Proc. Assoc. Advmt. Anim. Breed. Genet. 26: 182-184

DUAL-PURPOSE NORWEGIAN RED CATTLE FOR SUSTAINABLE DAIRY AND BEEF PRODUCTION IN PASTURE-BASED SYSTEMS

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SUMMARY

The Norwegian Red (NR) breed has been developed as a dual-purpose dairy and beef cattle breed, offering opportunities to improve sustainability in New Zealand's pasture-based livestock systems. This study evaluates NR cattle's milk production and beef performance in comparison to existing New Zealand dairy breeds. Our results indicate that NR-sired cows maintain milk solid production comparable to New Zealand Holstein-Friesians while demonstrating superior fertility and persistent lactations. Additionally, surplus NR-sired calves achieve significantly higher carcass weights and greater economic returns than pure Holstein-Friesian (HF) calves in the same rearing system, presenting a viable alternative to add value to surplus dairy-origin calves (reducing reliance on low-value bobby calves) without compromising dairy output. The findings highlight NR cattle's potential to enhance farm profitability and environmental sustainability through better dairy-beef integration.

INTRODUCTION

New Zealand's dairy industry faces growing pressure to improve sustainability while maintaining profitability. One key challenge is the surplus of dairy-origin calves with limited beef value. This contributes to ethical concerns and resource inefficiency (Beukes *et al*. 2009). The Norwegian Red (NR) breed has been selectively bred for both milk and beef traits (Aass and Vangen 1998), making it a potential solution to improve calf utilization without compromising dairy production. Historically beef traits accounted for approximately 10% of the total merit index for the NR and today they represent 8% of the index (Geno 2023). NR cattle exhibit high fertility, strong health traits, and favorable feed efficiency, aligning well with New Zealand's pasture-based systems. This study examines NR cattle's dual-purpose potential in New Zealand dairy herds by comparing their milk production, reproductive performance, and beef value against traditional dairy breeds.

MATERIALS AND METHODS

Animals and data collection. In New Zealand, Performance data were collected from 1,621 dairy cows across two age groups (2-year-olds and 3-year-olds) representing three breed groups: Viking Red (n = 482, 435), NR (n = 50, 21), and New Zealand Holstein-Friesian (n = 284, 349). The NR-sired cows were managed alongside NZ Holstein-Friesian herdmates under the same pasture-based conditions. Milk production traits recorded included fat production (kg), milk solids (kg), protein production (kg), lactation days, and total lactation solids. In Norway, beef carcass data from slaughter records were obtained for 160 pure Holstein and 106 crossbred (NR × Holstein) cattle (all dams were Norwegian Red cows). These animals were finished for beef production, and their growth and carcass traits (carcass weight, price per unit weight, total carcass value, and fat score) were recorded.

Statistical analysis. Data were analyzed using R (version 4.3.0). Welch's ANOVA and the Games-Howell post-hoc test assessed breed differences in milk production traits. Carcass performance was compared using t-tests. Effect sizes were calculated using partial eta-squared (ηp^2) to determine the practical significance of observed differences.

RESULTS AND DISCUSSION

Milk production performance.NR cows demonstrated no significant difference ($P > 0.05$) in total milk solids production (kg/day) compared to Holstein-Friesians, supporting their suitability for New Zealand dairy systems. NR cows had significantly longer lactations ($P < 0.001$). While lactation length is not a direct measure of fertility, in seasonal systems it can reflect earlier conception. This aligns with previous studies reporting shorter days open and higher conception rates for NR cows compared to Holsteins (Walsh *et al*. 2008; Ferris *et al*. 2014).

Table 1. Means (±SD) of milk production traits by breed and age group

Trait	2-year-olds			3-year-olds		
	Viking	Norwegian	NZ Friesian	Viking	Norwegian	NZ Friesian
Fat (kg/day)	0.72±0.15	0.67±0.13	0.66±0.14	0.78±0.16	0.84±0.17	0.79±0.15
Milk Solids (kg/day)	1.33±0.26	1.22±0.20	1.31±0.27	1.44±0.30	1.46±0.24	1.44±0.28
Protein (kg/day)	$0.55±0.09^{a}$	$0.54±0.08^{ab}$	$0.53±0.09^{b}$	0.61±0.12	0.62±0.09	0.60±0.10
Lactation Days	$236.9±26.8^{a}$	$242.9±23.0^{a}$	$227.3±41.1^{b}$	$231.7±35.5^{b}$	$268.8±16.3^{a}$	$225.3±46.3^{b}$
Lactation Solids (kg)	292.2±72.4	274.3±68.0	299.2±98.9	$315.8±72.4^{b}$	$396.7±68.0^{a}$	$323.8±98.9^{ab}$

Different superscripts a,b within a row indicate significant difference at $P < 0.05$

Beef performance. In the Norwegian beef dataset, NR-sired calves demonstrated better carcass characteristics compared to Holstein-Friesians, including higher carcass weights (807 lbs vs. 770 lbs, $P < 0.05$) and higher carcass value ($1,302 vs. $1,204, $P < 0.05$). Improved muscling and dressing percentages make NR crosses more marketable for beef production, presenting an opportunity to integrate dairy-beef systems effectively. Similar benefits of NR genetics for beef performance have been reported (McNamee *et al*. 2015).

Table 2. Carcass performance of Holstein vs. NR×Holstein crosses

Trait	Holstein	NR X Holstein crosses
Number of cows	160	106
Carcass weight (lb)	770	807*
Carcass price per pound ($/lb)	1.57	1.63*
Carcass value ($)	1204.07	1302.26
Carcass fat (based on grades ranked 1 to 4)	2.43	2.51

* $P<0.05$ for difference between NR and NR×Holstein.

Environmental and Economic Impact. Adopting NR genetics presents a unique opportunity to reduce the environmental impact of dairy-beef production by optimizing resource utilization. Integrating surplus dairy calves into beef production can lower greenhouse gas emissions (van Selm *et al*. 2021; Yang *et al*. 2020). Although feed efficiency and antibiotic use were not measured in this study, previous research has shown that NR-sired cattle can achieve similar or greater milk solids yield with comparable or lower feed intake than Holsteins, indicating favourable feed efficiency (McClearn *et al*. 2022; Dong *et al*. 2015). Additionally, the Norwegian Red breed has been selected for mastitis resistance and other health traits for decades, contributing to lower disease incidence and reduced reliance on antibiotics (Begley *et al*. 2009; Rajala-Schultz *et al*. 2021). These attributes align with New Zealand's national targets to reduce antimicrobial use in livestock (NZVA 2024).

Future Prospects. The widespread adoption of NR cattle could significantly improve the integration of dairy and beef systems in New Zealand. Further research should focus on long-term genetic evaluations to optimize NR crossbreeding strategies and maximize profitability. Additionally, economic modeling could be performed to assess the financial viability of NR genetics at the farm level, considering both dairy and beef revenue streams.

CONCLUSION

NR cattle could offer a dual-purpose solution for New Zealand dairy herds, combining competitive milk production with enhanced beef value. While this study did not directly measure fertility or health traits, longer lactations observed in NR cows reflects timely conception in the seasonal systems, Improved fertility, longer lactations, and high carcass performance suggest that NR genetics can enhance dairy-beef integration while addressing sustainability concerns. Together with evidence from other studies, these results suggest that NR genetics could support more integrated and sustainable dairy-beef systems. However, the relatively small NR sample size in this study should be considered, and further research is needed to confirm these trends under New Zealand conditions. Widespread adoption of NR genetics in New Zealand could lead to improved farm profitability, reduced environmental impact, and enhanced animal welfare.

ACKNOWLEDGEMENTS

The authors thank Norway's national dairy herd database for providing the beef data used in this study. We clarify that the dairy performance data were collected from cows raised on commercial farms in New Zealand,

REFERENCES

Aass L. and Vangen O. (1998) *Acta Agr. Scand.* **48**: 65.

Beukes P., Gregorini P., Romera A., Levy G. and Waghorn G. (2009) *Agr. Ecosyst. Environ.* **136**: 358.

Begley N., Patton J., Pierce K.M. and Buckley F. (2009) *J. Dairy Sci*. **92**: 749.

Dong L.F., Yan T., Ferris C.P., McDowell D.A. and McCoy M.A. (2015) *J. Dairy Sci*. **98**: 1136.

Ferris C.P., Patterson D.C., Gordon F.J., Watson S. and Kilpatrick D.J. (2014). *J. Dairy Sci.* **97**: 5206.

Geno (2023). https://www.geno.no/fagstoff-og-hjelpemidler/avlsprogram-for-norsk-rodt-fe/avlsmalet-for-nrf/

McClearn B., Delaby L., Gilliland T.J., Guy C., Coughlan F., McCarthy B. and Buckley F. (2022) *J. Dairy Sci.* **105**: 242.

McNamee A., Keane M., Kenny D., Moloney A., Buckley F. and Riordan E. (2015) *Livest. Sci.* **173**: 95.

NZVA (2024) New Zealand Veterinary Association. "Antimicrobial Resistance Strategy." https://nzva.org.nz/clinicalresources/general/amr/ (accessed 4 March 2024).

Rajala-Schultz P.J., Nødtvedt A., Halasa T. and Persson Waller K. (2021) *Front. Vet. Sci.* **8**: 623998.

van Selm B., De Boer I.J., Ledgard S.F. and van MiddelaarC.E. (2021) *Agr. Sys.* **186**: 102936.

Walsh S., Buckley F., Pierce K.M., Byrne N., Patton J. and Dillon P. (2008). *J. Dairy Sci.* **91**: 4401.

Yang W., Rennie G., Ledgard S., Mercer G. and Lucci G. (2020) *Agr. Sys.* **178**: 102747.