**Table S1.** Composition and nutrients contents of diets

|  |  |
| --- | --- |
| Ingredients | Dietary Trp levels (g kg-1) |
| 2.6 | 3.1 | 3.7 | 4.2 | 4.7 | 5.6 |
| Soybean meal1 | 80 | 80 | 80 | 80 | 80 | 80 |
| Rapeseed meal | 100 | 100 | 100 | 100 | 100 | 100 |
| Fishmeal | 160 | 160 | 160 | 160 | 160 | 160 |
| Corn starch | 206.3 | 206.2 | 206.1 | 205.9 | 205.8 | 205.5 |
| Corn gluten meal | 330 | 330 | 330 | 330 | 330 | 330 |
| Soybean oil | 40 | 40 | 40 | 40 | 40 | 40 |
| L-Glycine (98%) | 2.2 | 1.8 | 1.4 | 1.1 | 0.7 | 0.0 |
| L-Lysine-HCL (78%) | 14 | 14 | 14 | 14 | 14 | 14 |
| L-Tryptophan | 0.0 | 0.5 | 1.0 | 1.5 | 2.0 | 3.0 |
| L-Threonine (98%) | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
| L-Arginine (98%) | 10 | 10 | 10 | 10 | 10 | 10 |
| CaH2PO4 | 20 | 20 | 20 | 20 | 20 | 20 |
| Choline chloride | 30 | 30 | 30 | 30 | 30 | 30 |
| Vitamin premix2 | 10 | 10 | 10 | 10 | 10 | 10 |
| Mineral premix3 | 20 | 20 | 20 | 20 | 20 | 20 |
| Nutrients content4 |  |  |  |  |  |  |
| Crude protein | 412.1 | 417.6 | 412.4 | 414.7 | 413.4 | 413.2 |
| Crude lipid | 67.3 | 62.4 | 61.6 | 69.5 | 62.1 | 63.0 |
| Ash | 93.5 | 93.7 | 92.6 | 92.4 | 92.3 | 93.8 |
| Moisture | 109.9 | 103.1 | 108.3 | 101.8 | 104.9 | 104.2 |

1 Soybean meal (COFCO Oil Qinzhou Co., Ltd. China), rapeseed meal (Chengdu Huatai Grain and Oil Ltd., China), fish meal (TASA Steam dried fishmeal, Peru), corn gluten meal (Changchun Dacheng Industry Group, China), soybean oil (Baker Commodities Inc., China).

2 Vitamin premix (IU or g kg-1): retinyl acetate, 2,500,000 IU; cholecalciferol, 500,000 IU; α-tocopherol, 6700 IU; thiamine, 10; riboflavin, 6; pyridoxine hydrochloride, 12; nicotinic acid, 40; d-calcium pantothenate, 15; biotin, 0.25; folic acid, 0.4; inositol, 200; cyanocobalamin 0.02; menadione, 4. All ingredients were diluted with corn starch to 1 kg.

3 Mineral premix (g kg-1): FeC6H5O7, 4.57; ZnSO4·7H2O, 9.43; MnSO4·H2O, 4.14; CuSO4·5H2O, 6.61; MgSO4·7H2O, 238.97; KI, 1.10 g; NaSeO3, 2.50 g; CoCl2·6H2O, 1.36. All ingredients were diluted with CaCO3 to 1 kg.

4 Crude protein, fat, and ash contents (g kg-1) were measured by using the Association of Official Analytical Chemists (AOAC) methods.

**Table S2.** Amino acids contents of the experimental diets (g kg-1 dry diet)1

|  |  |
| --- | --- |
| Ingredients | Dietary Trp levels (g kg-1) |
| 2.6 | 3.1 | 3.7 | 4.2 | 4.7 | 5.6 |
| Essential amino acid |
| Arginine | 23.8 | 24.0 | 23.9 | 23.6 | 23.7 | 24.2 |
| Histidine | 6.1 | 6.5 | 6.3 | 5.9 | 6.2 | 6.3 |
| Isoleucine | 9.9 | 9.5 | 10.2 | 9.7 | 9.6 | 9.8 |
| Leucine | 19.1 | 19.5 | 19.3 | 18.9 | 19.4 | 19.2 |
| Lysine | 25.7 | 26.1 | 25.9 | 25.4 | 26.3 | 26.4 |
| Methionine | 8.5 | 8.9 | 8.7 | 8.8 | 8.4 | 8.7 |
| Phenylalanine | 9.7 | 9.3 | 9.6 | 9.8 | 9.4 | 9.9 |
| Threonine | 14.0 | 13.7 | 14.5 | 13.9 | 14.1 | 14.5 |
| Valine | 12.1 | 12.4 | 11.8 | 12.7 | 12.3 | 12.2 |
| Tryptophan | 2.6 | 3.1 | 3.7 | 4.2 | 4.7 | 5.6 |
| Non-essential amino acid |
| Aspartic acid | 44.5 | 44.9 | 43.8 | 44.1 | 44.7 | 44.3 |
| Serine | 3.7 | 3.3 | 3.5 | 3.1 | 3.4 | 3.9 |
| Glycine | 5.6 | 5.2 | 4.8 | 4.5 | 4.1 | 3.4 |
| Alanine | 23.4 | 23.7 | 23.1 | 23.9 | 23.5 | 23.6 |
| Cystine | 3.2 | 2.8 | 3.4 | 2.7 | 3.5 | 3.0 |
| Tyrosine | 7.5 | 7.9 | 7.3 | 6.9 | 7.2 | 7.8 |
| Glutamic acid | 62.7 | 61.9 | 62.9 | 62.5 | 62.3 | 62.7 |
| Proline | 24.5 | 23.8 | 24.1 | 24.6 | 23.9 | 24.9 |

1 Values are means from duplicate samples of experimental diets. Amino acids contents were determined using high-performance liquid chromatography (Agilent Technologies, PaloAlto, CA). The samples were lyophilized overnight and then hydrolyzed for 24 h in 6 N HCl at 110 °C for total amino acid contents analysis. Trp content analysis was performed by hydrolyzed for 20 h in 5 N NaOH at 110 °C.

**Table S3.** Primer sequences, optimal annealing temperatures (OAT), and amplification products of genes selected for analysis by real-time PCR.

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Sequence (5′-3′) | OAT (°C) | GenBank ID |
| IGF1-QF | CAGCCAAGTCTGGTGGTAAAGC | 56.8 | KX434878 |
| IGF1-QR | CTACATCCGATAGTTCCTCCCC |  |  |
| IGF2-QF | GTGGAGGAATGCTGTTTTCGGAG | 61.4 | JN378897 |
| IGF2-QR | AACTTTCTGGAGCGGAGGATGG |  |  |
| IGF1R-QF | CCTCAATCCAAGCAAGCCTAT | 56.6 | MG773202 |
| IGF1R-QR | TCCCCAATCTATCACTGTTCC |  |  |
| PIK3Ca-QF | GTGGACCATCAACAGCAACCT | 62.6 | MG773208 |
| PIK3Ca-QR | GGACAGACAAAGACGAGCAGC |  |  |
| AKT1-QF | ACACGACCGCTTGTGCTTC | 61.7 | KX131157.1 |
| AKT1-QR | TCCGTCCGTTATGCCCTCT |  |  |
| TOR-QF | TCCCTTGCCCAGACCTACA | 58.2 | MG773199 |
| TOR-QR | CATTATCGTCCCTCAGCGG |  |  |
| 4EBP1-QF | ACGCCACCCAGTTGCCTA | 62.6 | MG773207 |
| 4EBP1-QR | GGATGCTTTTGCTGCCGAC |  |  |
| S6K1-QF | GCAAACTGAATCTCCCACCC | 61.7 | MG773195 |
| S6K1-QR | AGGCTTGAAAGGCGGCTC |  |  |
| myf5-QF | CTCCAGTCCTTCATCATCCACC | 64.9 | MK253547 |
| myf5-QR | CACTCGCACTCTGACCTTCGT |  |  |
| MyoD1-QF | CCTAATCAGAGGCTTCCCA | 55.5 | HM363525 |
| MyoD1-QR | TCACCGCTGTATTGTTCCA |  |  |
| MyoG-QF | TACTTTTTCCCCGAACAGC | 57.6 | HQ246723 |
| MyoG-QR | TCCAGTCCTACATTGCCAGA |  |  |
| MRF4-QF | CAGACTGTCAGAGGACGGGG | 52.8 | MK281342 |
| MRF4-QR | CAGCCTTCTCTTTGGTGGGA |  |  |
| PCNA-QF | GTTGATGGACTTGGATGTGGA | 60.1 | MK281343 |
| PCNA-QR | CGTTGCTGGTTTGGGAGA |  |  |
| MyHC-QF | GCAATGAAGGAGAACTATG | 60.0 | MK440319 |
| MyHC -QR | TCACACTTTCCTCAGCGT |  |  |
| MSTN-QF | ACGCCACTACCGAGACCG | 64.6 | DQ767967 |
| MSTN-QR | CTCAATACCCCAGTTTGTTTCC |  |  |
| CuZnSOD-QF | ATCTGGGTAATGTGACTGCCGA | 60.4 | KX455916 |
| CuZnSOD-QR | TTCATCATCTCCGCCCTTGC |  |  |
| CAT-QF | ACACCGATGAGGGAAACTGG | 58 | KX455919 |
| CAT-QR | GTGGATGAAGGACGGGAACA |  |  |
| GST-QF | TCTACCCTTTACACCTGCTGAC | 62.6 | (33) |
| GST-QR | GATGGCTGGGATTGCTTTC |  |  |
| GPx1a-QF | GTGAATGGGAAAGACGCTC | 61.7 | MG773203 |
| GPx1a-QR | GCACACAGGACTCCAGATGA |  |  |
| GCLC-QF | GACAAACGGAGGAAGGAGG | 58.2 | KX455918 |
| GCLC-QR | TCATCAGGAAAGAAGAGGGACT |  |  |
| Nrf2-QF | CGGAACAAGATGGAGAAGCC | 64.0 | KX455917 |
| Nrf2-QR | ACAGGGAGGAATGGAGGGA |  |  |
| Keap1-QF | GCATCCTCTTCACCTGTCT | 61.7 | MG773201 |
| Keap1-QR | CGTGTAGGCGAACTCTATC |  |  |
| β-actin-QF | CCTAAAGCCAACAGGGAAAA | 59.0 | EU161066 |
| β-actin-QR | ATGGGGCAGAGCATAACC |  |  |
| 18S-QF | CCTGAGAAACGGCTACCACATCC | 57.1 | KP938527 |
| 18S-QR | AGCAACTTTAATATACGCTATTGGAG |  |  |

**Table S4.** Correlation coefficient of some parameters.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent parameters | Dependent parameters | Correlation coefficients | *P* |
| d≤ 20 μm frequencyd> 50 μm frequencyProtein contentIGF-I mRNAIGF-II mRNA | IGF-I mRNA | 0.790 | 0.062 |
| IGF-II mRNA | 0.970 | 0.001 |
| IGF-IR mRNA | 0.922 | 0.009 |
| PCNA mRNA | 0.920 | 0.009 |
| myf5 mRNA | 0.600 | 0.208 |
| MyoD1 mRNA | 0.714 | 0.111 |
| IGF-I mRNA | 0.748 | 0.087 |
| IGF-II mRNA | 0.863 | 0.027 |
| IGF-IR mRNA | 0.902 | 0.014 |
| MyoG mRNA | 0.867 | 0.025 |
| MRF4 mRNA | 0.787 | 0.063 |
| MyHC mRNA | 0.591 | 0.217 |
| IGF-I mRNA | 0.960 | 0.002 |
| IGF-II mRNA | 0.605 | 0.204 |
| IGF-IR mRNA | 0.771 | 0.072 |
| PIK3Ca mRNA | 0.669 | 0.146 |
| AKT1 mRNA | 0.434 | 0.390 |
| TOR mRNA | 0.881 | 0.020 |
| S6K1 mRNA | 0.840 | 0.031 |
| 4EBP1 mRNA | -0.795 | 0.059 |
| IGF-IR mRNA | 0.829 | 0.042 |
| MSTN mRNA | -0.277 | 0.595 |
| PCNA mRNA | 0.872 | 0.023 |
| myf5 mRNA | 0.600 | 0.208 |
| MyoD1 mRNA | 0.714 | 0.111 |
| MyoG mRNA | 0.588 | 0.219 |
| MRF4 mRNA | 0.500 | 0.312 |
| IGF-IR mRNA | 0.946 | 0.004 |
| MSTN mRNA | 0.337 | 0.514 |
| PCNA mRNA | 0.925 | 0.008 |
| myf5 mRNA | 0.395 | 0.438 |
| IGF-IR mRNAAHR activity | MyoD1 mRNA | 0.604 | 0.204 |
| MyoG mRNA | 0.588 | 0.219 |
| MRF4 mRNA | 0.543 | 0.266 |
| PCNA mRNA | 0.823 | 0.044 |
| myf5 mRNA | 0.601 | 0.207 |
| MyoD1 mRNA | 0.707 | 0.116 |
| MyoG mRNA | 0.886 | 0.019 |
| MRF4 mRNA | 0.689 | 0.130 |
| MyHC mRNA | 0.793 | 0.060 |
| MSTN mRNA | 0.224 | 0.670 |
| PIK3Ca mRNA | 0.943 | 0.005 |
| AKT1 mRNA | 0.706 | 0.117 |
| TOR mRNA | 0.849 | 0.032 |
| S6K1 mRNA | 0.827 | 0.042 |
| 4EBP1 mRNA | -0.686 | 0.132 |
| CAT activity | 0.708 | 0.115 |
| GST activity | 0.551 | 0.257 |
|  | GR activity | 0.885 | 0.019 |
|  | GSH content | 0.886 | 0.019 |
| ASA activity | CAT activity | 0.863 | 0.027 |
|  | GST activity | 0.870 | 0.024 |
|  | GR activity | 0.732 | 0.098 |
|  | GPx activity | 0.659 | 0.155 |
|  | GSH content | 0.839 | 0.037 |
| CAT activity | CAT mRNA | 0.761 | 0.079 |
| GST activity | GST mRNA | 0.366 | 0.476 |
| GPx activity | GPx mRNA | 0.879 | 0.021 |
| GSH content | GST activity | 0.767 | 0.075 |
|  | GR activity | 0.677 | 0.140 |
|  | GPx activity | 0.323 | 0.533 |
|  | MyoD1 mRNA | 0.886 | 0.019 |
|  | MyoG mRNA | 0.943 | 0.005 |
| Nrf2 mRNA | CuZnSOD mRNA | 0.829 | 0.042 |
|  | CAT mRNA | 0.704 | 0.118 |
|  | GPx mRNA | 0.728 | 0.101 |
|  | GST mRNA | 0.771 | 0.072 |
|  | GSH content | 0.848 | 0.033 |
|  | MyoD1 mRNA | 0.886 | 0.019 |
|  | MyoG mRNA | 0.714 | 0.111 |
|  | TOR mRNA | 0.593 | 0.214 |
|  | S6K1 mRNA | 0.936 | 0.006 |
| Keap1 mRNA | CuZnSOD mRNA | -0.543 | 0.266 |
|  | CAT mRNA | -0.429 | 0.397 |
|  | GST mRNA | -0.785 | 0.064 |