**Table S1** Composition and nutrient levels of basal diets (air-dry basis)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Items | Growth stage | | | | |
| 0 to 14 days | | 15 to 28 days | 29 to 35 days | 35 to 42 days |
| Ingredients, % | | | | | |
| Corn | | 56.66 | 59.97 | 62.03 | 62.08 |
| Peel soybean meal | | 34.00 | 29.80 | 26.60 | 26.60 |
| Corn protein meal (60%) | | 2.00 | 2.00 | 2.00 | 2.00 |
| Soybean oil | | 2.50 | 3.80 | 5.00 | 5.00 |
| Calcium hydrogen phosphate, CaHPO4 | | 1.45 | 1.18 | 1.11 | 1.11 |
| Limestone (38%) | | 1.22 | 1.20 | 1.20 | 1.20 |
| Choline chloride (50%) | | 0.10 | 0.10 | 0.10 | 0.10 |
| Sodium bicarbonate (24.1%) | | 0.21 | 0.21 | 0.20 | 0.20 |
| NaCl | | 0.26 | 0.24 | 0.22 | 0.22 |
| *DL-*Met | | 0.29 | 0.24 | 0.24 | 0.24 |
| Lys (98%) | | 0.19 | 0.14 | 0.16 | 0.16 |
| Thr (98.5%) | | 0.03 | 0.03 | 0.05 | 0.05 |
| High temperature resistant phytase (20000) | | 0.01 | 0.01 | 0.01 | 0.01 |
| Compound enzyme preparation | | 0.03 | 0.03 | 0.03 | 0.03 |
| Salinomycin | | 0.05 | 0.05 | 0.05 | — |
| Pre-premix1 | | 1.00 | — | — | — |
| Intermediate premix2 | | — | 1.00 | — | — |
| Late premix3 | | — | — | 1.00 | 1.00 |
| Total | | 100.00 | 100.00 | 100.00 | 100.00 |
| Nutrient levels4 | | | | | |
| Metabolic energy, MJ/kg | | 2,837 | 2,954 | 3,051 | 3,051 |
| Crude protein, % | | 21.61 | 19.87 | 18.61 | 18.61 |
| Calcium, % | | 0.90 | 0.82 | 0.80 | 0.80 |
| Total phosphorus, TP, % | | 0.65 | 0.62 | 0.50 | 0.50 |
| Available phosphorus, AP, % | | 0.45 | 0.41 | 0.39 | 0.39 |
| Digestible lysine, % | | 1.23 | 1.09 | 1.02 | 1.02 |
| Digestible methionine, % | | 0.60 | 0.53 | 0.51 | 0.51 |
| Digestible threonine, % | | 0.74 | 0.68 | 0.65 | 0.65 |
| Digestible tryptophan, % | | 0.24 | 0.22 | 0.20 | 0.20 |
| Digestible methionine+ Digestible cysteine, % | | 0.89 | 0.79 | 0.76 | 0.76 |

1The pre-premix provided the following per kg of diets: Fe 40 mg, Zn 100 mg, Mn 100 mg, Cu 15 mg, Se 0.35 mg, I 1 mg, vitamin A 12 000 IU, vitamin D3 5 000 IU, vitamin E 30 IU, vitamin K 3 mg, vitamin B1 3 mg, vitamin B2 8 mg, vitamin B6 4 mg, vitamin B12 12 μg, niacin 35 mg, pantothenate acid 15 mg, folic acid 0.7 mg, biotin 0.15 mg.

2The intermediate premix provided the following per kg of diets: Fe 40 mg, Zn 100 mg, Mn 100 mg, Cu 15 mg, Se 0.35 mg, I 1 mg, vitamin A 10 000 IU, vitamin D3 5 000 IU, vitamin E 30 IU, vitamin K 3 mg, vitamin B1 2 mg, vitamin B2 8 mg, vitamin B6 3 mg, vitamin B12 10 μg, niacin 30 mg, pantothenate acid 12 mg, folic acid 0.7 mg, biotin 0.12 mg.

3The late premix provided the following per kg of diets: Fe 40 mg, Zn 100 mg, Mn 100 mg, Cu 15 mg, Se 0.35 mg, I 1 mg, vitamin A 10 000 IU, vitamin D3 5 000 IU, vitamin E 30 IU, vitamin K 3 mg, vitamin B1 2 mg, vitamin B2 6 mg, vitamin B6 3 mg, vitamin B12 10 μg, niacin 30 mg, pantothenate acid 10 mg, folic acid 0.6 mg, biotin 0.12 mg.

4Crude protein, calcium and total phosphorus were measured values, while the others were calculated values.

**Table S2** Effect of different treatment groups on the growth performance of Cobb broilers1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Items | Groups | | | | | | |
| Control | VM | EM | EOA1 | EOA2 | SEM2 | *P* |
| **Mean body weight / g** | | | | | | | |
| 1 day of age | 40.48 | 40.18 | 40.21 | 40.09 | 40.24 | 0.10 | 0.829 |
| 14 days of age | 496.73b | 524.11a | 520.54a | 527.98a | 518.45a | 2.38 | 0.000 |
| 28 days of age | 1358.63b | 1462.50a | 1453.57a | 1452.08a | 1441.37a | 6.13 | 0.000 |
| 35 days of age | 1934.82b | 2023.81a | 2020.24a | 2027.98a | 2011.01a | 8.60 | 0.001 |
| 42 days of age | 2544.64b | 2663.99a | 2651.79a | 2664.29a | 2615.18a | 10.44 | 0.000 |
| **Average daily gain (ADG) / g** | | | | | | | |
| 1~14 days of age | 32.59b | 34.57a | 34.30a | 34.85a | 34.16a | 0.17 | 0.000 |
| 15~28 days of age | 61.56b | 67.03a | 66.65a | 66.01a | 65.92a | 0.40 | 0.000 |
| 29~35 days of age | 82.31 | 80.19 | 80.95 | 82.27 | 81.38 | 1.05 | 0.967 |
| 36~42 days of age | 87.12 | 91.45 | 90.22 | 90.90 | 86.31 | 1.06 | 0.437 |
| 1~42 days of age | 59.62b | 62.47a | 62.18a | 62.48a | 61.31a | 0.25 | 0.000 |
| **Average daily feed intake (ADFI) / g** | | | | | | | |
| 1~14 days of age | 35.37 | 35.44 | 35.03 | 35.27 | 35.31 | 0.15 | 0.940 |
| 14~28 days of age | 94.41 | 94.71 | 93.35 | 93.32 | 93.15 | 0.34 | 0.482 |
| 28~35 days of age | 136.44 | 137.71 | 138.95 | 134.31 | 135.25 | 0.87 | 0.467 |
| 35~42 days of age | 159.18 | 159.99 | 160.38 | 156.63 | 155.99 | 0.69 | 0.149 |
| 1~42 days of age | 92.53 | 93.00 | 92.68 | 91.35 | 91.36 | 0.26 | 0.127 |
| **F/G** | | | | | | | |
| 1~14 days of age | 1.09a | 1.03b | 1.02b | 1.01b | 1.03b | 0.01 | 0.000 |
| 14~28 days of age | 1.54a | 1.41b | 1.40b | 1.41b | 1.42b | 0.01 | 0.000 |
| 28~35 days of age | 1.67 | 1.73 | 1.73 | 1.67 | 1.67 | 0.02 | 0.797 |
| 35~42 days of age | 1.83 | 1.77 | 1.79 | 1.74 | 1.82 | 0.02 | 0.687 |
| 1~42 days of age | 1.55a | 1.49b | 1.49b | 1.46b | 1.49b | 0.01 | 0.000 |

1Value with different small letters mean significant difference (*P* < 0.05).

2SEM, standard error of means.