

Physiologic responses to feeding rumen-protected glucose (RPG) to lactating dairy cows

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BACKGROUND ...

- Progesterone clearance rate is a function of hepatic blood flow and liver enzyme activity (Sangsritavong et al., 2002).
- Feeding a high starch diet yielding more glucose increased insulin production resulting in decreased liver enzyme activity (Lemley et al., 2010).
- Demand for glucose by the mammary gland for milk synthesis may decrease the amount of glucose available to other body tissues including the tissues involved in reproduction (Garverick et al., 2013).

HYPOTHESIS ...

- Supplementing RPG will increase concentrations of glucose and insulin resulting in decreased activity of liver cytochrome P450 2C and P450 3A, thus increasing blood progesterone concentrations.

MATERIALS AND METHODS ...

- 61 Holstein cows (24 primiparous and 37 multiparous) were enrolled in a randomized complete block design before first postpartum insemination.
- Cows were individually fed twice daily experimental diets: 0, 1, 2, or 4 kg/d RPG (SoyBest; West Point, NE). Ground corn was added to the treatment diet in order for each cow to receive a total of 4 kg/d. The treatment was hand-mixed with the basal ration from 58 to 72 ± 3 DIM.
- All cows were inseminated at 82 ± 3 DIM
- Outcomes of interest included:
 - Change in insulin concentrations
 - Daily progesterone concentrations
 - Dry matter intake, milk yield, and milk composition

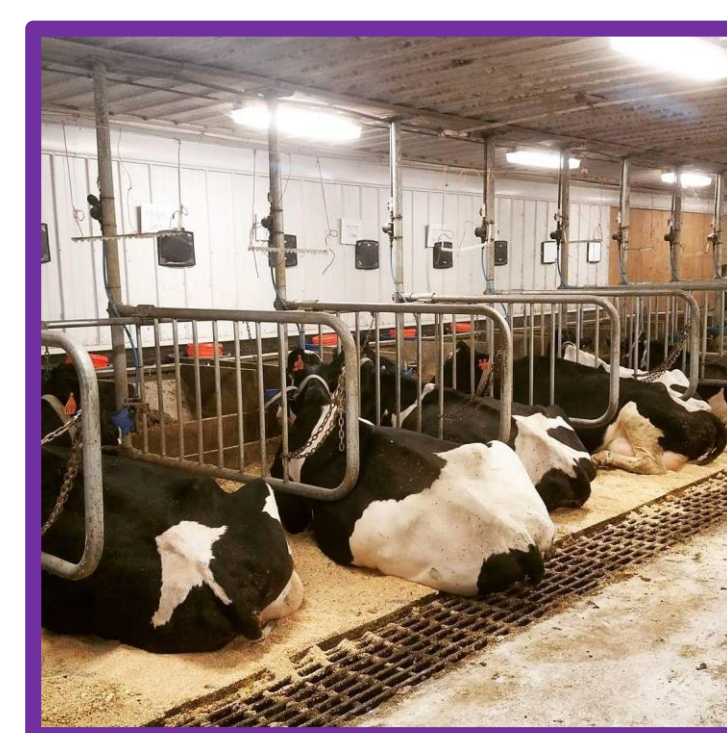
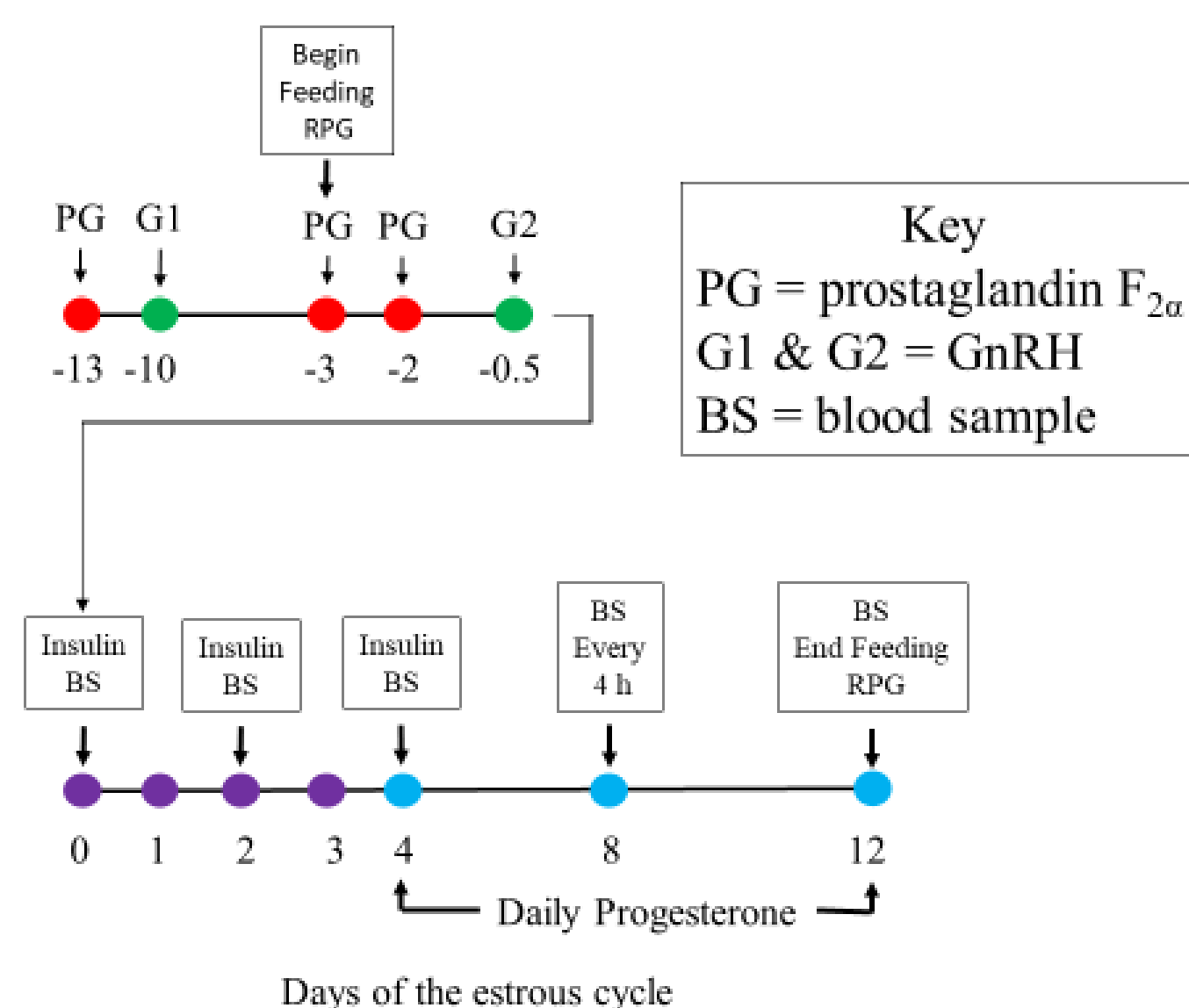


Table 1. Ingredient and nutritional composition of the basal diet¹

Ingredients	% DM		
Corn silage	22.5		
Triticale silage	15.0		
Alfalfa hay ²	6.2		
Corn gluten feed ³	22.8		
Whole cottonseed	4.0		
Corn grain, finely ground	13.4		
Concentrate mix	16.1		
Nutrient, % of DM (unless otherwise specified)			
	Basal ration	Ground corn	RPG⁴
DM, % as-fed	47.8	86.3	82.9
CP	18.2	9.8	43.2
ADF	23.9	3.9	4.9
aNDF	36.5	9.8	20.2
Starch	12.3	69.7	1.1
Ethanol-soluble carbs (simple sugars)	8.1	5.5	38.6
TDN	70.0	88.0	81.0
NE _t , Mcal/kg	0.75	0.94	0.86

¹ Nutrient composition are results of NIR analysis of the basal ration.

² 50:50 mixture of lower (22.1% CP) and higher quality alfalfa (23.9% CP).

³ Sweet Bran (Cargill Inc., Blair, NE).

⁴ Rumen-protected glucose product.

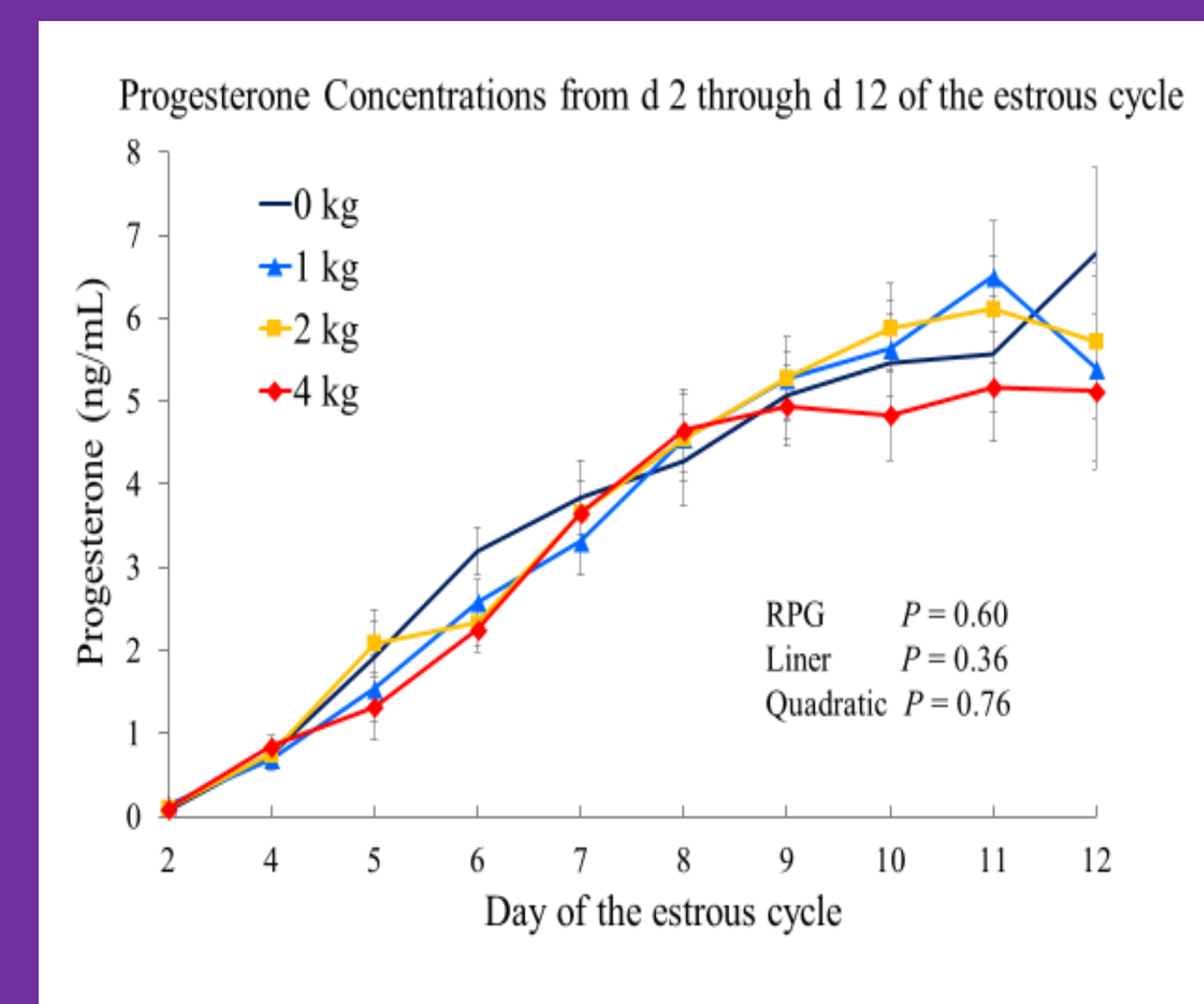
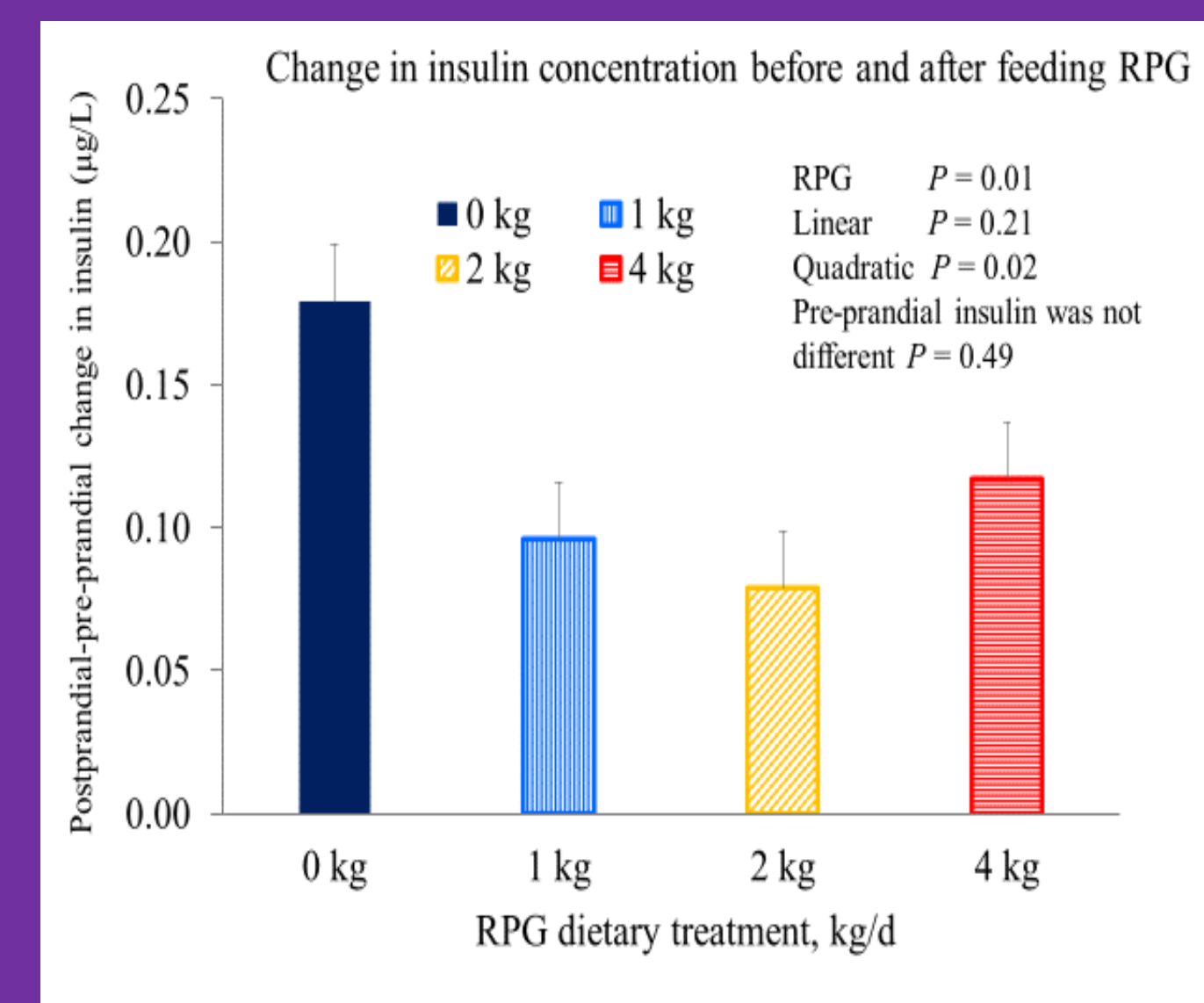


Table 2. Intake and productivity variables in cows supplemented with varying doses of rumen-protected glucose (RPG)

Item	Treatment ¹ , kg				SEM	P-value		
	0	1	2	4		RPG ²	L ³	Q ³
Intake								
Starch, kg/d	5.47	4.93	4.26	3.30	0.11	<0.01	<0.01	0.06
CP, kg/d	5.19	5.61	5.82	6.84	0.17	<0.01	<0.01	0.09
ESC ⁴ , kg/d	1.79	2.13	2.41	3.15	0.06	<0.01	<0.01	<0.01
DM, kg/d	24.3	24.8	24.0	25.5	0.74	0.62	0.42	0.51
Preprandial glucose, mg/dL								
	65.04	65.35	65.95	68.54	2.85	0.65	0.36	0.80
Postprandial glucose, mg/dL								
	60.37	62.51	67.08	66.24	2.76	0.16	0.12	0.36
Milk, kg/d								
	49.9	50.6	48.9	50.5	1.27	0.96	0.88	0.57
ECM, kg/d								
	47.8	49.5	48.9	49.0	1.10	0.29	0.60	0.46
ECM:DMI								
	1.56	1.60	1.72	1.57	0.05	0.21	0.79	0.02
Fat, %								
	3.78	3.91	3.99	4.04	0.16	0.20	0.36	0.72
Fat, kg								
	1.84	2.07	1.93	2.06	0.12	0.29	0.28	0.65
Lactose, %								
	5.03	5.02	5.01	5.04	0.03	0.81	0.78	0.49
Lactose, kg								
	2.47	2.70	2.41	2.52	0.09	0.48	0.76	0.87
MUN, mg/dL								
	15.31	16.35	17.44	20.08	0.61	< 0.01	<0.01	0.73
Protein, %								
	2.68	2.62	2.65	2.61	0.02	0.10	0.15	0.74
Protein, kg								
	1.32	1.40	1.28	1.32	0.05	0.79	0.67	0.95
SCS								
	3.26	3.06	3.43	3.23	0.18	0.94	0.83	0.73

¹ Lactating dairy cows were supplemented with either 0 (control), 1, 2, or 4 kg of a rumen-protected glucose product in replacement of finely-ground corn grain.

² Contrasts of the 0 kg (control) were compared with the other 3 treatment means.

³ A priori orthogonal contrasts for unevenly spaced treatment amounts to determine linear (L) and quadratic (Q) effects of treatment, respectively.

⁴ Ethanol soluble carbohydrates.

Table 3. Corpus luteum volume and pregnancy per AI of cows supplemented with varying doses of rumen-protected glucose (RPG)

Item	Treatment ¹ , kg				P-value		
	0	1	2	4	RPG ²	L ³	Q ³
CL volume, cm ³	9.5 ± 1.5	10.3 ± 1.5	9.4 ± 1.5	12.0 ± 1.4	0.53	0.25	0.60
P/AI, % (n)	69.2 (13)	14.2 (14)	42.9 (14)	25.0 (16)	0.01	0.09	0.33

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³ A priori orthogonal contrasts for unevenly spaced treatment amounts to determine linear (L) and quadratic (Q) effects of treatment, respectively.

CONCLUSIONS ...

- Insulin response was diminished with RPG diets relative to control.
- CP intake and MUN increased linearly with RPG dose.
- RPG did not affect milk yield or DMI.
- RPG did not increase progesterone concentrations.