Nutrient Balances in California Dairy Farms: 1. Effect of total solids content in drinking water and milk yield per cow on nutrient utilization efficiency

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(Abstract #: W411. ADSA Meeting July 11-15, 2010, Denver, Colorado)

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 balances should be also associated with good feed management practices.

Water is the most important nutrient for dairy cows (NRC, 2001). The term total solids (**TS**) in water refers to the residue obtained in an oven (105° C, 24 h). It was suggested that low TS content in drinking water (~500 mg/L) could be affecting dietary nutrient contents and manure composition (Castillo, et al. 2007).

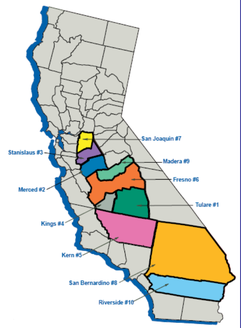
This study was designed to identify possible effects of low TS (**LTS**) and high TS (**HTS**) content in the drinking water, and low (**LMY**) and high (**HMY**) MY per cow on dietary nutrient content (Total Mixed Rations, **TMR**), feed management practices and production efficiency variables in lactating dairy cows.

OBJECTIVE

The objective was to study TMR nutrient content, dietary cation-anion difference (**DCAD**), number of TMR/dairy, number of lactating cows/dairy, feed conversion (**FC**) and nitrogen utilization efficiency (**NUE**) in dairies with high total solids (HTS) and low total solids (LTS) in water, and high milk yield (HMY) and low milk yield (LMY) per cow.

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)
-Mean TS in drinking water: 557 mg/L (100 to 1683)



Samples
-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 studies
- 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 determined 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**) estimated by the difference among CP supply & CP required according to the NRC, 2001.

Data analysis
Data was analyzed as 2 x 2 factorial with water **HTS** (> 500 mg/L) and **LTS** (< 500 mg/L), and **HMY** (> 32 kg/cow per day) and **LMY** (< 32 kg/cow per day) as the main factors. The model included effect of water TS, the effect of MY per cow, and the interaction water of TS x MY.

RESULTS

The estimated DMI in this survey was 23.3±1.71 kg MS/cow per d (18.5 to 26.0). Levels of TS in the drinking water were: 809 (535 to 1683) and 307 (100 to 515) mg/L for HTS and LTS, respectively. Levels of MY were 36.0 (31.6 to 43.5) and 27.6 (20.6 to 31.6) kg/cow per day for HMY and LMY per dairy farm, respectively. Table 1 contains the statistical analysis with TS water and MY effects. The interaction of water TS and MY per cow was not significant for any variable analyzed in this work and not included in the Table.

Table 1. TMR nutrient content, feed management practices, feed conversion and nitrogen utilization efficiency for dairies with high (HTS) and low (LTS) total solids in water, and high (HMY) and low (LMY) milk yield.

	Water TS[1]		Milk Yield[2]				
Item	LTS	HTS	LMY	HMY	SEM[3]	Minimum[4]	Maximum
NDF, %	34.5	35.7	36.3[a]	33.9[b]	0.50	29.99	42.15
ADF, %	23.3	23.9	24.1	23.1	0.41	20.08	26.73
CP, %	17.6	17.3	17.7	17.2	0.31	13.91	22.19
NFC, %	35.0	34.2	33.3[b]	35.9[a]	0.61	27.44	41.18
Fat, %	4.3	4.7	4.3	4.8	0.20	2.40	7.30
Ash, %	8.6	8.1	8.4	8.2	0.22	6.76	11.89
CPB, g/cow per d	360.2	348.6	518.1[a]	190.8[b]	84.01	-435.00	1547.00
DCAD, mEq/kg DM	29.1[a]	23.4[b]	26.2	26.2	1.67	13.30	53.49
FC, kg FCM3.5%/kg DMI	1.39	1.36	1.25[b]	1.50[a]	0.031	0.95	1.81
NUE, kg N milk/kg N intake	0.24	0.24	0.21[b]	0.26[a]	0.008	0.15	0.33
TMR/dairy (milk cows)	3.0	2.9	2.2[b]	2.7[a]	0.26	1.00	5.00
Milking cows/dairy	936.2[a]	611.1[b]	512.6[b]	1061.7[a]	113.10	210.00	2435.00

[1]Water TS: low and high total solids (LTS & HTS)
[2]Milk Yield: low and high milk yield (LMY & HMY)
[3]SEM = standar error of the means
[4] Minimum & maximum values
[a-b] Means within a row with different superscripts differ ($P < 0.05$)

Water TS content was only related to DCAD and number of cows per farm. Dietary DCAD (TMR + Water) was lower with HTS water. A lower number of cows/farm was related to a higher TS content in the drinking water.

Milk yield affected TMR NDF content (34 and 36%) and NFC (36 and 33%) for HMY and LMY, respectively. The main effects of MY were on efficiency variables. The CPB was 2.7 times higher in LMY cows. FC and NUE were about 20% higher for HMY. Also, HMY cows were associated with a larger number of cows/dairy. High MY farms have more milking cows feeding groups or TMR, 3.7 vs. 2.2 TMR for low MY farms.

CONCLUSIONS & REFERENCES

Mineral contents in the drinking water should be considered to calculate DCAD in lactating cows. The relation between cows per farm and HTS water might be related to lower acreages in small farms for manure applications.

The dietary CP was not different for HMY & LMY, which can explain the observed CPB differences. Both, NUE and FC are directly related to MY as well as the number of cows per farm and the number of TMR/farm.

Results of this survey indicates an association among HMY cows, good feed management practices and production efficiency variables.

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ACKNOWLEDGEMENTS

The authors thank dairy producers in Merced County, CA for their support and participation.

This project was supported by the University of California, ANR Core Issues Grants Program.

Larry Burrow, working with flow meters for water intake estimations