FARMING PRACTICE
LIVESTOCK FEEDING TECHNIQUES

IMPACT: ANIMAL PRODUCTION

Reference 2

Salami, SA; Moran, CA; Warren, HE; Taylor-Pickard, J 2021 Meta-analysis and sustainability of feeding slow-release urea in dairy production PLOS ONE, 16(2), e0246922. 10.1371/journal.pone.0246922

Background and objective

There is an increasing interest to optimize the utilization of dietary protein in dairy cows to enhance production efficiency, reduce feed cost and mitigate environmental impacts of dairy production. A meta-analysis was conducted to evaluate the effects of replacing vegetable protein sources with slow-release urea (SRU) (Optigen, Alltech Inc., USA) on the production performance of dairy cows. Additionally, the impact of SRU supplementation on dairy sustainability was examined by quantifying the carbon footprint (CFP) of feed use for milk production and manure nitrogen excretion of dairy cows. Here, results on the production performance of dairy cows are reported.

Search strategy and selection criteria

A literature search was conducted using online academic databases (Google Scholar, Scopus, PubMed, CAB Direct, Web of Science, and Mendeley) to retrieve published studies evaluating the effect of the SRU product in dairy cows. The search strategy included the following words "dairy cow", "slow-release urea", "polymer-coated urea", "Optigen", and "milk production". No date restriction was applied to the literature search to encompass the entire duration that the SRU product has been used in dairy nutrition research. Additionally, the company's bibliography database was searched to retrieve published and unpublished trial reports that evaluated the effect of SRU in dairy cows. 1) The trial was reported in English; 2) the experiment was conducted in dairy cattle breeds; 3) studies contain at least one control diet without SRU supplement and a diet supplemented with the SRU product as a partial replacement for plant protein sources; 4) the SRU dosage was reported; 5) information on feed ingredient composition of diets was provided or available on request from authors; and 6) information on production performance parameters (dry matter intake, milk yield and composition) was reported or available on request from authors.

Data and analysis

The effect of SRU supplementation on feed intake and production performance parameters were subjected to statistical analysis using a linear mixed model. The treatment effect was included as a fixed effect, experimental duration as covariates and the study effect was included as a random effect. The number of animals was used as a weighing factor for the analysis. Results of treatment effect are reported as least square means for the control and SRU diets. Significance of treatment effect was declared when $P < 0.05$. Furthermore, regression analyses were performed to investigate the relationship between feed intake and production performance in response to SRU inclusion level and dietary crude protein content. Each of the feed intake and production performance parameters was considered as the respective dependent variable while the SRU inclusion level and dietary crude protein content were considered as predictive/independent variables. The number of animals was used as a weighing factor for the regression analyses. The model accuracy was evaluated by estimating the residual error as root mean square error (RMSE) and adjusted $R2$. The intercept and slope coefficients, and their respective standard error and significant levels are reported. The linear mixed model and regression analyses were performed using the SPSS software (IBM Statistics version 22). The presence of publication bias in the studies used for the meta-analysis was examined both graphically with funnel plots and statistically with Begg's test using the Comprehensive Meta-analysis software (version 3, Biostat Inc., USA). Publication bias assessed with the Begg's test was considered significant when $P < 0.05$.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
17	Dairy cattle	Slow-release urea (SRU) supplementation	No SRU supplementation	Metric: 1) Milk yield; 2) Fat-corrected milk; 3) Milk protein yield; 4) Feed efficiency; 5)Nitrogen use efficiency; Effect size: Difference of the considered metrics between intervention and control	87.5

Results

- SRU supplementation did not influence ($P > 0.05$) milk yield, fat corrected milk, energy corrected milk, milk fat and protein percentages or milk protein and fat yields.
- The partial replacement of plant protein sources with SRU significantly improved the feed efficiency (+3%) and nitrogen use efficiency (+4%) of dairy cows.
- The symmetrical shape of the funnel plots and results of the Begg's test indicated that there was no significant publication bias in the studies used for meta-analysis evaluation of feed intake and production performance variables.
- Increasing SRU inclusion level and diet crude protein content had a positive relationship to increase milk yield ($P < 0.001$, $R2 = 0.307$) and feed efficiency ($P < 0.001$, $R2 = 0.427$). Moreover, the nitrogen use efficiency ($P < 0.001$, $R2 = 0.542$) increased with increasing SRU level while diet crude protein content had a negative relationship on nitrogen use efficiency.
- NULL

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

No significant effect (P > 0.05) of slow-release urea supplementation supplementation on milk yield, fat-corrected milk, energy-corrected milk, and milk fat and protein composition. However, slow-release urea supplementation improved (P < 0.05) feed efficiency (+3%).