

## **An Evaluation of Rumen Bypass Vitamin Supplements During the Prefresh and early Postfresh Period**

Conducted for Morgan Inc.,  
Fall and Winter, 2007-2008

By FARME Institute  
Homer, NY

### **Procedures**

Four groups of 25 mature Holstein cows each were blocked by ME305 and expected calving date. Each group was fed different bypass vitamin supplements from -21 to 60 DIM. Supplements were Morgan Inc.'s BPC, an experimental Morgan product BIO, Balchem's Reassure, and an unsupplemented Control. Morgan Inc. supplied their products; Reassure was purchased from a local feed supplier. Approximately 2 months were required to enter all cows in the trial. Assigning this number of cows resulted in 20, 22, 22, and 23 animals completing the study for BPC, BIO, Reassure, and Control, respectively.

Cows were housed in a naturally ventilated freestall barn during Fall and Winter months. Cows were milked three times per day. Cows were hand-fed supplements on the same base ration for the prefresh and fresh periods (-21 to 0 DIM, 1-30 DIM). Any cow not consuming their supplement after 5 days was replaced on the study. After leaving the fresh group, they were sent to separate pens for the duration of the feeding period unless they become sick or injured.

During the prefresh period, the basal diet was a low potassium ration with a forage base of straw and corn silage. After freshening, all cows were housed in a common pen and fed a ration balanced according to the NRC2001 guidelines. Ration ingredients and nutrient specifications are reported in Appendices 11 and 12.

Milk weights were daily. Component testing was monthly for the first 60 days in milk. Body condition scoring was conducted at the entry into prefresh pens, freshening, and 60 DIM. All health events were recorded for all cows assigned to the study. Weekly forage samples were obtained and submitted for a complete NIR analysis; rations were adjusted if necessary.

Statistical analysis was accomplished using the Mixed procedure of SAS (SAS Institute, Cary, NC), according to a randomized complete block model with repeated measures. Previous lactation ME305 and calving block served as covariate adjustments for milk production. Parity, either 2 or 3+, served as an additional fixed effect. Herd health measures (displaced abomasum, mastitis, uterine infection, milk fever, and ketosis) were evaluated using a categorical model with Proc CatMod.

### **Results and Discussion**

Milk production in this group of cattle averaged 100 lbs/d or more for the first 60 DIM (Appendix 1). Production level was significantly impacted ( $P < .05$ ) by previous lactation ME305

and parity. A significant ( $P=.0158$ ) interaction between treatment and parity was due to higher production by parity 2 cows receiving BPC than for all other treatments. For parity 3 cows, there was no difference in daily milk production among treatments. Overall, milk fat and protein contents were low for this group of cows; however, since fat:protein ratios were normal this is likely a dilution effect due to high milk production in the herd (Appendices 2 and 3). Milk fat and protein content and yield were all unaffected ( $P>.10$ ) by dietary treatment (Appendices 2-5). Numerically, milk fat was lowest for BPC cows. This could be due to several factors, including both dilution by higher milk volume and less fat mobilized from body fat (ie - less loss of body condition). Since fat:protein ratio tended to be lowest ( $P=.0795$ ) with BPC and apparent fat mobilization (BCS changes, see below) was lowest for this group, it would seem that lower milk fat content was likely due to fewer fatty acids being mobilized from fat stores to become available for milk fat production.

Although the herd was experiencing a mastitis outbreak during the course of this study, average SCC for study cows was acceptable at 193,000 (Appendix 7). There was a statistically significant parity by treatment interaction for SCC ( $P=.0076$ ). This appears to be due to the fact that the lowest SCC value was for BPC parity 2 cows, but the highest was for BPC parity 3+ cows. Again, the lowered SCC for parity 2 cows receiving BPC may be a sign of a less stressful transition for these cows.

At -30 DIM, average BCS for all cows was 2.9 and did not differ ( $P=.7470$ ) between treatment groups. This value is slightly lower than the recommended 3-3.5 BCS at dry-off and calving. Cows were evidently in negative energy balance, as they averaged a drop in BCS of approximately one third of a condition score unit over the course of the study (Appendices 8-10). This is within the targeted condition score loss of half a unit between calving and peak intake. However, cows did experience small losses in body condition during the prefresh period which is not optimal for production or intake. Differences in BCS values and changes in BCS were not different ( $P>.10$ ) among treatment groups. Numerically, BPC resulted in the smallest loss in condition score over the course of the study (Appendix 10).

#### Body Condition Score at -30, 0, and 60 DIM.

DIM	Test Product				Std. dev.
	<u>BPC</u>	<u>BIO</u>	<u>Reassure</u>	<u>Control</u>	
-30	2.9	2.9	2.9	2.9	.05
0	2.8	2.8	2.7	2.7	.04
60	2.64	2.51	2.49	2.56	.05

Overall, herd health was good; however, mastitis incidence was somewhat higher than normal for this herd. Incidence of mastitis for test cows was not higher than for the herd as a whole, nor did any particular treatment suffer from a disproportionate number of mastitis cases. With the relatively small number of animals per treatment, detecting statistically significant health problems would be problematic. Of interest, BPC cows suffered from no health problems, other than mastitis. Uterine disorders were high for BIO and Reassure, but statistically significant likely due to small animal numbers.

Health Problems in Test Cows, arithmetic averages converted to incidence percent.

<b>Test Product</b>	<b>DA</b>	<b>Milk fever</b>	<b>Metritis</b>	<b>Ketosis</b>	<b>Mastitis</b>
BPC	0	0	0	0	35.0
BIO	4.5	4.5	18.2	9.1	18.2
Reassure	0	0	18.2	0	22.7
Control	0	4.3	4.3	4.3	26.1

\*Standard deviations were equivalent to or greater than mean incidences for all health problems and treatments.

## **Conclusions**

Overall, BPC appeared to reduce some of the stresses of early lactation. Parity 2 cows that tend towards lower feed intakes than older cows had higher milk production with BPC. Cows receiving BPC had the numerically highest BCS at 60 DIM and the numerically lowest losses of condition across the entire study. While milk fat content was lower for BPC cows, this may well be due to the dilution effect of higher milk production in the parity 2 cows.

Appendix 1. Daily Milk Production (lbs/d), all cows  
The Mixed Procedure

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
me305	1	170	7.92	0.0055
block	22	171	1.68	0.0355
trtmnt	3	171	0.29	0.8292
trtmnt*parity	4	171	3.15	0.0158

Least Squares Means

Effect	trtmnt	parity	Estimate	Standard Error	DF	t Value	Pr >  t
trtmnt	bio		100.26	1.7220	170	58.22	<.0001
trtmnt	bpc		102.03	1.8861	171	54.10	<.0001
trtmnt	c		100.56	1.6789	172	59.90	<.0001
trtmnt	r		102.06	1.7240	170	59.20	<.0001
trtmnt*parity	bio	2	95.8699	2.8193	169	34.01	<.0001
trtmnt*parity	bio	3	104.66	2.4387	175	42.92	<.0001
trtmnt*parity	bpc	2	100.75	2.8901	168	34.86	<.0001
trtmnt*parity	bpc	3	103.32	2.8076	174	36.80	<.0001
trtmnt*parity	c	2	96.5276	2.2566	170	42.78	<.0001
trtmnt*parity	c	3	104.60	2.9077	173	35.97	<.0001
trtmnt*parity	r	2	98.6738	2.6982	169	36.57	<.0001
trtmnt*parity	r	3	105.44	2.4614	171	42.84	<.0001

Differences of Least Squares Means

Effect	trtmnt	parity	_trtmnt	_parity	Estimate	Standard Error	DF	t Value	Pr >  t
trtmnt	bio		bpc		-1.7670	2.5728	171	-0.69	0.4931
trtmnt	bio		c		-0.2997	2.4410	172	-0.12	0.9024
trtmnt	bio		r		-1.7952	2.4642	171	-0.73	0.4673
trtmnt	bpc		c		1.4674	2.5511	171	0.58	0.5659
trtmnt	bpc		r		-0.02817	2.5548	170	-0.01	0.9912
trtmnt	c		r		-1.4955	2.3533	170	-0.64	0.5260
trtmnt*parity	bio	2	bio	3	-8.7879	3.9912	172	-2.20	0.0290
trtmnt*parity	bio	2	bpc	2	-4.8764	4.1678	168	-1.17	0.2436
trtmnt*parity	bio	2	c	2	-0.6576	3.6940	170	-0.18	0.8589
trtmnt*parity	bio	2	r	2	-2.8038	3.9587	169	-0.71	0.4798
trtmnt*parity	bio	3	bpc	3	1.3423	3.7963	175	0.35	0.7241
trtmnt*parity	bio	3	c	3	0.05828	3.9609	176	0.01	0.9883
trtmnt*parity	bio	3	r	3	-0.7866	3.6432	175	-0.22	0.8293
trtmnt*parity	bpc	2	bpc	3	-2.5693	4.2711	170	-0.60	0.5483
trtmnt*parity	bpc	2	c	2	4.2188	3.4833	167	1.21	0.2275
trtmnt*parity	bpc	2	r	2	2.0726	3.7497	168	0.55	0.5812
trtmnt*parity	bpc	3	c	3	-1.2840	4.0153	174	-0.32	0.7495
trtmnt*parity	bpc	3	r	3	-2.1289	3.6838	171	-0.58	0.5641
trtmnt*parity	c	2	c	3	-8.0720	3.9773	172	-2.03	0.0439
trtmnt*parity	c	2	r	2	-2.1462	3.2577	169	-0.66	0.5109
trtmnt*parity	c	3	r	3	-0.8449	3.5679	171	-0.24	0.8131
trtmnt*parity	r	2	r	3	-6.7707	3.8457	170	-1.76	0.0801

## Appendix 2. Milk fat percentage.

### Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
me305	1	283	11.97	0.0006
trtmnt	3	283	1.45	0.2271

### Least Squares Means

Effect	trtmnt	Estimate	Standard Error	DF	t Value	Pr >  t
trtmnt	bio	3.4912	0.1409	283	24.77	<.0001
trtmnt	bpc	3.2070	0.1449	283	22.14	<.0001
trtmnt	c	3.6171	0.1380	283	26.20	<.0001
trtmnt	r	3.4595	0.1439	283	24.04	<.0001

### Differences of Least Squares Means

Effect	trtmnt	_trtmnt	Estimate	Standard Error	DF	t Value	Pr >  t
trtmnt	bio	bpc	0.2843	0.2022	283	1.41	0.1609
trtmnt	bio	c	-0.1259	0.1972	283	-0.64	0.5238
trtmnt	bio	r	0.03174	0.2016	283	0.16	0.8750
trtmnt	bpc	c	-0.4101	0.2002	283	-2.05	0.0414
trtmnt	bpc	r	-0.2525	0.2041	283	-1.24	0.2170
trtmnt	c	r	0.1576	0.1995	283	0.79	0.4303

### Appendix 3. Milk protein percentage.

#### Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
me305	1	282	3.24	0.0727
parity	1	282	5.91	0.0156
trtmnt	3	282	0.28	0.8374

#### Least Squares Means

Effect	trtmnt	Estimate	Standard Error	DF	t Value	Pr >  t
trtmnt	bio	2.8195	0.1009	282	27.95	<.0001
trtmnt	bpc	2.6873	0.1034	282	25.98	<.0001
trtmnt	c	2.7618	0.09964	282	27.72	<.0001
trtmnt	r	2.7453	0.1028	282	26.70	<.0001

#### Differences of Least Squares Means

Effect	trtmnt	_trtmnt	Estimate	Standard Error	DF	t Value	Pr >  t
trtmnt	bio	bpc	0.1322	0.1446	282	0.91	0.3615
trtmnt	bio	c	0.05767	0.1424	282	0.40	0.6858
trtmnt	bio	r	0.07423	0.1440	282	0.52	0.6066
trtmnt	bpc	c	-0.07450	0.1436	282	-0.52	0.6042
trtmnt	bpc	r	-0.05795	0.1458	282	-0.40	0.6913
trtmnt	c	r	0.01655	0.1437	282	0.12	0.9084

## Appendix 4. Ratio of milk fat to protein.

### Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
me305	1	263	9.11	0.0028
parity	1	263	5.74	0.0173
trtmnt	3	263	2.28	0.0795

### Least Squares Means

Effect	trtmnt	Estimate	Standard Error	DF	t Value	Pr >  t
trtmnt	bio	1.2653	0.03207	263	39.45	<.0001
trtmnt	bpc	1.1943	0.03328	263	35.89	<.0001
trtmnt	c	1.3125	0.03150	263	41.67	<.0001
trtmnt	r	1.2707	0.03251	263	39.09	<.0001

### Differences of Least Squares Means

Effect	trtmnt	_trtmnt	Estimate	Standard Error	DF	t Value	Pr >  t
trtmnt	bio	bpc	0.07104	0.04629	263	1.53	0.1260
trtmnt	bio	c	-0.04723	0.04513	263	-1.05	0.2962
trtmnt	bio	r	-0.00544	0.04567	263	-0.12	0.9053
trtmnt	bpc	c	-0.1183	0.04567	263	-2.59	0.0101
trtmnt	bpc	r	-0.07648	0.04653	263	-1.64	0.1015
trtmnt	c	r	0.04179	0.04536	263	0.92	0.3578

Appendix 5. Milk fat yield, lbs/d.

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
me305	1	205	0.26	0.6085
parity	1	205	0.03	0.8558
trtmnt	3	205	1.92	0.1275
trtmnt*parity	3	205	0.47	0.7014

Least Squares Means

Effect	trtmnt	Estimate	Standard Error	DF	t Value	Pr >  t
trtmnt	bio	3.4672	0.1816	205	19.09	<.0001
trtmnt	bpc	3.0400	0.1834	205	16.58	<.0001
trtmnt	c	3.5510	0.1817	205	19.55	<.0001
trtmnt	r	3.5891	0.1802	205	19.91	<.0001

Differences of Least Squares Means

Effect	trtmnt	_trtmnt	Estimate	Standard Error	DF	t Value	Pr >  t
trtmnt	bio	bpc	0.4272	0.2582	205	1.65	0.0996
trtmnt	bio	c	-0.08384	0.2569	205	-0.33	0.7445
trtmnt	bio	r	-0.1219	0.2561	205	-0.48	0.6346
trtmnt	bpc	c	-0.5110	0.2581	205	-1.98	0.0491
trtmnt	bpc	r	-0.5491	0.2570	205	-2.14	0.0338
trtmnt	c	r	-0.03808	0.2559	205	-0.15	0.8819



Appendix 6. Milk protein yield, lbs/d.

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
me305	1	205	1.62	0.2051
parity	1	205	1.37	0.2430
trtmnt	3	205	0.43	0.7343
trtmnt*parity	3	205	0.98	0.4030

Least Squares Means

Effect	trtmnt	Estimate	Standard Error	DF	t Value	Pr >  t
trtmnt	bio	2.8243	0.1336	205	21.13	<.0001
trtmnt	bpc	2.6559	0.1349	205	19.68	<.0001
trtmnt	c	2.8409	0.1337	205	21.25	<.0001
trtmnt	r	2.8278	0.1326	205	21.32	<.0001

Differences of Least Squares Means

Effect	trtmnt	_trtmnt	Estimate	Standard Error	DF	t Value	Pr >  t
trtmnt	bio	bpc	0.1684	0.1900	205	0.89	0.3765
trtmnt	bio	c	-0.01661	0.1890	205	-0.09	0.9301
trtmnt	bio	r	-0.00345	0.1885	205	-0.02	0.9854
trtmnt	bpc	c	-0.1850	0.1900	205	-0.97	0.3312
trtmnt	bpc	r	-0.1719	0.1891	205	-0.91	0.3646
trtmnt	c	r	0.01316	0.1883	205	0.07	0.9444

Appendix 7. Somatic Cell Count, natural log of value.

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
me305	1	256	4.82	0.0290
parity	1	256	16.03	<.0001
trtmnt	3	256	1.35	0.2599
trtmnt*parity	3	256	4.06	0.0076

Least Squares Means

Effect	trtmnt	parity	Estimate	Standard Error	DF	t Value	Pr >  t
trtmnt	bio		3.9027	0.1502	256	25.98	<.0001
trtmnt	bpc		4.1590	0.1505	256	27.64	<.0001
trtmnt	c		4.3000	0.1501	256	28.65	<.0001
trtmnt	r		4.0063	0.1482	256	27.04	<.0001

Least Squares Means

Effect	trtmnt	parity	Estimate	Standard Error	DF	t Value	Pr >  t
trtmnt*parity	bio	2	3.8685	0.2241	256	17.26	<.0001
trtmnt*parity	bio	3	3.9370	0.2005	256	19.63	<.0001
trtmnt*parity	bpc	2	3.4210	0.2095	256	16.33	<.0001
trtmnt*parity	bpc	3	4.8970	0.2161	256	22.66	<.0001
trtmnt*parity	c	2	4.0512	0.1796	256	22.56	<.0001
trtmnt*parity	c	3	4.5488	0.2412	256	18.86	<.0001
trtmnt*parity	r	2	3.8183	0.2132	256	17.91	<.0001
trtmnt*parity	r	3	4.1943	0.2075	256	20.22	<.0001

Appendix 8. Change in Body Condition Score from -30 to 0 DIM.

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
pre	1	74	19.67	<.0001
trt	3	74	0.74	0.5316

Least Squares Means

Effect	trt	Estimate	Standard Error	DF	t Value	Pr >  t
trt	bio	-0.08500	0.04220	74	-2.01	0.0476
trt	bpc	-0.05366	0.04311	74	-1.24	0.2171
trt	c	-0.1076	0.03991	74	-2.70	0.0087
trt	r	-0.1385	0.04015	74	-3.45	0.0009

Differences of Least Squares Means

Effect	trt	_trt	Estimate	Standard Error	DF	t Value	Pr >  t
trt	bio	bpc	-0.03133	0.06029	74	-0.52	0.6048
trt	bio	c	0.02263	0.05809	74	0.39	0.6980
trt	bio	r	0.05353	0.05859	74	0.91	0.3639
trt	bpc	c	0.05396	0.05874	74	0.92	0.3613
trt	bpc	r	0.08487	0.05894	74	1.44	0.1541
trt	c	r	0.03090	0.05660	74	0.55	0.5867

## Appendix 9. Change in Body Condition Score from 0 to 60 DIM.

### Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
pre	1	72	0.05	0.8181
trt	3	72	0.56	0.6440

### Least Squares Means

Effect	trt	Estimate	Standard Error	DF	t Value	Pr >  t
trt	bio	-0.2749	0.05137	72	-5.35	<.0001
trt	bpc	-0.1908	0.05396	72	-3.54	0.0007
trt	c	-0.2004	0.04976	72	-4.03	0.0001
trt	r	-0.2393	0.04879	72	-4.90	<.0001

### Differences of Least Squares Means

Effect	trt	_trt	Estimate	Standard Error	DF	t Value	Pr >  t
trt	bio	bpc	-0.08414	0.07436	72	-1.13	0.2616
trt	bio	c	-0.07448	0.07168	72	-1.04	0.3022
trt	bio	r	-0.03565	0.07128	72	-0.50	0.6185
trt	bpc	c	0.009657	0.07344	72	0.13	0.8957
trt	bpc	r	0.04849	0.07286	72	0.67	0.5079
trt	c	r	0.03883	0.06955	72	0.56	0.5783

Appendix 10. Change in Body Condition Score from -30 to 60 DIM.

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
pre	1	72	16.50	0.0001
trt	3	72	1.77	0.1603

Least Squares Means

Effect	trt	Estimate	Standard Error	DF	t Value	Pr >  t
trt	bio	-0.3581	0.04912	72	-7.29	<.0001
trt	bpc	-0.2286	0.05160	72	-4.43	<.0001
trt	c	-0.3073	0.04758	72	-6.46	<.0001
trt	r	-0.3769	0.04665	72	-8.08	<.0001

Differences of Least Squares Means

Effect	trt	_trt	Estimate	Standard Error	DF	t Value	Pr >  t
trt	bio	bpc	-0.1295	0.07111	72	-1.82	0.0727
trt	bio	c	-0.05075	0.06854	72	-0.74	0.4614
trt	bio	r	0.01878	0.06816	72	0.28	0.7837
trt	bpc	c	0.07874	0.07023	72	1.12	0.2659
trt	bpc	r	0.1483	0.06968	72	2.13	0.0368
trt	c	r	0.06954	0.06650	72	1.05	0.2992

Appendix 11. Ration mixes  
Lactating cows

<u>Ingredient</u>	<u>Lbs/hd/d, DM</u>
Mixed, mostly legume haylage	10.5
Corn Silage	19.1
Megalac	.70
Corn meal	11.5
Canola	3.3
Soybean meal, solvent extracted	2.7
Roasted Soybeans	2.5
Protein mix*	5.3
Straw	.40

\*Contains Corn gluten meal, Yeast culture, Bicarb, Min-Ad, Salt, Urea, MagOx, Limestone, SelPlex600, Vitamin E, Calcium sulfate, Bio Mos, Trace mineral/vitamin package, Tallow, Smartamine, BioFix, Dicalcium phosphate, and Zinpro 40.

Prefresh cows

<u>Ingredient</u>	<u>Lbs/hd/d, DM</u>
Corn silage	13.52
48% Soybean meal	2.6
Straw	5.5
Close-up protein mix**	4.9

\*\*Contains SoyPlus, Corn meal, Soy hulls, Limestone, Megalac Plus, Dicalcium phosphate, Calcium sulfate, Trace mineral/vitamin package, Magnesium sulfate, Molasses, Magnesium oxide, Yeast culture, Salt, BioFix, SelPlex600, and Vitamin E.

Appendix 12. Nutrient specifications, DM basis except as noted

Nutrient	Lactating cows	Prefresh cows
DM, %	47.2	49.81
ADF	16.5	24.71
NDF	27.65	38.15
fNDF	23.84	37.32
NFC	40.28	34.89
Starch	28.29	20.86
NEI, mCal/kg	81	72.8
CP	18.19	13.25
Soluble CP, %CP	36.2	28.18
UIP, % CP	37.34	43.53
Fat	5.01	3.07
P	.36	.4
Ca	.94	1.2
S	.23	.34
K	1.37	1.12
Mg	.31	.4
Na	.38	.09
Cl	.39	.33
Co, ppm	.91	1.29
Cu, ppm	22.53	20.14
I, ppm	2.07	2.37
Fe, ppm	259	368
Mn, ppm	65.7	62.2
Se, ppm	.32	.42
Zn, ppm	77	101
Vitamin A	3828	6895
Vitamin D	638	983
Vitamin E	9.22	38
Forage:concentrate, %	54	72