

The Effects of Supplemental Rumen-Protected Methionine and Lysine on Lactation Performance in Early Postpartum Holstein Cows

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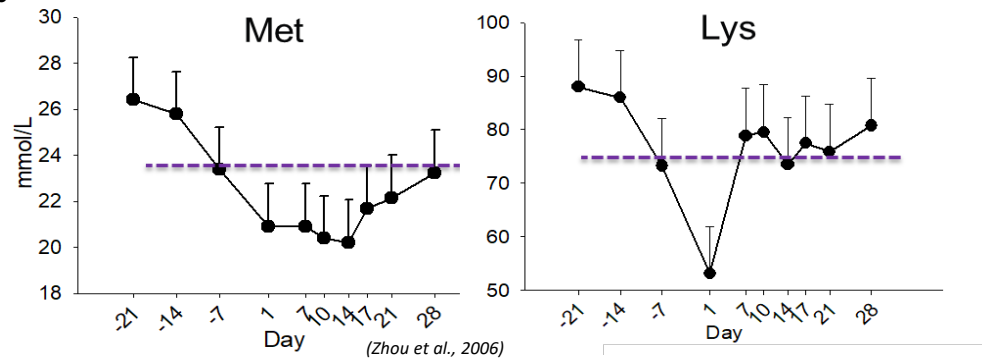
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Introduction

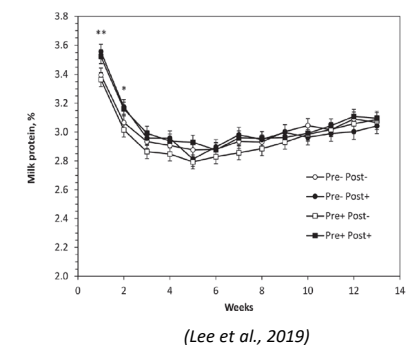
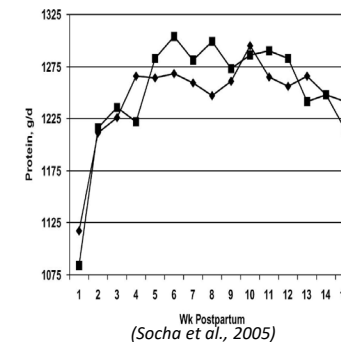
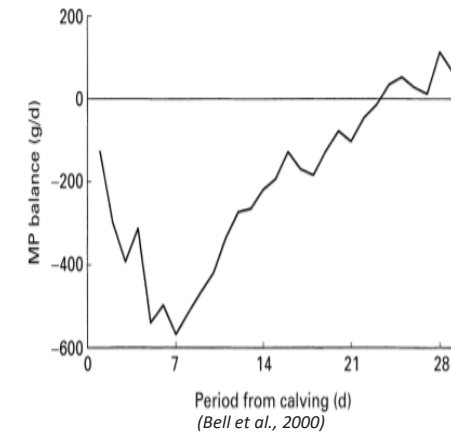
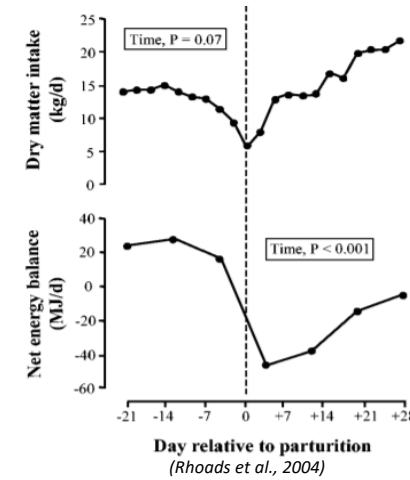
- Cows need more nutrients than they can consume for milk production after calving

- Cows mobilize stored fatty acids and amino acids to meet this demand (*Drackley, 1999*)



- A balanced diet with an improved AA profile can reduce AA mobilization, supporting better milk production and protein synthesis (*Lee et al., 2019*).

- Research showed supplementing rumen-protected methionine and lysine during the transition period may enhance milk production and protein yield (*Socha et al., 2005*)



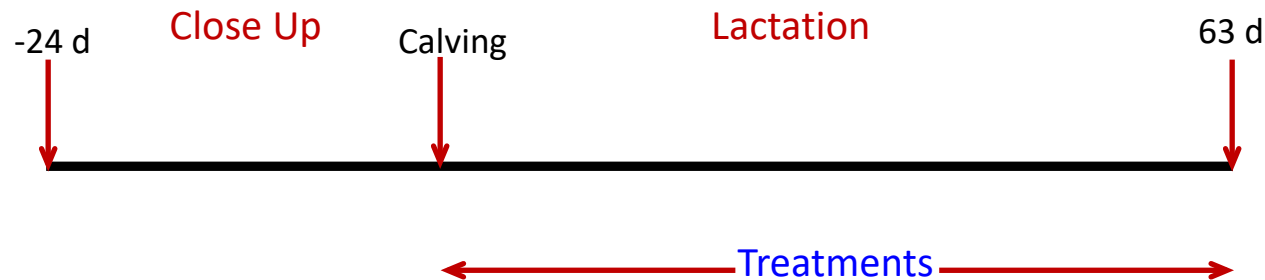
Objective

Determine the optimal lysine/methionine ratio in fresh cows during the early lactation period

Material & Method

❖ Animals

- 98 Holstein transition cows : **Primiparous** (n = 40) and **multiparous** (n = 58) Holstein cows
- Cows were on experiment from 24 d before expected calving, and treatments continued from calving until 63 d (wk 9) post-calving.
- During **the far-off and close-up dry periods**, all cows received **the same diets**.
- Blocked by calving date and lactation number, and within blocks they were assigned randomly to **1 of 4 treatments** beginning at calving.



❖ Treatments

- After calving, treatments were as follows:
 - 1) **CON**: basal diet **without RPAA supply**, 45 g/d of Met and 137 g/d of Lys (**3.06 Lys:Met**),
 - 2) **MET**: supplemental **Met**, 53 g/d Met and 137 g/d Lys (**2.61 Lys:Met**),
 - 3) **ML**: supplemental **Met and Lys**, 53 g/d Met and 162 g/d Lys (**3.04 Lys:Met**),
 - 4) **HML**: **high** supplemental **Met plus Lys**, 62 g/d Met and 162 g/d Lys (**2.61 Lys:Met**).



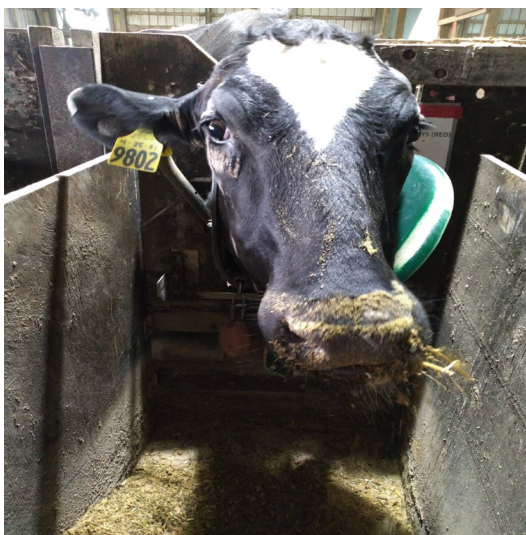
Material & Method

- **Experimental measurements**
 - Daily DMI, milk yield, energy-corrected milk yield (ECM), fat-corrected milk yield (FCM),
 - Weekly BW, BCS, and milk composition (protein, fat, MUN, SCC) were measured.
 - Blood samples: d -23, -10, 1, 7, 14, 21, and 28 relative to calving (glucose, NEFA, BHB, albumin, AA, urea, inflammation parameters)
 - Liver biopsies: d -10, 7 and 25 for genes expression to monitor metabolism and inflammation
 - Reproduction: uterine biopsies and reproductive parameters
- **Data analysis**
 - Data were analyzed using a randomized block design with the MIXED procedure of SAS (SAS Institute Inc., Cary, NC).
 - The model contained the fixed effects of treatment, parity, week or day, and all interactions, with the random effect of block.



Diet Formulation and Nutrient Composition: Prepartum

Ingredient, %DM	Close-Up
Corn Silage	33.62
Corn Grain Ground	6.56
Wheat Straw	30.42
Corn Gluten Feed	8.40
Canola Meal	1.66
Close Up Mixture	19.32
Water	0.02
Total	100



Close Up Mixture Composition	% DM
Soy Plus	30.74
Wheat Midds	21.47
Animate	14.66
Soybean Meal 47.5 Solvent	11.49
Calcium Carbonate	12.42
Vitaplus Dry Cow Mineral Mix 953369	4.76
Smartamine ML	1.45
Urea 281 CP	1.24
Salt White	1.67
Vitamin Premix E20K	1.24
Smartamine M	0.37
Zinpro Availa 4	0.14

Ingredients, %DM	Close-Up
aNDFom	42.8
ADF	31.8
NFC	28.38
Starch	19.32
CP	14.45
LYS (g)	92.31
MET (g)	35.51
LYS:MET	2.60
Ca	1.47
P	0.40
DCAD (meq/kg)	-81.78

Diet Formulation: Postpartum

Ingredients, %DM	Groups			
	CON	MET	ML	HML
Alfalfa Silage	21.37	21.33	21.31	21.31
Corn Silage	37.38	37.33	37.28	37.29
Corn Grain Ground	20.30	20.35	20.24	20.24
Canola Meal	6.50	6.48	6.44	6.42
Lactation Mixture	14.43	14.49	14.71	14.72
Water	0.02	0.02	0.02	0.02
Total	100	100	100	100



Lactation Mixture, %DM	CON	MET	ML	HML
Soy Plus	54.05	53.68	52.56	52.35
Molasses Beet	18.08	17.96	17.59	17.52
Vitaplus Mineral Mix (9.6.18)	17.98	17.86	17.48	17.42
Energy Booster 100	5.55	5.52	5.43	5.43
Calcium Phosphate Di (Dical)	2.32	2.30	2.26	2.25
Urea 281 CP	0.74	0.92	0.90	0.90
Magnesium Ox	0.71	0.71	0.69	0.36
Vitamin Premix E20K	0.37	0.37	0.36	0.36
Salt White	0.08	0.08	0.08	0.08
Rumensin 200 gm per kg	0.06	0.06	0.06	0.06
Zinpro Availa 4	0.06	0.06	0.05	0.05
Smartamine M	-	0.48	-	0.54
Smartamine ML	-	-	2.53	2.68

Nutrient Composition of Diet: Postpartum

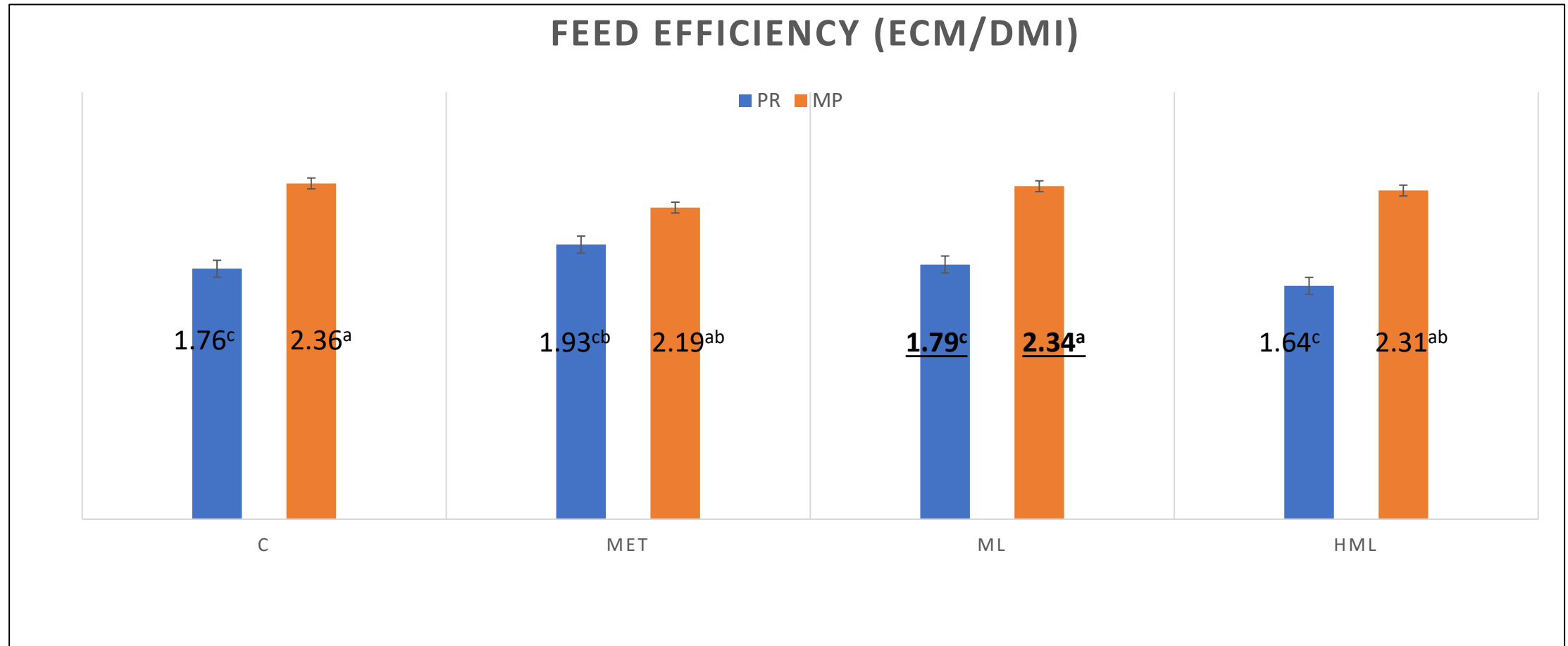
	Groups			
Ingredients, %DM	CON	MET	ML	HML
aNDFom	30.10	30.06	29.99	29.99
ADF	21.22	21.19	21.15	21.15
NFC	39.43	39.42	39.29	39.27
Starch	27.95	27.96	27.86	27.86
CP	17.02	17.13	17.24	17.29
LYS (g)	137.31	137.41	161.34	162.58
MET (g)	44.92	52.60	53.12	62.37
LYS:MET	3.06	2.61	3.04	2.61
Ca	0.95	0.95	0.94	0.94
P	0.46	0.46	0.46	0.46

Results: Week 1-4

Parameters	GROUPS				SEM	P Values					
	CON (n=24)	MET (n=24)	ML (n=25)	HML (n=25)		T	P	W	T*P	T*W	P*W
DMI (kg)	14.67	15.84	16.3	15.5	0.71	0.43	<.0001	<.0001	0.21	0.13	0.22
Milk Yield (kg/d)	32.02^b	34.4 ^{ab}	<u>36.98^a</u>	32.67 ^{ab}	1.27	<u>0.03</u>	<.0001	<.0001	0.46	0.68	<.0001
ECM (kg/d)	31.62^b	35.5 ^{ab}	<u>37.99^a</u>	32.84 ^{ab}	1.5	<u>0.02</u>	<.0001	0.004	0.24	0.22	0.01
FCM (kg/d)	32.56^b	36.46 ^{ab}	<u>39.23^a</u>	33.68 ^{ab}	1.58	<u>0.02</u>	<.0001	0.001	0.27	0.16	0.01
Feed Efficiency (ECM/DMI)	2.34	2.5	2.48	2.25	0.12	0.3	<.0001	<.0001	<u>0.07</u>	0.55	0.58
BW (kg)	625.32	630.21	626.37	616.08	9.47	0.54	<.0001	<.0001	0.03	1	0.87
BCS	3.16	3.21	3.18	3.17	0.02	0.34	0.81	<.0001	0.11	0.96	0.77

- ✓ No statistical difference was detected in daily DMI and weekly BW and BCS
- ✓ Cows fed ML (ratio of 3.04) had greater milk production than CON : +5kg
- ✓ Both FCM and ECM were greater for cows fed ML (ratio of 3.04) than CON
- ✓ FE tends to be affected by parity and treatment interaction

Feed efficiency: Parity*Treatment Interactions (W 1-4)



✓ In multiparous cows, the ratio 3.04 of Lys over Met (CON and ML groups) looks like to have higher feed efficiency

Results: Week 1-4

Parameters	GROUPS				SEM	P Values					
	CON (n=24)	MET (n=24)	ML (n=25)	HML (n=25)		T	P	W	T*P	T*W	P*W
Protein (%)	3.1	3.22	3.13	3.2	0.06	0.51	0.11	<.0001	0.53	0.07	0.07
Fat (%)	4.29	4.56	4.55	4.23	0.17	0.2	0.36	<.0001	0.41	0.05	0.65
Protein Yield (kg/d)	0.98	1.1	<u>1.15</u>	1.03	0.05	<u>0.06</u>	<.0001	0.09	0.34	0.03	0.28
Fat Yield (kg/d)	1.35^b	1.55 ^{ab}	<u>1.67^a</u>	1.41 ^{ab}	0.09	<u>0.02</u>	<.0001	0.76	0.27	0.14	0.09
MUN, mg/dl	11.72	11.31	11.93	12.15	0.54	0.53	0.88	0.12	0.14	0.38	0.97
SCC (x 1000)	136.21	572.4	293.4	387.4	136.74	0.16	0.1	0.01	0.49	0.6	0.08

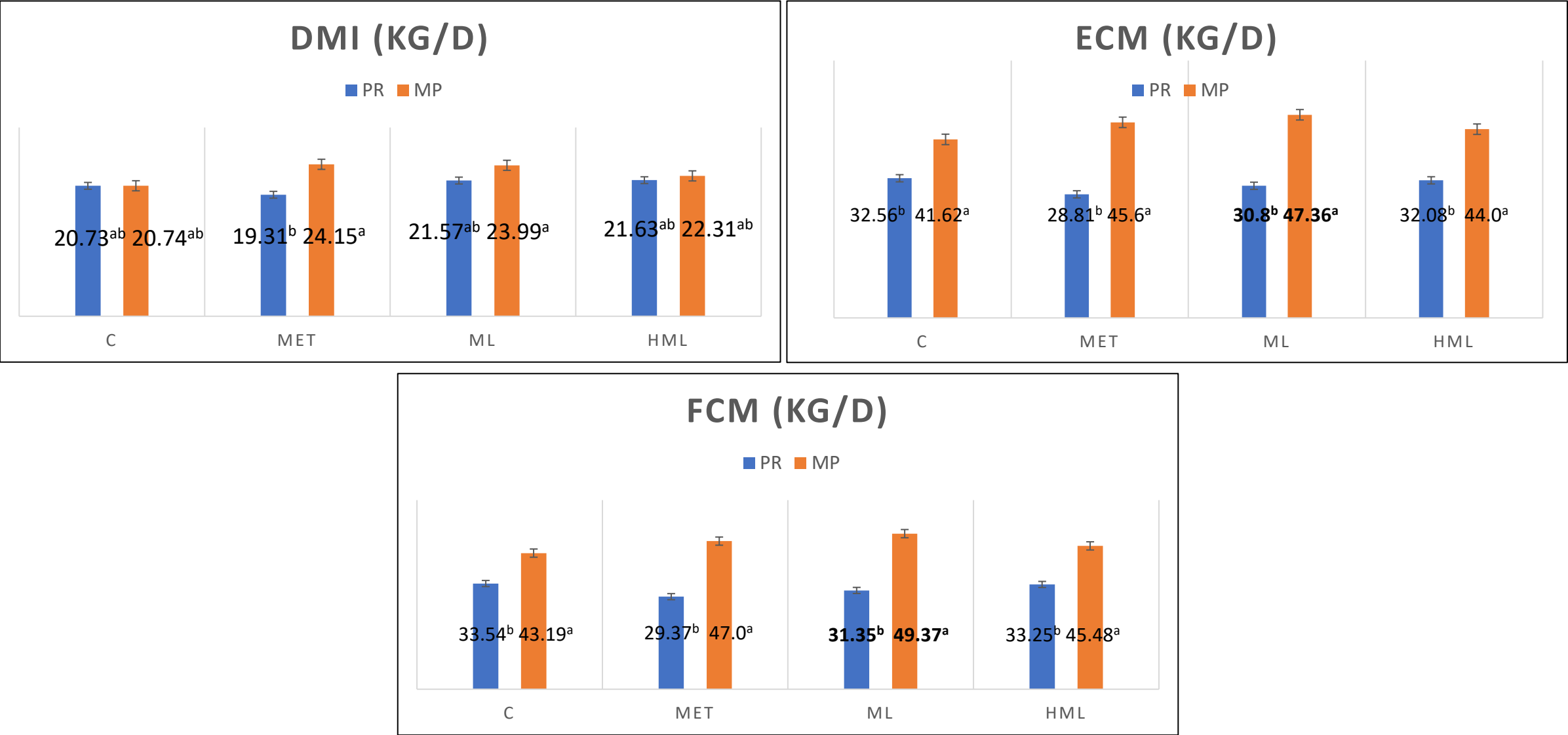
- ✓ Fat yield was higher for cows in ML (ratio of 3.04) than CON
- ✓ Cows in ML (ratio of 3.04) tended to have greater protein yield than CON

Results: Week 5-9

Parameters	GROUPS				SEM	P Values					
	CON (n=24)	MET (n=24)	ML (n=25)	HML (n=25)		T	P	W	T*P	T*W	P*W
DMI (kg)	20.74	21.73	22.78	21.97	0.74	0.29	0.01	<.0001	<u>0.11</u>	0.78	0.71
Milk Yield (kg/d)	40.94	41.12	42.82	41.54	1.25	0.71	<.0001	<.0001	0.56	0.35	0.71
ECM (kg/d)	37.09	37.21	39.08	38.04	1.27	0.66	<.0001	0.07	<u>0.10</u>	0.39	0.34
FCM (kg/d)	38.36	38.26	40.36	39.37	1.33	0.65	<.0001	0.25	<u>0.08</u>	0.42	0.3
Feed Efficiency (ECM/DMI)	1.85	1.72	1.75	1.77	0.06	0.53	<.0001	0.0001	0.89	0.82	0.15
BW (kg)	602.12	617.89	610.61	600.48	8.26	0.17	<.0001	0.35	0.07	1	0.96
BCS	2.94^b	3.03 ^a	<u>3.02^a</u>	3.01 ^a	0.02	<u>0.004</u>	0.001	0.71	1	0.99	0.98

- ✓ No statistical difference was detected in daily DMI, milk production, FCM, ECM, and weekly BW
- ✓ Cows fed CON had lower weekly BCS than cows fed MET, ML and HML
- ✓ DMI, ECM and FCM tend to be affected by parity and treatment interaction

DMI, ECM and FCM Parity*Treatment Interactions (W 5-9)



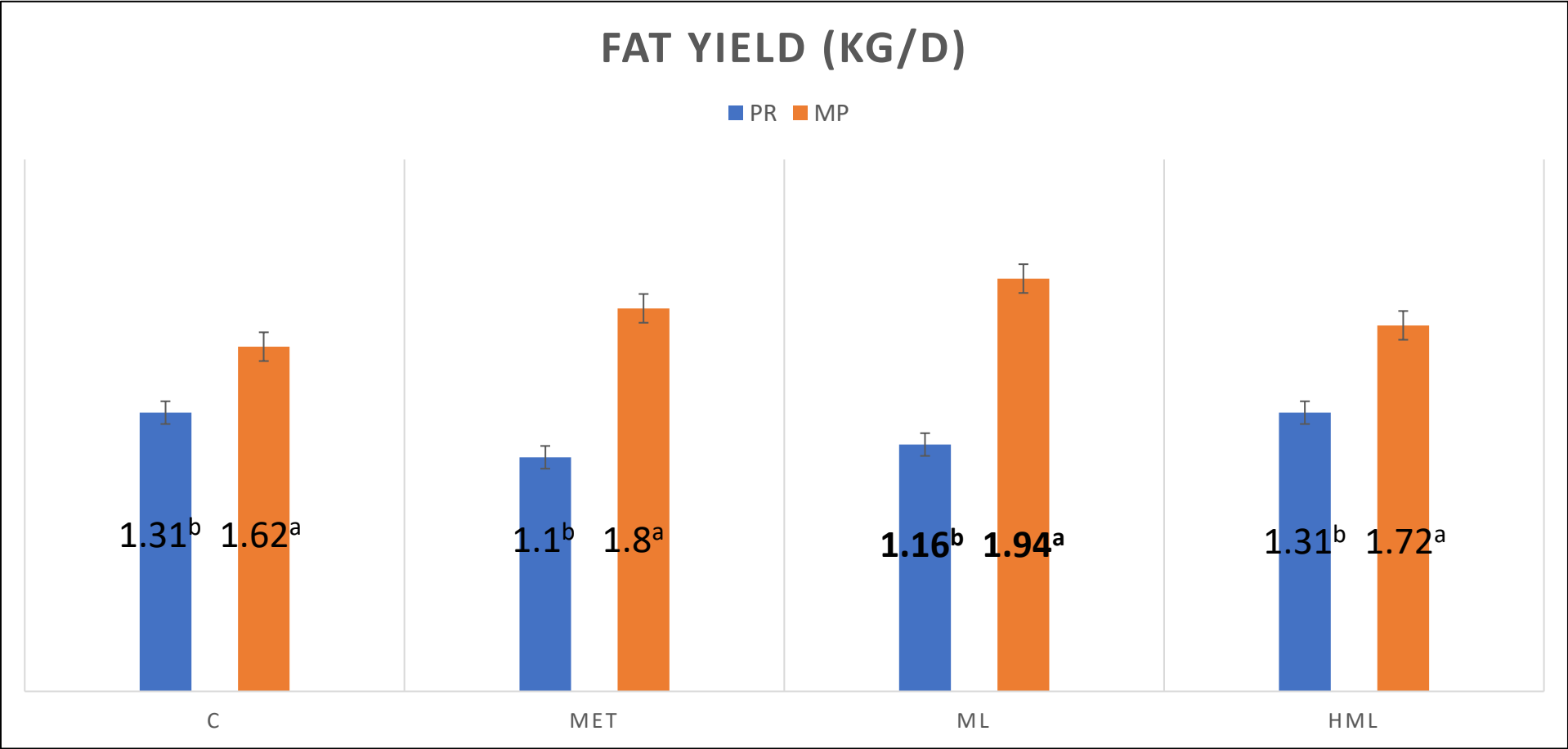
✓ ECM and FCM: the multiparous cows have higher production rates at ML group (with the ratio of 3.04).

Results: Week 5-9

Parameters	GROUPS				SEM	P Values					
	CON (n=24)	MET (n=24)	ML (n=25)	HML (n=25)		T	P	W	T*P	T*W	P*W
Protein (%)	2.87	2.9	2.88	2.87	0.04	0.91	0.002	0.01	0.18	0.77	0.79
Fat (%)	3.62	3.54	3.6	3.68	0.12	0.12	0.67	0.3	<u>0.02</u>	0.66	0.17
Protein Yield (kg/d)	1.17	1.2	1.23	1.19	0.04	0.78	<.0001	<.0001	0.37	0.7	0.82
Fat Yield (kg/d)	1.47	1.45	1.55	1.52	0.06	0.69	<.0001	0.78	<u>0.03</u>	0.55	0.3
MUN	10.39	10.61	11.02	10.82	0.4	0.52	0.91	0.68	0.82	0.03	0.92
SCC (x 1000)	94.47	253.79	111.34	185.56	63.4	0.27	0.2	0.2	0.43	0.82	0.66

- ✓ Fat yield and protein yield, and weekly SCC and MUN were not different
- ✓ Protein and fat percentages were not different among treatments
- ✓ Milk fat content and yield tend to be impacted by parity and treatment interaction

Milk Fat Parity*Treatment Interactions (Week 5-9)



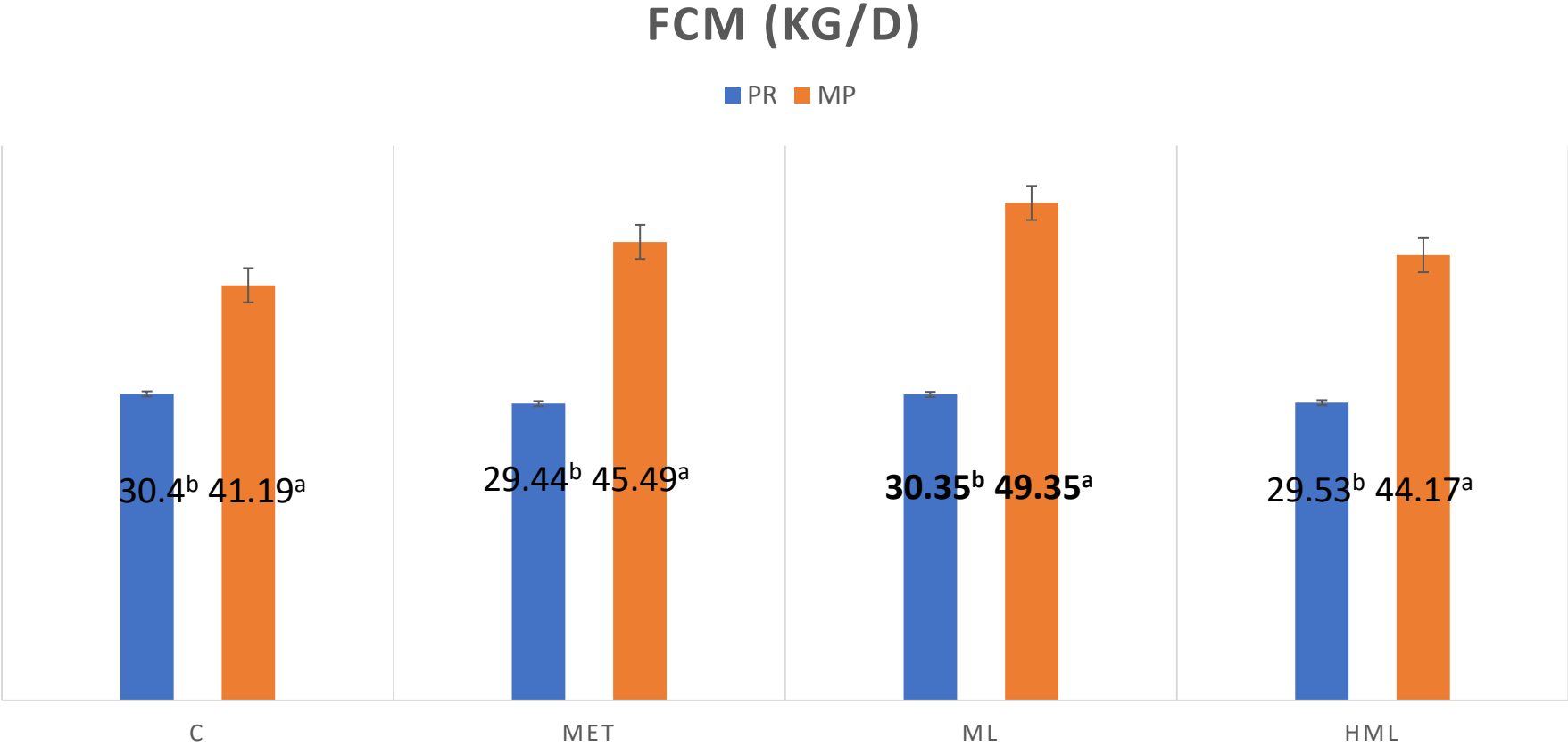
✓ Fat yield is higher at ML group (ratio of 3.04) for multiparous cows

Results: Week 1-9

Parameters	GROUPS				SEM	P Values					
	CON (n=24)	MET (n=24)	ML (n=25)	HML (n=25)		T	P	W	T*P	T*W	P*W
DMI (kg)	18.04	19.11	19.9	19.1	0.625	0.23	0.0001	<.0001	<u>0.07</u>	0.33	0.42
Milk Yield (kg/d)	36.99	38.15	40.21	37.62	1.08	0.17	<.0001	<.0001	0.52	0.55	<.0001
ECM (kg/d)	34.67	36.46	38.59	35.74	1.14	0.1	<.0001	<.0001	0.13	0.24	0.01
FCM (kg/d)	35.79	37.48	39.85	36.85	1.17	0.1	<.0001	<.0001	<u>0.10</u>	0.18	0.01
Feed Efficiency (ECM/DMI)	2.06	2.06	2.07	1.98	0.07	0.74	<.0001	<.0001	0.16	0.63	0.58
BW (kg)	615.03	625.96	620.29	610.09	17.4	0.85	<.0001	<.0001	0.6	0.71	0.01
BCS	3.03	3.11	3.09	3.08	0.04	0.51	0.25	<.0001	0.95	0.64	0.1

- ✓ No statistical difference was detected in daily DMI, milk production, FCM, ECM, feed efficiency and weekly BW and BCS
- ✓ DMI and milk fat yield tend to be affected by parity and treatment interaction

DMI, ECM, FCM Parity*Treatment Interactions (W1-9)



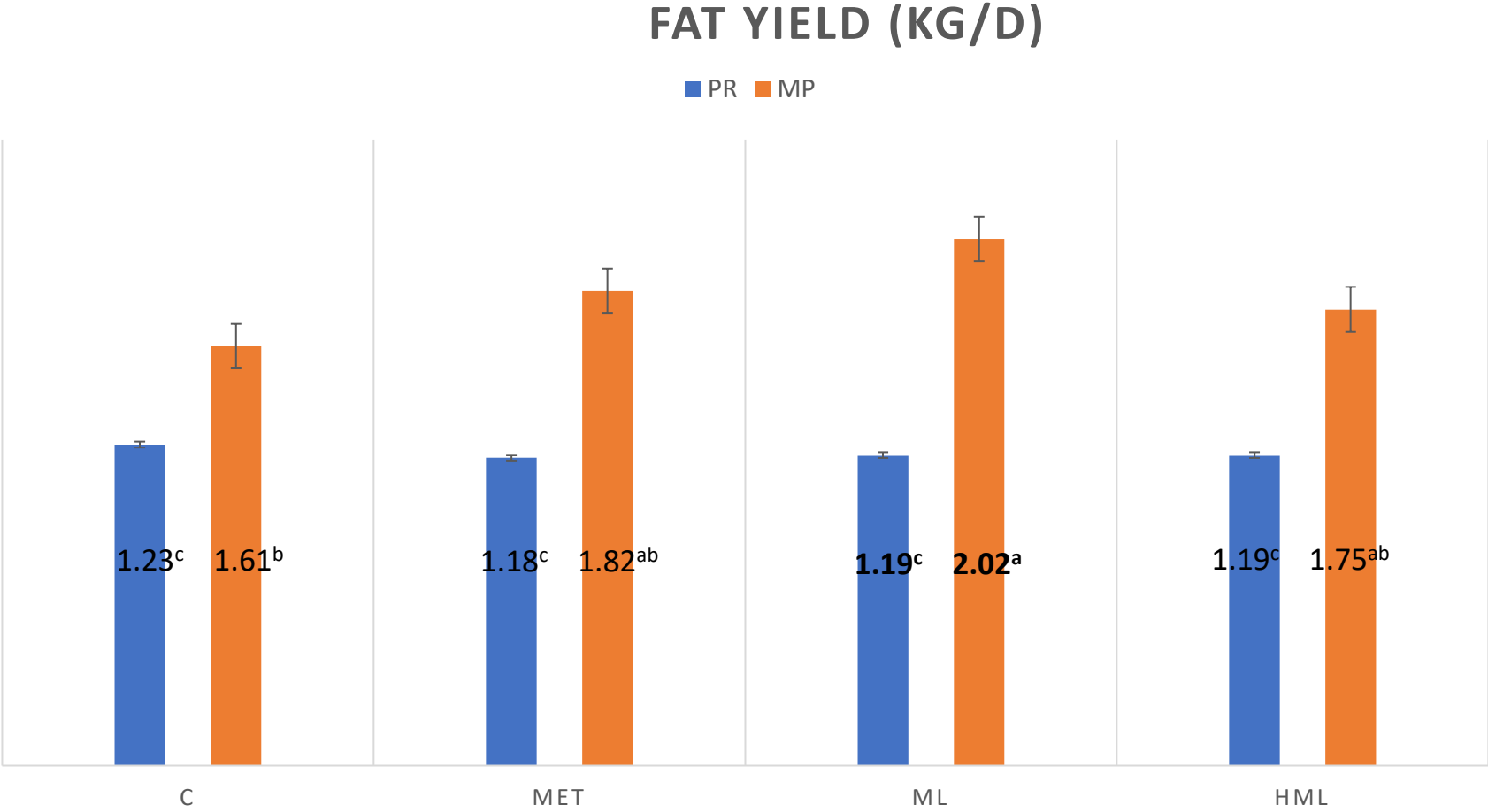
✓ Multiparous cows at ML group (ratio of 3.04) have higher FCM.

Results: Week 1-9

Parameters	GROUPS				SEM	P Values					
	CON (n=24)	MET (n=24)	ML (n=25)	HML (n=25)		T	P	W	T*P	T*W	P*W
Protein (%)	2.97	3.04	2.99	3.02	0.04	0.6	0.62	<.0001	0.59	0.06	0.01
Fat (%)	3.93	4.01	4.04	3.94	0.11	0.82	0.34	<.0001	0.12	0.08	0.62
Protein Yield (kg/d)	1.09	1.15	1.19	1.12	0.04	0.21	<.0001	<.0001	0.48	0.05	0.18
Fat Yield (kg/d)	1.42	1.5	1.6	1.47	0.06	0.11	<.0001	0.9	<u>0.04</u>	0.19	0.12
MUN, mg/dl	11.02	10.96	11.47	11.45	0.35	0.39	0.9	0.04	0.27	0.08	0.99
SCC (x 1000)	113.02	395.39	192.26	275.27	78.71	0.08	0.06	0.0001	0.29	0.67	0.04

- ✓ No statistical difference was detected in fat yield and protein yield, and weekly SCC and MUN
- ✓ Milk fat yield tends to be impacted by parity and treatment interaction

Milk fat Parity*Treatment Interactions (W 1-9)



✓ Multiparous cows at ML group (ratio of 3.04) have higher fat yield.

Conclusion

- Addition of RPMet and RPLys to the fresh cow diet at a Lys:Met of 3.04 had a positive effect on milk production, especially during the first month after calving.
- However, additional Met at the same elevated Lys to decrease the Lys:Met to 2.61 negated the beneficial effects of higher Lys.
- Primiparous cows look that they utilize RAAs for maturation rather than production. On the other hand, the differences at production in multiparous cows are much clear.





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Thank you for your attention

Treatment*Week Interactions

