

Table S1. Ingredients and chemical composition of experimental concentrate.

Ingredients ¹	Percentage (%)
Corn fine	31.17
Corn gluten feed	21.00
Soy hulls	13.00
Wheat fine	10.00
Rice bran	5.00
Wheat flour	5.32
DDGS	3.40
Molasses	3.00
Palm kernel meal	2.14
Limestone fine	1.90
Palm kernel meal (Solvent)	1.80
CMS	1.50
Brown rice	0.45
Salt	0.17
Mineral/Vitamin premix ²	0.15
Total	100.00
Calculated nutrients, as fed	
Crude Protein	13.03
Crude Fat	3.84
Ash	5.77
NDF	23.44
Moisture	11.50
Crude Fiber	8.65
Calcium	1.00
Phosphorus	0.48
Ca/P	2.09
Sulfur	0.20
Potassium	0.84
Magnesium	0.24
Sodium	0.21
TDN	76.44

¹DDGS, dried distillers' grains with solubles; CMS, condensed molasses solubles; NDF, neutral detergent fiber; TDN, total digestible nutrients.

²Mineral & vitamin premix contained vit. A 2,650,000 IU, vit. D3 530,000 IU, vit. E 1,050 IU, niacin 10,000 mg, Mn 4,400 mg, Zn 4,400 mg, Fe 13,200 mg, Cu 2,200 mg, iodine 440 mg, and Co, 440 mg/kg of Grobic-DC provided from Bayer Health Care (Leverkusen, Germany).

Table S2. Formulated buffer agent treatments for *in vitro* and *in vivo* experiments.

Treatment	Ingredient (%)				Total (%)
	A	B	C	D	
RB-1	30	10	30	30	100
RB-2	20	10	30	40	100
RB-3	20	10	40	30	100

A: calcium oxide; B: processed coral (powdered form); C: magnesium oxide; D: sodium bicarbonate

Table S3. Neutralizing and buffering capacity of formulated buffer agent treatments.

Parameter	RB-1	RB-2	RB-3	SEM	<i>p</i> -value
initial pH	9.67	9.46	9.60	0.069	0.255
Neutralizing capacity (mmol/L)	21.73	14.27	20.31	2.665	0.237
Buffering capacity (mmol/L)	42.20 ^a	30.60 ^c	35.70 ^b	0.143	<0.001

RB-1: 30% calcium oxide; 10% processed coral; 30% magnesium oxide; 30% sodium bicarbonate

RB-2: 20% calcium oxide; 10% processed coral; 30% magnesium oxide; 40% sodium bicarbonate

RB-3: 20% calcium oxide; 10% processed coral; 40% magnesium oxide; 30% sodium bicarbonate

Table S4. Effect of treatments on *in vitro* rumen fermentation parameters after 0, 6, 12, and 24 h of incubation.

Parameters	Time (h)	Treatment ¹							SEM	<i>p</i> -value
		CON	BEN	CC	CO	SB	SS	PC		
pH	0	6.33 ^c	6.29 ^c	6.28 ^c	9.80 ^a	6.92 ^b	7.05 ^b	9.63 ^a	0.036	<0.001
	6	5.41 ^e	5.64 ^d	5.60 ^d	6.73 ^a	6.29 ^b	6.45 ^b	6.11 ^c	0.034	<.0001
	12	5.34 ^d	5.36 ^d	5.34 ^d	6.16 ^a	6.11 ^{ab}	6.03 ^b	5.91 ^c	0.025	<.0001
	24	5.26 ^d	5.27 ^d	5.24 ^d	6.01 ^a	5.56 ^c	5.75 ^b	5.98 ^a	0.023	<.0001
Total gas (ml)	6	142.67 ^c	138.00 ^c	149.00 ^c	36.00 ^e	258.00 ^a	190.33 ^b	84.00 ^d	7.217	<0.001
	12	165.33 ^c	190.33 ^b	188.67 ^b	129.00 ^d	276.00 ^a	270.67 ^a	175.67 ^{bc}	4.244	<0.001
	24	236.00 ^d	240.67 ^{cd}	313.33 ^b	278.00 ^{bc}	400.67 ^a	394.67 ^a	302.67 ^b	7.752	<0.001
NH ₃ -N (mg/dL)	0	19.57 ^a	15.23 ^b	16.48 ^b	9.89 ^d	11.97 ^c	12.23 ^c	8.38 ^d	0.399	<0.001
	6	21.76 ^a	16.73 ^c	18.95 ^b	18.66 ^b	13.77 ^d	11.43 ^e	14.41 ^d	0.403	<0.001
	12	26.02 ^a	21.21 ^c	23.56 ^b	16.00 ^d	25.12 ^{ab}	19.26 ^c	14.55 ^d	0.579	<0.001
	24	22.22 ^d	23.38 ^{cd}	24.73 ^{bc}	24.26 ^{bcd}	26.19 ^b	24.46 ^{bcd}	32.11 ^a	0.690	<0.001
Total VFA (mmol/L)	0	165.67 ^{ab}	151.26 ^{bc}	142.82 ^c	148.23 ^{bc}	187.00 ^a	184.27 ^a	175.39 ^a	5.592	0.001
	6	207.82 ^b	189.93 ^c	197.68 ^{bc}	191.66 ^{bc}	243.21 ^a	227.89 ^a	228.54 ^a	4.774	<0.001
	12	224.10 ^c	208.73 ^c	221.22 ^c	253.05 ^b	251.49 ^b	273.29 ^a	262.83 ^{ab}	5.237	<0.001
	24	223.76 ^d	219.27 ^d	235.80 ^d	296.56 ^{ab}	278.22 ^{bc}	304.72 ^a	263.50 ^c	5.135	<0.001
VFA (mmol/L)										
Acetate	0	117.85 ^a	94.75 ^{bc}	86.57 ^{cd}	72.36 ^d	113.17 ^a	109.08 ^{ab}	92.67 ^c	3.961	<0.001
	6	118.52 ^{cd}	115.10 ^d	116.87 ^d	116.19 ^d	132.55 ^a	123.17 ^{bc}	126.16 ^b	1.545	<0.001
	12	120.00 ^c	116.75 ^c	119.74 ^c	130.08 ^b	131.40 ^{ab}	129.78 ^b	135.07 ^a	1.243	<0.001
	24	117.28 ^c	124.23 ^b	124.29 ^b	143.03 ^a	141.50 ^a	145.65 ^a	127.35 ^b	1.124	<0.001
Propionate	0	31.58 ^c	30.86 ^c	31.62 ^c	59.78 ^a	41.75 ^b	43.45 ^b	66.54 ^a	1.684	<0.001
	6	46.60 ^b	43.08 ^b	43.82 ^b	47.02 ^b	55.62 ^a	51.88 ^a	52.46 ^a	1.139	<0.001
	12	37.37 ^d	44.20 ^c	49.33 ^{bc}	57.51 ^a	53.07 ^{ab}	56.73 ^a	56.90 ^a	1.465	<0.001
	24	47.73 ^{de}	46.03 ^e	53.51 ^{cd}	66.15 ^b	66.83 ^b	74.28 ^a	55.24 ^c	1.708	<0.001
Butyrate	0	16.23 ^c	25.64 ^{ab}	24.62 ^b	16.09 ^c	32.08 ^a	31.73 ^{ab}	16.17 ^c	1.906	<0.001
	6	42.69 ^{ab}	31.75 ^{bc}	36.99 ^{bc}	28.45 ^c	55.05 ^a	52.84 ^a	49.93 ^a	3.535	0.001
	12	66.73 ^b	47.78 ^c	52.14 ^c	65.47 ^b	67.02 ^b	86.78 ^a	70.86 ^b	3.693	<0.001
	24	58.75 ^{cd}	49.01 ^d	58.00 ^{cd}	87.38 ^a	69.89 ^{bc}	84.79 ^a	80.91 ^{ab}	3.056	<0.001
A/P ratio	0	3.73 ^a	3.08 ^b	2.74 ^{bc}	1.21 ^d	2.71 ^{bc}	2.57 ^c	1.39 ^d	0.097	<0.001
	6	2.54 ^{ab}	2.67 ^a	2.67 ^a	2.48 ^{ab}	2.38 ^b	2.38 ^b	2.41 ^b	0.055	0.015
	12	3.34 ^a	2.64 ^b	2.43 ^b	2.26 ^b	2.48 ^b	2.29 ^b	2.37 ^b	0.084	0.006
	24	2.46 ^b	2.70 ^a	2.32 ^{bc}	2.17 ^{cd}	2.12 ^{de}	1.96 ^e	2.32 ^{bc}	0.056	<0.001

¹ CON, control; BEN, bentonite; CC, calcium carbonate; CO, calcium oxide; SB, sodium bicarbonate; SS, sodium sesquicarbonate; PC, processed coral. ^{a-e} Means in each row with different superscripts are significantly different (*p* < 0.05). SEM, standard error of the mean; NH₃-N, ammonia-nitrogen; VFA, volatile fatty acid; A/P, acetate to propionate ratio.

Table S5. Effect of treatments on rumen fermentation profile of Holstein Friesian cows after 5 days of supplementation.

Parameter	Day (d)	Treatment ¹			SEM	<i>p</i> -value
		CON	RB-1	RB-3		
pH	0	5.56	5.58	5.93	0.310	0.704
	5	5.70 ^b	6.63 ^a	6.54 ^a	0.144	0.034
NH ₃ -N (mg/dL)	0	6.57	3.38	5.17	1.999	0.605
	5	2.53	2.51	3.34	0.613	0.745
Total VFA (mmol/L)	0	113.74	123.45	125.59	12.518	0.839
	5	115.53	126.04	127.09	7.465	0.653
VFA (mmol/L)						
Acetate	0	62.11	68.18	70.86	7.501	0.835
	5	67.73	71.42	77.65	3.646	0.187
Propionate	0	36.42	37.55	37.60	5.012	0.985
	5	30.49	32.41	31.47	2.686	0.885
Butyrate	0	15.21	17.72	17.13	1.382	0.568
	5	16.61	19.83	18.77	1.285	0.413
A/P ratio	0	1.76	1.82	1.87	0.177	0.920
	5	2.05	2.66	2.47	0.136	0.075

¹ CON, negative control; RB-1, (30% calcium oxide, 10% processed coral, 30% magnesium oxide, 30% sodium bicarbonate); RB-3, (20% calcium oxide, 10% processed coral, 40% magnesium oxide, 30% sodium bicarbonate). ^{a-b} Means in each row with different superscripts are significantly different ($p < 0.05$). SEM, standard error of the mean; NH₃-N, ammonia-nitrogen; A/P, acetate to propionate ratio.