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H. Terui

J.L Morrill

James J. Higgins

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## Evaluation of enzyme-modified wheat gluten as a component of milk replacers for calves

### Abstract

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. Enzymemodified WG was an effective substitute for milk protein in a calf milk replacer.; Dairy Day, 1994, Kansas State University, Manhattan, KS, 1994;

### Keywords

Dairy Day, 1994; Kansas Agricultural Experiment Station contribution; no. 95-141-S; Report of progress (Kansas Agricultural Experiment Station); 716; Wheat gluten; Milk replacers; Calves; Crude protein

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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. Higgins<sup>1</sup>*

## 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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<sup>1</sup>Department of Statistics.

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(x 10 <sup>3</sup> )	31.0	31.0	31.0	31.0	31.0
Vitamin D <sub>3</sub> (x 10 <sup>3</sup> )	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 Feed<sup>1</sup> (Calf Choice 16 B68)**

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

<sup>1</sup>Percentage 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 <sup>cd</sup>
20WG30	85.0	89.6	101.3	107.3 <sup>cd</sup>
20WG50	86.3	91.9	102.0	110.8 <sup>c</sup>
18WG0	87.7	93.4	102.0	104.6 <sup>d</sup>
18WG33	85.7	91.2	102.6	109.0 <sup>cd</sup>
SE	1.8	1.8	2.0	1.2

<sup>c,d</sup>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 <sup>cd</sup>	7.7 <sup>a</sup>	23.8 <sup>ab</sup>
20WG30	4.8	11.7 <sup>c</sup>	5.7 <sup>ab</sup>	22.2 <sup>ab</sup>
20WG50	5.1	9.5 <sup>cd</sup>	8.8 <sup>a</sup>	24.7 <sup>a</sup>
18WG0	5.7	8.6 <sup>d</sup>	2.6 <sup>b</sup>	17.2 <sup>b</sup>
18WG33	5.5	11.5 <sup>c</sup>	6.4 <sup>ab</sup>	23.3 <sup>ab</sup>
SE	1.5	1.1	1.5	2.4

<sup>a,b</sup>Means within column without a common superscript letter differ (P<.05).

<sup>c,d</sup>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 <sup>a</sup>	10.35 <sup>a</sup>
20WG30	.31	2.58	6.70 <sup>ab</sup>	9.58 <sup>ab</sup>
20WG50	.26	2.49	6.87 <sup>ab</sup>	9.74 <sup>ab</sup>
18WG0	.24	2.09	5.13 <sup>b</sup>	7.47 <sup>b</sup>
18WG33	.37	2.44	7.05 <sup>ab</sup>	9.87 <sup>ab</sup>
SE	.07	.29	.75	1.01

<sup>a,b</sup>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 <sup>a</sup>	2.26 <sup>bc</sup>	2.28	2.61 <sup>ab</sup>
20WG30	2.99 <sup>b</sup>	2.21 <sup>c</sup>	2.38	2.52 <sup>b</sup>
20WG50	3.22 <sup>ab</sup>	2.47 <sup>b</sup>	2.42	2.69 <sup>a</sup>
18WG0	3.14 <sup>ab</sup>	2.58 <sup>a</sup>	2.21	2.63 <sup>ab</sup>
18WG33	3.17 <sup>ab</sup>	2.40 <sup>ab</sup>	2.36	2.63 <sup>ab</sup>
SE	0.13	0.07	0.10	0.06

<sup>a,b,c,d</sup>Means within column without a common superscript letter differ (P<.05).