. B). Urea content was significantly higher in G1 at T2 (71.11 ± 7.84 mg/dL), with highly significant differences ($p<0.0001$) across other diet × time combinations (Fig. C).

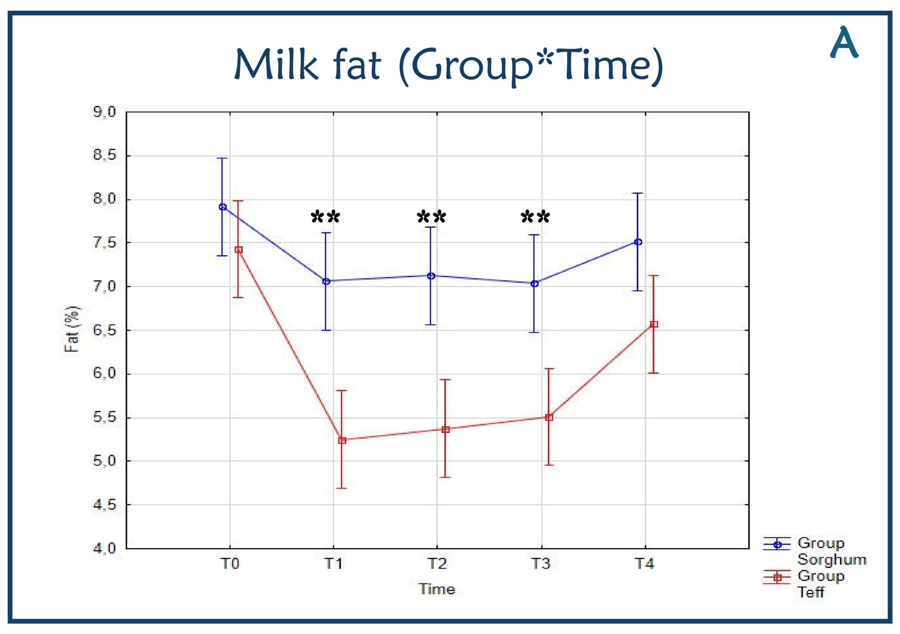
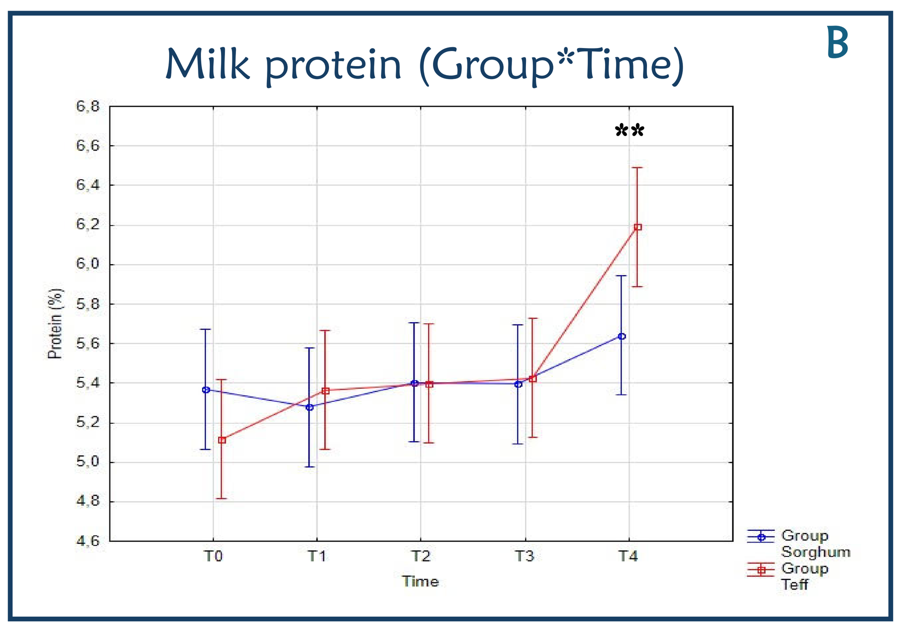
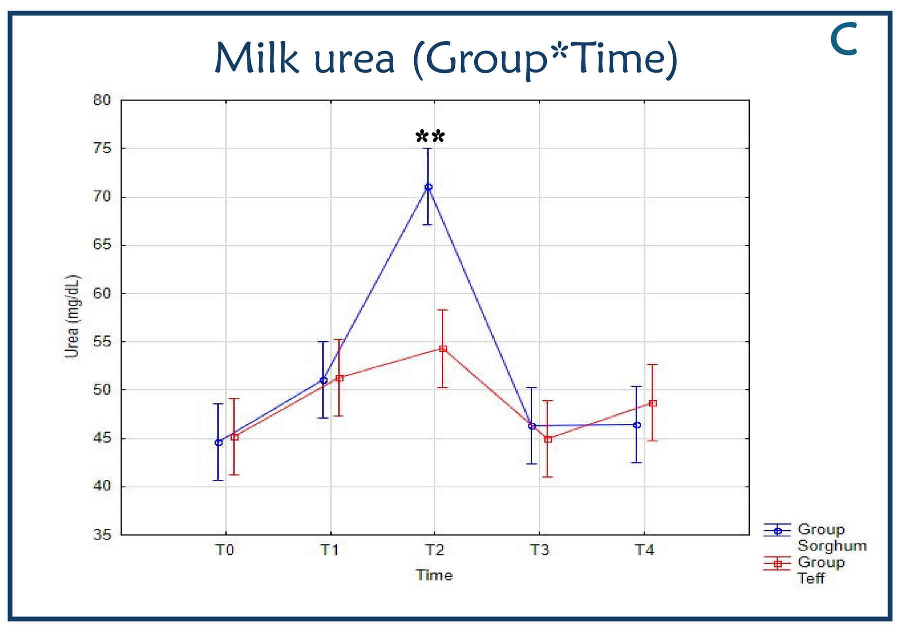


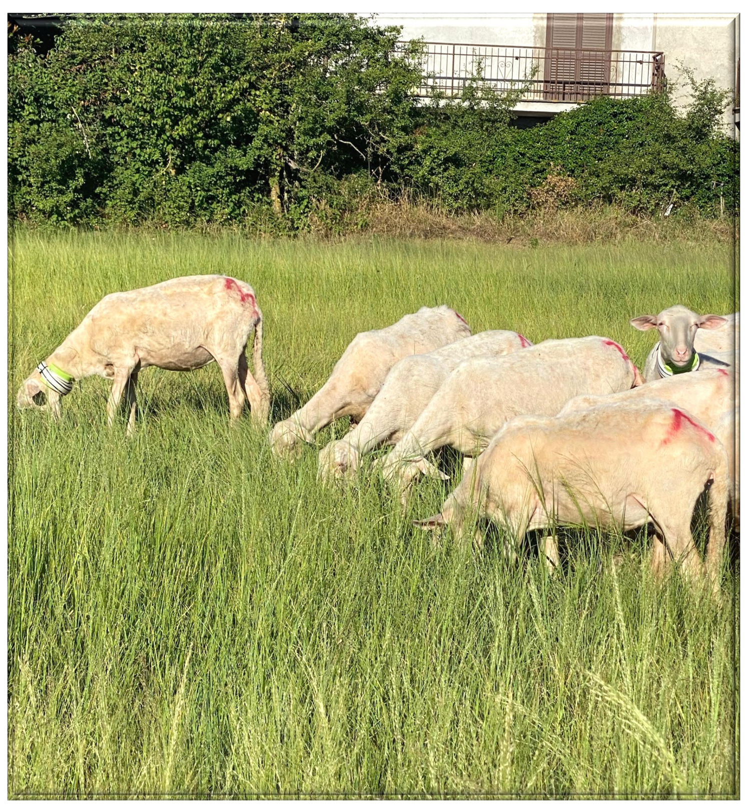
Figure A - Comparisons of milk fat content (%) between G1 (sorghum) and G2 (teff). ** = p<0.01.

Figure B - Comparison of milk protein content (%) between G1 (sorghum) and G2 (teff). ** = p<0.01.

Figure C - Comparison of milk urea content (mg/dL) between G1 (sorghum) and G2 (teff). ** = p<0.01.







References

[1] Ruggeri R., Rossini F., Ronchi B., Primi R., Stamigna C., Danieli P.P., 2024. J. Agr. Food Res. 17 (art. N. 10257), https://doi.org/10.1016/j.jafr.2024.101257

[2] AOAC. 1990. Official methods of analysis. 15th ed. Arlington, VA: AOAC Washington, DC.

[3] Van Soest P, Robertson JB, Lewis BA. 1991. J Dairy Sci. 74(10): 3583–3597. https://doi.org/10.3168/jds.S0022-0302(91)78551-2

[4] Pulina G., Macciotta N., Nudda A. (2005). Ital J Anim Sci. 4(sup1):5–14. https://doi.org/10.4081/ijas.2005.1s.5

Acknowledgements

Research supported by Agritech National Research Center and the European Union Next-GenerationEU (PIANO NAZIONALE DI RIPRESA E RESILIENZA (PNRR) – MISSIONE 4 COMPONENTE 2, INVESTIMENTO 1.4 – D.D. 1032 17/06/2022, CN00000022).

CONCLUSION

Maturation influenced the **chemical composition** of both forage species, with **dry matter** and **fiber components** increasing, while **crude protein** declined in sorghum but remained relatively stable in teff. The main effects of **diet** were significant for **milk fat** and **urea**, although **milk yield** was not affected. The lower milk fat in G2 may be related to **reduced intake** and a possible unfavorable interaction with **ruminal microbial populations**.

Teff shows strong potential as a **forage option for Mediterranean dairy systems** due to its adaptability to **arid climates** and favorable nutritional profile. **Further studies** are underway to investigate reduced intake, additional **milk quality traits**, and the economic and technical feasibility of teff as a **pasture**, as well as its performance in **other varieties**.

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA
agritech
26th Congress ASPA25 17/20 June 2025 | Turin, Italy
UNIVERSITÀ DEGLI STUDI DELLA TUSCIA DIPARTIMENTO DI SCIENZE AGRARIE E FORESTALI
Istituto Zooprofilattico Sperimentale del Lazio e della Toscana M. Aleandri