

References

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Tables and Figures

Table 1. Ingredient formulations and compositions of experimental diets.

Items	Barley	Brown rice	Corn	Mung bean	Rice
Ingredient (%)					
DM	88.73	87.88	91.09	89.10	86.33
CP	8.91	7.93	8.06	25.65	6.56
EE	1.33	1.72	0.03	1.41	0.31
CF	0.70	1.21	0.09	5.23	0.14
CA	0.75	1.09	0.34	3.81	0.55
NFE	77.04	75.93	82.57	53.00	78.77
Calories (kcal/kg)	4041	3917	4017	4011	3608
Ingredient composition (%)					
Barley powder	37.35	-	-	-	-
Brown rice powder	-	37.57	-	-	-
Corn powder	-	-	35.93	-	-
Mung bean powder	-	-	-	25.48	-
Rice powder	-	-	-	15.00	36.13
Lard	1.44	1.46	1.70	3.04	1.48
Water	35.00	35.00	35.00	35.00	35.00
Salt	0.20	0.20	0.20	0.20	0.20
Vitamin and mineral premix ¹	0.40	0.40	0.40	0.40	0.40
Calcium phosphate	1.00	1.02	1.01	1.15	0.95
Calcium carbonate	0.74	0.72	0.76	0.67	0.75
Potassium citrate	1.00	1.00	1.00	1.00	1.00
Tryptophan	0.01	0.02	0.01	0.04	0.01
Cabbage powder	1.00	1.00	1.00	1.00	1.00
Green laver	1.00	1.00	1.00	1.02	1.00
Yolk powder	8.00	8.00	8.00	8.00	8.00
Chicken breast	12.86	12.61	13.99	8.00	14.08

Values are expressed as means. DM, dry matter; CP, crude protein; EE, ether extract; CF, crude fiber; CA, crude ash; NFE, nitrogen-free extract; ME, metabolizable energy. ¹ Vitamin and mineral premix supplied per kg of diets: 3500 IU vitamin A; 250 IU vitamin D₃; 25 mg vitamin E; 0.052 mg vitamin K; 2.8 mg vitamin B₁(thiamine); 2.6 mg vitamin B₂ (riboflavin); 2 mg

vitamin B₆ (pyridoxine); 0.014 mg vitamin B₁₂; 6 mg Cal-d-pantothenate; 30 mg niacin; 0.4 mg folic acid; 0.036 mg biotin;
1,000 mg taurine; 44 mg FeSO₄; 3.8 mg MnSO₄; 50 mg ZnSO₄; 7.5 mg CuSO₄; 0.18 mg Na₂SeO₃; 0.9 mg Ca(IO₃)₂.

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Table 2. Analyzed chemical composition of experimental diets based on various carbohydrate ingredients

Item (%)	Barley	Brown rice	Corn	Mung bean	Rice
DM	70.09	70.97	70.63	74.21	70.15
CP	21.46	20.64	21.73	21.28	21.37
EE	7.86	7.45	5.63	10.92	7.50
CF	0.37	0.44	0.03	1.12	0.25
CA	3.94	4.05	3.12	5.25	4.05
NFE	36.46	38.39	40.12	35.64	36.98
ME (kcal/kg)	3577	3799	3886	4017	3637

Values are expressed as means. DM, dry matter; CP, crude protein; EE, ether extract; CF, crude fiber; CA, crude ash; NFE, nitrogen-free extract.

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Table 3. Average daily intake, metabolic energy, and body parameters of dogs fed with various carbohydrate sources diets

Items (unit)	Barley	Brown rice	Corn	Mung bean	Rice	F value	Pr(>F)
ADFI (g/day) ¹	292.0 ± 4.76 ^a	283.1 ± 4.67 ^{ab}	289.1 ± 4.77 ^a	269.9 ± 4.43 ^b	291.9 ± 4.73 ^a	3.96	<0.01
ME intake (kcal/day) ²	787.0 ± 12.84	764.2 ± 12.60	764.2 ± 12.60	788.1 ± 12.92	782.2 ± 12.67	0.89	0.480
Body weight (kg)							
Initial	12.1 ± 0.94	12.6 ± 1.10	12.4 ± 0.98	12.6 ± 1.20	11.7 ± 0.72	1.19	0.331
Final	12.4 ± 0.98	12.6 ± 1.20	12.6 ± 1.10	12.6 ± 1.12	12.1 ± 0.94	0.28	0.887
BWG (g)	300.0 ±		137.5 ±				
	98.20 ^{ab}	25.0 ± 75.00 ^b	83.32 ^{ab}	25.0 ± 61.96 ^b	462.5 ± 93.90 ^a	5.15	<0.01
FCR (ADFI/BWG)	-0.4	0.8	1.3	0.5	0.6	0.56	0.694

Values are expressed as the mean ± SEM. ADFI, average daily feed intake; ME, metabolizable energy; BWG, body weight gain; FCR, feed conversion ratio; SEM, standard error of the mean. ¹ ADFI values were calculated based on dry matter. ² ME was calculated using the following equation: ME (kcal/d) = (crude protein × 3.5) + (ether extract × 8.5) + (nitrogen-free extract × 3.5). Different letters (a and b) indicate significant differences between means. The letters a and ab or ab and b indicate non-significant differences. Additionally, if the ANOVA was not statistically significant, no letters were displayed in the table.

Table 4. Nutrient intake and apparent total trace nutrient digestibility in dogs fed with various carbohydrate sources diets

	Barley	Brown rice	Corn	Mung bean (correction)	Rice	SEM	F value	Pr(>F)
Daily DM intake (g)								
DM	204.66	200.93	204.21	200.27	204.75	1.44	0.43	0.786
CP	62.66 ^b	58.44 ^{ac}	62.83 ^b	57.43 ^c	62.37 ^{ab}	0.56	6.81	< 0.001
EE	22.95 ^a	21.09 ^b	16.28 ^c	29.47 ^d	21.89 ^{ab}	0.70	162.00	< 0.001
CA	11.50 ^a	11.47 ^{ac}	9.02 ^b	14.17 ^c	11.82 ^{ab}	0.27	90.67	< 0.001
NFE	106.46 ^a	108.69 ^{ac}	116.00 ^b	96.18 ^c	107.94 ^{ab}	1.26	16.36	< 0.001
OM	192.08	188.22	195.10	183.08	192.20	1.48	2.22	0.087
ME (kcal/kg) ¹	1044.48 ^a	1075.59 ^{ab}	1123.54 ^b	1084.09 ^{ab}	1061.55 ^{ab}	8.60	2.81	0.040
ATTD (%)								
DM	88.81 ^b	91.61 ^{ab}	92.95 ^a	80.74 ^c (70.14)	92.45 ^a	0.79	46.09	< 0.001
CP	91.87 ^a	91.56 ^{ab}	92.07 ^a	82.65 ^b (73.79)	92.43 ^a	0.66	39.49	< 0.001
EE	96.52 ^a	94.80 ^{ab}	93.62 ^b	94.40 ^{ab} (92.91)	96.06 ^{ab}	0.31	3.84	0.011
CA	51.61	54.42	63.12	56.80 (60.90)	52.26	1.69	1.62	0.192
NFE	90.10 ^b	95.56 ^a	96.14 ^a	83.38 ^c (70.99)	97.08 ^a	0.92	36.47	< 0.001
OM	91.44 ^b	94.24 ^a	94.62 ^a	84.93 ^c (75.40)	95.45 ^a	0.67	45.31	< 0.001
ME	90.15 ^b	93.63 ^a	94.22 ^a	83.71 ^c (73.80)	94.67 ^a	0.71	53.66	< 0.001

Values are expressed as means. Different letters (a, b, c, and d) above the number indicate significant differences between means. If the same letters, such as a and ab or ab and b, are present, it indicates an insignificant difference. Additionally, if the ANOVA was not statistically significant, no letters were displayed in the table. DM, dry matter; CP, crude protein; EE, ether extract; CA, crude ash; NFE, nitrogen-free extract; OM, organic matter; ME, metabolizable energy; ATTD, apparent total tract nutrient digestibility. ¹ ME was calculated using the following equation: ME (kcal/kg) = (CP × 3.5) + (EE × 8.5) + (NFE × 3.5).

Table 5. Apparent total trace nutrient digestibility of amino acids in various carbohydrate sources diets in dogs

Amino acid (%)	Barley	Brown rice	Corn	Mung bean (correction)	Rice	SEM	F value	Pr(>F)
Essential amino acid								
Arginine	93.51 ^a	94.17 ^a	93.91 ^a	85.69 ^b (78.19)	93.98 ^a	0.61	26.29	< 0.001
Histidine	91.36 ^a	91.87 ^a	91.66 ^a	79.13 ^b (67.81)	91.64 ^a	0.87	46.10	< 0.001
Isoleucine	92.37 ^a	92.38 ^a	92.71 ^a	82.93 ^b (74.18)	92.61 ^a	0.71	26.35	< 0.001
Leucine	93.13 ^a	91.99 ^a	94.10 ^a	83.03 ^b (74.14)	92.85 ^a	0.75	25.86	< 0.001
Lysine	91.74 ^a	92.71 ^a	92.00 ^a	81.55 ^b (71.55)	92.60 ^a	0.77	34.39	< 0.001
Methionine	95.19 ^{ac}	91.49 ^b	96.75 ^c	85.68 ^d (79.75)	92.23 ^{ab}	0.70	26.81	< 0.001
Phenylalanine	92.80 ^a	90.90 ^a	92.45 ^a	82.03 ^b (73.16)	91.84 ^a	0.76	22.42	< 0.001
Threonine	89.17 ^a	90.32 ^a	90.29 ^a	74.28 ^b (59.33)	90.80 ^a	1.17	28.13	< 0.001
Tryptophan	88.86 ^a	89.87 ^a	90.65 ^a	76.81 ^b (64.34)	90.60 ^a	1.15	10.62	< 0.001
Valine	91.06 ^a	91.03 ^a	91.38 ^a	79.69 ^b (69.09)	91.41 ^a	0.86	2.72	< 0.001
Nonessential amino acid								
Alanine	90.18 ^a	90.87 ^a	91.51 ^a	79.45 ^b (68.93)	91.08 ^a	0.85	26.30	< 0.001
Aspartic acid	89.10 ^a	90.75 ^a	90.34 ^a	78.98 ^b (68.54)	90.51 ^a	0.82	30.05	< 0.001
Cysteine	84.24 ^a	78.76 ^a	87.47 ^a	59.85 ^b (41.73)	79.88 ^a	1.81	22.43	< 0.001
Glutamic acid	93.57 ^a	91.55 ^a	91.31 ^a	82.35 ^b (73.80)	91.80 ^a	0.74	35.47	< 0.001
Glycine	88.05 ^a	89.36 ^a	88.91 ^a	73.71 ^b (59.46)	89.46 ^a	1.08	39.03	< 0.001
Proline	92.49 ^a	89.27 ^a	91.85 ^a	74.84 ^b (60.87)	90.27 ^a	1.16	38.60	< 0.001
Serine	82.68 ^a	83.54 ^a	84.63 ^a	70.95 ^b (60.93)	82.02 ^a	1.04	12.64	< 0.001
Tyrosine	90.51 ^a	88.70 ^a	92.28 ^a	77.99 ^b (67.13)	89.99 ^a	0.97	20.29	< 0.001

Values are expressed as means. Different letters (a, b, c, and d) above the number indicate significant differences between means. If the same letters, such as a and ab or ab and b, are present, this indicates an insignificant difference. Additionally, if the ANOVA was not statistically significant, no letters were displayed in the table. SEM: standard error of the mean.