

220 As the level of β -mannanase supplementation in the diet of weaning pigs increased, positive trends were
221 observed in growth performance, nutrient digestibility, and blood metabolites, which are typically influenced by
222 the presence of β -mannan. Therefore, supplementing β -mannanase up to 0.15% in the diet of weaning pigs
223 could enhance their productivity, as it breaks down indigestible β -mannan.

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329 **1. Tables and Figures**

330 **Table 1.** Formulation and chemical composition of the experimental diets for the early weaning phase
 331 (0 - 2 weeks)

Criteria	Treatment ¹			
	β -Man0	β -Man0.05	β -Man0.1	β -Man0.15
Ingredient, %				
Expanded corn	62.27	62.24	62.22	62.19
Soybean meal	2.76	2.78	2.80	2.82
Fermented soybean meal	7.70	7.70	7.70	7.70
Soy oil	0.59	0.62	0.65	0.68
Whey base	4.19	4.12	4.04	3.97
Lactose base	10.00	10.00	10.00	10.00
Fish meal	5.00	5.00	5.00	5.00
Blood plasma	4.00	4.00	4.00	4.00
L-lysine, 50%	0.65	0.65	0.65	0.65
DL-Methionine, 98%	0.09	0.09	0.09	0.09
L-Threonine, 98.5%	0.07	0.07	0.07	0.07
L-Tryptophan, 99%	0.02	0.02	0.02	0.02
DCP	1.37	1.37	1.37	1.37
Limestone	0.69	0.69	0.69	0.69
Vit. Mix ²	0.10	0.10	0.10	0.10
Min. Mix ³	0.10	0.10	0.10	0.10
Salt	0.30	0.30	0.30	0.30
Zinc oxide	0.10	0.10	0.10	0.10
β -mannanase ⁴	0.00	0.05	0.10	0.15
Total	100.00	100.00	100.00	100.00
Chemical composition⁵				
ME, kcal/kg	3400.00	3400.00	3400.00	3400.00
CP, %	17.50	17.50	17.50	17.50
Lysine, %	1.35	1.35	1.35	1.35
Methionine, %	0.39	0.39	0.39	0.39
Threonine, %	0.79	0.79	0.79	0.79
Tryptophan, %	0.22	0.22	0.22	0.22
Total Ca, %	0.80	0.80	0.80	0.80
Total P, %	0.65	0.65	0.65	0.65
β -mannan ⁶ , %	0.31	0.31	0.31	0.31

¹ β -Man0: corn-SBM based basal diet + β -mannanase 0%; β -Man0.05: basal diet + β -mannanase 0.05%; β -Man0.1: basal diet + β -mannanase 0.1%; β -Man0.15: basal diet + β -mannanase 0.15%

² Supplied at the following levels per kilogram of diet: vitamin A, 8,000 IU; vitamin D3, 1,600IU; vitamin E, 32IU; d-biotin, 64g; riboflavin, 3.2mg; calcium pantothenic acid, 8mg; niacin, 16mg; vitamin B12, 12g; vitamin K, 2.4mg.

³ Supplied at the following levels per kilogram of diet: Se, 0.1mg; I, 0.3mg; Mn, 24.8mg; CuSO4, 54.1mg; Fe, 127.3mg; Zn, 84.7mg; Co, 0.3mg.

⁴ CTCZYME, β -mannanase (800,000 IU/kg), provided from CTC Bio (Seoul, South Korea).

⁵ Calculated values.

⁶ The β -mannan content in the diet was calculated based on the methods described by Kwon and Kim, and Kiarie et al. [4, 5].

Table 2. Formulation and chemical composition of the experimental diets for the late weaning phase (2 - 5 weeks)

Criteria	Treatment ¹			
	β -Man0	β -Man0.05	β -Man0.1	β -Man0.15
Ingredient, %				
Expanded corn	71.63	71.71	71.80	71.88
Soybean meal	2.19	2.23	2.26	2.30
Fermented soybean meal	6.00	6.00	6.00	6.00
Wheat bran	1.25	1.09	0.93	0.77
Whey base	3.10	3.09	3.08	3.07
Lactose base	5.00	5.00	5.00	5.00
Fish meal	4.00	4.00	4.00	4.00
Blood plasma	3.50	3.50	3.50	3.50
L-lysine, 50%	0.68	0.68	0.68	0.68
DL-Methionine, 98%	0.08	0.08	0.08	0.08
L-Threonine, 98.5%	0.08	0.08	0.08	0.08
L-Tryptophan, 99%	0.02	0.02	0.02	0.02
DCP	1.23	1.23	1.23	1.23
Limestone	0.64	0.64	0.64	0.64
Vit. Mix ²	0.10	0.10	0.10	0.10
Min. Mix ³	0.10	0.10	0.10	0.10
Salt	0.30	0.30	0.30	0.30
Zinc oxide	0.10	0.10	0.10	0.10
β -mannanase ⁴	0.00	0.05	0.10	0.15
Total	100.00	100.00	100.00	100.00
Chemical composition⁵				
ME, kcal/kg	3350.00	3350.00	3350.00	3350.00
CP, %	16.00	16.00	16.00	16.00
Lysine, %	1.23	1.23	1.23	1.23
Methionine, %	0.36	0.36	0.36	0.36
Threonine, %	0.73	0.73	0.73	0.73
Tryptophan, %	0.20	0.20	0.20	0.20
Total Ca, %	0.70	0.70	0.70	0.70
Total P, %	0.60	0.60	0.60	0.60
β -mannan ⁶ , %	0.31	0.31	0.31	0.31

¹ β -Man0: corn-SBM based basal diet + β -mannanase 0%; β -Man0.05: basal diet + β -mannanase 0.05%; β -Man0.1: basal diet + β -mannanase 0.1%; β -Man0.15: basal diet + β -mannanase 0.15%

² Supplied at the following levels per kilogram of diet: vitamin A, 8,000 IU; vitamin D3, 1,600IU; vitamin E, 32IU; d-biotin, 64g; riboflavin, 3.2mg; calcium pantothenic acid, 8mg; niacin, 16mg; vitamin B12, 12g; vitamin K, 2.4mg.

³ Supplied at the following levels per kilogram of diet: Se, 0.1mg; I, 0.3mg; Mn, 24.8mg; CuSO₄, 54.1mg; Fe, 127.3mg; Zn, 84.7mg; Co, 0.3mg.

⁴ CTCZYME, β -mannanase (800,000 IU/kg), provided from CTC Bio (Seoul, South Korea).

⁵ Calculated values.

⁶ The β -mannan content in the diet was calculated based on the methods described by Kwon and Kim, and Kiarie et al. [4, 5].

Table 3. Effects of varying levels of β -mannanase on growth performance in weaning pigs

Criteria	Treatment ¹				SEM ²	p-value ³	
	β -Man0	β -Man0.05	β -Man0.1	β -Man0.15		Lin.	Quad.
Body weight, kg							
Initial		----- 8.66 -----			-	-	-
2 week	13.82	13.84	14.05	14.58	0.293	0.38	0.96
5 week	28.22	28.43	28.09	28.27	0.426	0.96	0.80
ADG, g							
0-2 weeks	370.99	370.96	385.34	421.71	10.131	0.07	0.93
2-5 weeks	653.32	665.94	668.52	651.57	8.433	0.97	0.91
0-5 weeks	559.13	564.74	555.25	559.62	7.408	0.91	0.69
ADFI, g							
0-2 weeks	691.55	692.33	680.11	721.14	17.317	0.65	0.69
2-5 weeks	1264.14	1253.83	1229.15	1134.79	25.199	0.08	0.80
0-5 weeks	1035.10	1029.23	1009.54	969.33	17.730	0.20	0.97
G:F ratio							
0-2 weeks	0.542	0.534	0.572	0.586	0.012	0.14	0.54
2-5 weeks	0.516	0.532	0.546	0.574	0.009	0.02	0.83
0-5 weeks	0.540	0.548	0.556	0.578	0.007	0.06	0.82

¹ β -Man0: corn-SBM based basal diet + β -mannanase 0%; β -Man0.05: basal diet + β -mannanase 0.05%; β -Man0.1: basal diet + β -mannanase 0.1%; β -Man0.15: basal diet + β -mannanase 0.15%

² Standard error of the mean

³ Abbreviation: Lin. (linear) and Quad. (quadratic)

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Table 4. Effects of varying levels of β -mannanase on ATTD of nutrients in weaning pigs

Criteria	Treatment ¹				SEM ²	p-value ³	
	β -Man0	β -Man0.05	β -Man0.1	β -Man0.15		Lin.	Quad.
ATTD of nutrients, %							
Dry matter	91.76	91.24	91.46	91.15	0.308	0.62	0.69
Crude protein	90.99	89.74	90.02	89.50	0.493	0.41	0.64
Crude ash	72.83	72.95	71.36	72.19	0.331	0.25	0.19
Crude fat	81.23	81.44	81.88	82.16	0.170	0.04	0.78
Nitrogen retention, g/day							
N-intake	5.16	5.16	5.17	5.16	-	-	-
N-feces	0.55	0.54	0.52	0.56	0.021	0.93	0.74
N-urine	2.16	2.22	2.17	2.21	0.034	0.73	0.61
N-retention ⁴	2.45	2.40	2.48	2.38	0.034	0.70	0.42

¹ β -Man0: corn-SBM based basal diet + β -mannanase 0%; β -Man0.05: basal diet + β -mannanase 0.05%; β -Man0.1: basal diet + β -mannanase 0.1%; β -Man0.15: basal diet + β -mannanase 0.15%

² Standard error of the mean

³ Abbreviation: Lin. (linear) and Quad. (quadratic)

⁴ N-retention (g) = N intake (g) – fecal N (g) – urinary N (g)

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Table 5. Effects of varying levels of β -mannanase on blood metabolites in weaning pigs

Criteria	Treatment ¹				SEM ²	p-value ³	
	β -Man0	β -Man0.05	β -Man0.1	β -Man0.15		Lin.	Quad.
Glucose, md/dL							
Initial	----- 127.50 -----				-	-	-
2 week	122.75	119.25	115.25	116.60	1.627	0.14	0.70
5 week	112.75	109.20	111.00	113.25	1.544	0.83	0.74
BUN, mg/dL							
Initial	----- 3.43 -----				-	-	-
2 week	2.98	3.44	2.80	3.08	0.281	0.90	0.46
5 week	3.18	3.30	1.95	2.45	0.335	0.27	0.29
Total protein, g/dL							
Initial	----- 4.15 -----				-	-	-
2 week	4.03	4.06	4.35	4.43	0.063	0.01	0.31
5 week	5.04	5.13	4.85	5.38	0.080	0.25	0.11
Triglyceride, mg/dL							
Initial	----- 36.25 -----				-	-	-
2 week	31.00	27.25	32.80	43.50	2.044	0.01	0.31
5 week	35.25	26.50	33.50	35.50	1.496	0.52	0.11
Total cholesterol, mg/dL							
Initial	----- 61.75 -----				-	-	-
2 week	50.75	56.25	60.40	68.75	2.142	<0.01	0.70
5 week	75.00	88.25	85.75	94.40	2.337	<0.01	0.11
HDL cholesterol, mg/dL							
Initial	----- 26.75 -----				-	-	-
2 week	23.50	23.75	26.20	29.25	0.923	0.02	0.83
5 week	25.50	28.75	27.00	33.40	1.116	0.02	0.13
LDL cholesterol, mg/dL							
Initial	----- 36.50 -----				-	-	-
2 week	29.25	34.00	36.20	41.00	1.687	0.02	0.70
5 week	51.00	61.50	61.00	63.00	1.805	0.02	0.35

¹ β -Man0: corn-SBM based basal diet + β -mannanase 0%; β -Man0.05: basal diet + β -mannanase 0.05%; β -Man0.1: basal diet + β -mannanase 0.1%; β -Man0.15: basal diet + β -mannanase 0.15%

² Standard error of the mean

³ Abbreviation: Lin. (linear) and Quad. (quadratic)

Table 6. Effects of varying levels of β -mannanase on diarrhea incidence in weaning pigs

Criteria	Treatment ¹				SEM ²	p-value ³	
	β -Man0	β -Man0.05	β -Man0.1	β -Man0.15		Lin.	Quad.
Fecal score⁴							
0-1 weeks	1.86	1.94	1.89	1.86	0.045	0.88	0.70
1-2 weeks	1.63	1.63	1.51	1.54	0.033	0.24	0.41
2-3 weeks	1.49	1.43	1.43	1.46	0.067	0.90	0.97
3-4 weeks	1.51	1.37	1.34	1.40	0.063	0.54	0.96
4-5 weeks	1.08	1.09	1.08	1.14	0.026	0.49	0.80
0-2 weeks	1.74	1.78	1.70	1.70	0.025	0.34	0.38
2-5 weeks	1.36	1.29	1.29	1.33	0.043	0.82	0.98
0-5 weeks	1.51	1.49	1.45	1.48	0.027	0.59	0.74

¹ β -Man0: corn-SBM based basal diet + β -mannanase 0%; β -Man0.05: basal diet + β -mannanase 0.05%; β -Man0.1: basal diet + β -mannanase 0.1%; β -Man0.15: basal diet + β -mannanase 0.15%

² Standard error of the mean

³ Abbreviation: Lin. (linear) and Quad. (quadratic)

⁴ The fecal score was measured by scoring the feces as point 1 (firm feces), point 2 (soft feces), point 3 (light diarrhea), point 4 (heavy diarrhea), and point 5 (watery diarrhea)

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