Nutrient Balances in California Dairy Farms: 2. Factors associated with feed conversion and nitrogen utilization efficiencies

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INTRODUCTION

Improving milk yield (**MY**) per cow is an important strategy to increase production efficiency in dairy herds. Balancing dietary nutrients contents according to animal requirements is the first step to maximizing MY per cow. Nutrient balancing should also be associated with good feed management practices.

From the economical and regulatory point of view, it is recommended to control and maximize feed conversion (**FC**) and nitrogen utilization efficiencies (**NUE**) to improve production efficiency on well managed dairy farms (Castillo, 2009).

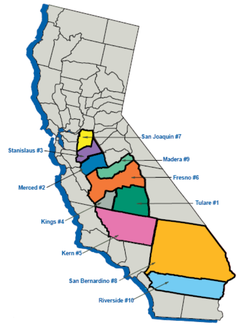
This study was designed to identify variables associated with feed management practices that might help to explain and improve feed conversion and nitrogen utilization efficiencies in dairy herds with high and low total solids (**TS**) in drinking water, and high and low MY per cow.

OBJECTIVE

The objective was to study dietary factors and feed management practices associated with feed conversion and nitrogen utilization efficiencies in lactating dairy cows on California commercial dairy farms.

METHODS

Dairies Surveyed
-Number of dairies: 40 (forty)
-Location: Merced County, CA
-Herd size: 787 cows (210 to 2435)
-Mean MY 3.5%FC: 31.8 kg/cow (20.6 to 43.5 kg)
-Mean TS in drinking water: 550 mg/L (100 to 1700 mg/L)



Samples
-Total Mixed Rations (**TMR**) from 40 dairies (n = 118 TMR or feeding groups of cows)
-Drinking water from water troughs
-Milk samples (am + pm) from the bulk tanks

All samples were collected in duplicate on two non-consecutive days

Chemical Analysis & variables studied
- Water TS were estimated by oven drying (105ºC, 24 h)
- Milk yield per cow and milk composition estimate on Dairy Herd Improvement (DHI) records and on bulk tank milk samples and UC Davis, ANR Analytical Lab
-TMR nutrient content by farm was determine by wet chemistry (UC Davis, ANR Analytical Lab), in each feeding group (% DM, NDF, ADF, Lignin, CP (N*6.25), Fat, Ash, non-fiber carbohydrates [**NFC** = 100-(CP+NDF+fat+ash)], and weight by the proportion of animals in each production group
- DCAD content was estimated based on TMR and water mineral content (Castillo et al. 2009)
- Number of TMR per farm for lactating dairy animals
- Number of lactating dairy cows per dairy farm
- Feed conversion (**FC**=MY/DMI)
- Nitrogen utilization efficiency (NUE=N milk/N intake) and CP balance (**CPB**= difference among CP supply & required, NRC, 2001)

Data analysis
A Pearson correlation analysis was used to study the linear association of feed conversion (FC) and nitrogen utilization efficiency (NUE), and water TS, MY per cow, DCAD, TMR nutrient content (NDF, ADF, CP, CPB, NFC, lignin, fat, ash), number of TMR/dairy for lactating cows, and cow number/dairy (for more details see also Castillo et al. ADSA, 2010 -W411).

RESULTS

The results of this study are presented in a correlations table, only lineal correlations with r>0.30 and *P*<0.05 are reported in Table 1.

Feed Conversion was positively and strongly correlated to MY and NUE (r = 0.88 and 0.86, respectively), positive and moderately correlated to NFC (r = 0.37) and number of TMR for lactating animals, and negatively correlated to diet quality as %NDF and excess of crude protein (CPB).

Nitrogen Utilization Efficiency was also positively and strongly correlated to MY per cow and dietary quality expressed as %NFC (r = 0.70 and 0.55, respectively), positive and moderately correlated to TMR number for lactating cows. NUE was negatively affected by the %CP in the diet and dietary excess of CP indicated as CPB (r = -0.64 and -0.70, respectively).

Milk Yield per cow was associated to almost all the variables analyzed in this study (except dietary %CP). It was positively correlated to feed management practices as the number of TMR, and also, MY was negatively affected by unbalanced and/or low quality diets, which were expressed in this study as CPB and dietary %NDF, respectively.

Table 1. Lineal correlation analysis among variables related to feed conversion and nitrogen utilization efficiency

	FC[1]	NUE[2]	COWS[3]	TMR[4]	CPB[5]	NFC[6]	CP[7]	NDF[8]	MY[9]
MY	0.88**	0.70**	0.40**	0.51**	-0.38*	0.37*	--	-0.44**	--
NDF	-0.33*	--	-0.40**	-0.49**	0.33*	-0.77**	--	--	
CP	--	-0.64**	--	--	0.88**	-0.48**	--		
NFC	0.37*	0.55**	0.31*	0.32*	-0.71**	--			
CPB	-0.35*	-0.70**	--	-0.45**	--				
TMR	0.40*	0.36*	0.50**	--					
COWS	--	--	--						
NUE	0.86**	--							
FC	--								

[1]**FC**= feed conversion (kgFC3.5% milk/kg DMI)
[2]**NUE**= nitrogen utilization efficiency (kg milk nitrogen/kg nitrogen intake)
[3]**COWS**= number of lactating cows per farm
[4]**TMR**= number of total mixed ration for lactating animals
[5]**CPB**= dietary crude protein balance, daily supply – required (g/cow per d)
[6]**NFC**= dietary non-fiber carbohydrates content (%)
[7]**CP**= dietary crude protein content (%)
[8]**NDF**= dietary neutral detergent fiber content (%)
[9]**MY**= milk yield per cow
** (*P*<0.01), *(*P*<0.05)

CONCLUSIONS

Results from this study suggested MY per cow as the most important variable to improve production efficiency.

Feed Conversion and NUE were high and positively correlated, indicating that both variables should be controlled and managed together to maximize production efficiency.

The TMR number for lactating animals should be considered an important strategy for improving milk yield, feed conversion and nitrogen utilization efficiency in dairy farms. The TMR dietary nutrient content related to balanced and/or unbalanced diets affected the production efficiency variables.

REFERENCES

-Castillo, A.R., N. St-Pierre, N. and J Silva del Rio. 2010. Nutrient balances in California dairy farms. 1. Effects of total solids content in drinking water and milk yield per cow on nutrient utilization efficiency . J. Dairy Sci. (93) Suppl. 1, Abstract W411.
-Castillo, A.R., J Silva del Rio, N. and N. St-Pierre. 2009. Total mixed ration mineral contents in California dairy farms. J. Dairy Sci. (92) Suppl. 1, Abstract W293.
-Castillo, A.R. 2009. Whole-farm nutrient balances are an important tool for California dairy farms. California Agriculture 63(3):149-151.
-National Research Council (NRC). 2001. Nutrient Requirements of Dairy Cattle. 7th Revised Edition. Natl. Acad. Press. Washington, D.C.

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