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EVALUATION OF ENZYME-MODIFIED WHEAT GLUTEN AS A COMPONENT OF MILK REPLACERS FOR CALVES

H. Terui, J. L. Morrill, and J. J. Higgins¹

Summary

Holstein bull calves (n=120) were assigned randomly to be fed either of five milk replacers (MR) that contained different amounts of crude protein (CP) and protein from wheat gluten (WG) for 6 weeks. Weight gains of calves fed MR containing 20% CP, with either 0, 30, or 50% of the protein coming from WG, were similar, as were gains of calves fed MR containing 18% CP with either none or 33% of the protein from WG. When WG supplied 33% of the protein, calves fed 18% CP gained as much as calves fed MR containing 20% CP. Calves fed MR containing 20% CP consumed more dry feed than those fed MR containing 18% CP, when both used only milk sources for protein. Calf feces were more solid when calves were fed MR containing 20% CP if 30% of the protein was supplied by WG, compared to when 50% was supplied by WG. Enzyme-modified WG was an effective substitute for milk protein in a calf milk replacer.

(Key Words: Wheat Gluten, Milk Replacers, Calves, Crude Protein.)

Introduction

Calves need milk or a high energy, high protein MR in very early stages of life. Good performance can be attained by using all-milk protein MR; however, more economical sources for part or all of the protein for MR are needed. In a recent study conducted at Kansas State University, nursery pigs showed a significant improvement in performance when WG was included at 6 to 8% of their diet. The objective of this study was to evaluate soluble (enzyme modified) WG as a protein source in MR for calves.

Procedures

Holstein bull calves (n=120) were purchased in Oklahoma and transported to Cottonwood Farm in McLouth, KS, within 3 d after birth. Those calves were blocked randomly and assigned to be fed either of five MR (Table 1). All MR contained 20% fat. The contents of CP for those MR were: 20% CP (100% of protein from milk [MP]) (20WG0); 20% CP (30% of protein from wheat gluten [WG]) (20WG30); 20% CP (50% WG) (20WG50); 18% CP (100% MP) (18WG0); and 18% CP (33% WG) (18WG33). Calf starter (Calf Choice 16 B68, Farmland Industries Inc., Table 2) was available ad libitum during wk 4 to 6 for all calves and fed daily in amounts necessary to ensure freshness. Weekly starter consumption was determined. Fecal scores were recorded (1 = firm to 4 = liquid) during wk 1 to 3.

Results and Discussion

Five calves died during the 6 wk of the experiment: one each on 20WG0, 20WG30, and 20WG50, and two on 18WG0.

Table 3 summarizes averages of body weights. At wk 6, calves fed 20WG50 were heavier ($P<.10$) than calves on 18WG0. No other differences in body weights occurred among other treatments during the 6-wk study.

Table 4 presents body weight gain. From wk 2 to wk 4, the calves on 18WG0 gained less ($P<.10$) than calves on 20WG30 and 18WG33. From wk 4 to 6, weight gains of calves on 20WG0 and 20WG50 were greater ($P<.05$) than gains of calves on 18WG0. Calves fed

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18WG33 gained more ($P<.10$) than calves on 18WG0. Overall, calves on 20WG50 gained more ($P<.05$) than calves on 18WG0. In addition, calves fed 20WG0 and 18WG33 gained more weight than calves on 18WG ($P<.10$). No other difference in body weight gain was observed.

Table 5 illustrates dry feed consumption. Wk 6 and overall amounts of dry feed consumed were greater ($P<.05$) for calves on 20WG0 than calves on 18WG0.

The average fecal scores (Table 6) were lower ($P<.05$; less diarrhea likely) for the calves on 20WG30 than for the calves on 20WG0 in wk 1. In wk 2, calves on 20WG30 had lower ($P<.05$) fecal scores than calves on

20WG50, 18WG33, and 18WG0. Calves on 20WG0 had lower ($P<.05$) fecal scores than calves on 20WG50 and 18WG0. According to overall fecal scores, more ($P<.05$) diarrhea was likely for calves on 20WG50 than for calves on 20WG30.

In conclusion, enzyme-modified WG was a good source of protein for calf milk replacers. Growth of calves fed MR containing 20% CP did not differ when WG furnished 0, 30, or 50% of the CP. Between 18% CP milk replacers, calves gained more weight ($P<.10$) when 33% of CP was supplied by wheat gluten. In wk 1 to 3, replacing 50% of CP with WG caused more diarrhea than replacing 30% of CP with wheat gluten in 20% CP milk replacers.

Table 1. Compositions of the Milk Replacers (Dry Matter Basis)

Item	20WG0	20WG30	20WG50	18WG0	18WG33
	----- % -----				
Lactose	47.0	45.0	45.0	48.5	47.3
Crude protein	19.9	20.1	20.1	18.0	18.0
Milk protein (% of CP)	100.0	70.0	50.0	100.0	67.0
Wheat protein (% of CP)	--	30.0	50.0	--	33.0
Crude fat	19.9	19.8	19.8	19.9	20.0
Energy (ME Mcal/kg)	4.3	4.2	4.2	4.3	4.2
Ash	5.7	6.0	6.2	6.0	6.3
Ca	0.76	0.78	0.79	0.79	0.81
P	0.68	0.71	0.73	0.70	0.73
Na	0.55	0.68	0.76	0.58	0.70
K	1.37	1.29	1.23	1.40	1.31
Mg	0.10	0.10	0.11	0.11	0.11
	----- mg/kg -----				
Fe	105.11	108.43	110.71	105.01	108.28
Co	1.24	1.23	1.22	1.24	1.23
Cu	11.40	11.72	11.94	11.34	11.65
Mn	41.54	42.35	42.93	41.86	42.66
Zn	105.39	107.19	108.50	105.49	107.33
Se	0.31	0.31	0.31	0.31	0.31
I	8.40	6.90	5.79	7.88	6.37
	----- IU/lb -----				
Vitamin A($\times 10^3$)	31.0	31.0	31.0	31.0	31.0
Vitamin D ₃ ($\times 10^3$)	11.0	11.0	11.0	11.0	11.0
Vitamin E	110.1	110.1	110.1	110.1	110.1

Table 2. Nutrient Content of Dry Feed¹ (Calf Choice 16 B68)

Nutrient		Percent
CP	(minimum)	16.0
C-Fat	(minimum)	2.0
C-Fiber	(maximum)	12.5
Lasalocid		68 g/ton

¹Percentage guaranteed by Farmland Industries, Inc.

Table 3. Mean Body Weight of Calves Fed Milk Replacers

Milk replacer	Week			
	0	2	4	6
	----- lb -----			
20WG0	85.7	91.9	101.8	109.7 ^{cd}
20WG30	85.0	89.6	101.3	107.3 ^{cd}
20WG50	86.3	91.9	102.0	110.8 ^c
18WG0	87.7	93.4	102.0	104.6 ^d
18WG33	85.7	91.2	102.6	109.0 ^{cd}
SE	1.8	1.8	2.0	1.2

^{c,d}Means within column without a common superscript letter differ (P<.10).

Table 4. Average Body Weight Gain of Calves Fed Milk Replacers

Milk replacer	Week			
	0 to 2	2 to 4	4 to 6	Total (0 to 6)
	----- lb -----			
20WG0	5.9	9.9 ^{cd}	7.7 ^a	23.8 ^{ab}
20WG30	4.8	11.7 ^c	5.7 ^{ab}	22.2 ^{ab}
20WG50	5.1	9.5 ^{cd}	8.8 ^a	24.7 ^a
18WG0	5.7	8.6 ^d	2.6 ^b	17.2 ^b
18WG33	5.5	11.5 ^c	6.4 ^{ab}	23.3 ^{ab}
SE	1.5	1.1	1.5	2.4

^{a,b}Means within column without a common superscript letter differ (P<.05).

^{c,d}Means within column without a common superscript letter differ (P<.10).

Table 5. Mean Weekly Feed Consumption of Calves Fed Milk Replacers

Milk replacer	Week			
	4	5	6	Total (0 to 6)
	----- lb -----			
20WG0	.29	2.60	7.44 ^a	10.35 ^a
20WG30	.31	2.58	6.70 ^{ab}	9.58 ^{ab}
20WG50	.26	2.49	6.87 ^{ab}	9.74 ^{ab}
18WG0	.24	2.09	5.13 ^b	7.47 ^b
18WG33	.37	2.44	7.05 ^{ab}	9.87 ^{ab}
SE	.07	.29	.75	1.01

^{a,b}Means within column without a common superscript letter differ (P<.05).

Table 6. Mean Fecal Scores of Calves Fed Milk Replacers

Milk replacers	Week			
	1	2	3	Total (1 to 3)
20WG0	3.35 ^a	2.26 ^{bc}	2.28	2.61 ^{ab}
20WG30	2.99 ^b	2.21 ^c	2.38	2.52 ^b
20WG50	3.22 ^{ab}	2.47 ^b	2.42	2.69 ^a
18WG0	3.14 ^{ab}	2.58 ^a	2.21	2.63 ^{ab}
18WG33	3.17 ^{ab}	2.40 ^{ab}	2.36	2.63 ^{ab}
SE	0.13	0.07	0.10	0.06

^{a,b,c,d} Means within column without a common superscript letter differ (P<.05).