**Table S1** Composition and nutrient content of basal diet, g/kg.

|  |  |  |  |
| --- | --- | --- | --- |
| Ingredients |  | Nutrients contente |  |
| Fish meal | 170.0 | Crude protein | 387.8 |
| Casein | 10.0 | Crude lipid | 71.0 |
| Gelatin | 10.0 | Crude ash | 145.2 |
| Corn starch | 168.3 | ω-3 | 15.2 |
| α-starch | 30.0 | ω-6 | 13.9 |
| Fish oil | 26.0 | Available phosphorus | 14.8 |
| Soybean oil | 210.0 |  |  |
| Monocalcium phosphate | 40.0 |  |  |
| Vitamin premix a | 10.0 |  |  |
| Ile premix b | 120.0 |  |  |
| Mineral element premix c | 20.0 |  |  |
| Crystal amino acid premix d | 170.0 |  |  |
| Choline chloride (50%) | 10.0 |  |  |
| Ethoxy quinoline (30%) | 0.5 |  |  |
| Cellulose | 5.0 |  |  |
| Xanthophy II | 0.2 |  |  |
| Total | 1000.0 |  |  |

a The premix provides vitamin for a kilogram of diet: D, L-α-tocopherol acetate (500 g/kg), 53.600 g; menadione (230 g/kg), 0.217 g; retinyl acetate (50,0000 IU/g), 8.063 g; cholecalciferol (50,0000 IU/g), 0.100 g; thiamin nitrate (900 g/kg), 0.111 g; riboflavine (800 g/kg), 1.125 g; pyridoxine hydrochloride (810 g/kg), 0.370 g; cyanocobalamin (10 g/kg), 0.100 g; niacin (990 g/kg), 3.143 g; folic acid (960 g/kg), 0.521 g; meso-inositol (990 g/kg), 52.323 g; D-biotin(20 g/kg), 5.0 g; calcium-D-pantothenate (900 g/kg), 1.667 g; ascorhyl acetate (930 g/kg), 86.022 g. All ingredients were diluted with corn starch to 1 kg.

b The premix provides Ile, glycine, and corn starch for a kilogram of diet 1 to 7: L-Ile 0.000, 20.833, 41.667, 62.500, 83.333, 104.167, 125.000 g; glycine 89.777, 74.814, 59.851, 44.888, 29.926, 14.963, 0.000 g; corn starch 910.223, 904.353, 898.482, 892.612, 886.741, 880.871, 875.000 g, respectively.

c The premix provides mineral for a kilogram of diet: FeSO4·7H2O (300 g/kg Fe), 13.333 g; CuSO4·5H2O (250 g/kg Cu), 1.300 g; ZnSO4·7H2O (345 g/kg Zn), 13.043 g; MnSO4·H2O (318 g/kg Mn), 4.717 g; KI (38 g/kg I), 1.447 g; NaSeO3 (10 g/kg Se), 1.000 g. All ingredients were diluted with CaCO3 to 1 kg.

d The premix provides crystal amino acid for a kilogram of diet: lysine (780 g/kg), 125.204 g; methionine (990 g/kg), 60.071 g; tryptophan (980 g/kg), 11.723 g; arginine (997 g/kg), 116.491 g; histidine (997 g/kg), 27.508 g; threonine (980 g/kg), 163.764 g; leucine (985 g/kg), 20.824 g; phenylalanine (996 g/kg), 17.364 g; valine (992 g/kg), 11.302 g; cystine (999 g/kg), 11.432 g. All ingredients were diluted with corn starch to 1 kg.

e Crude protein, crude fat, crude ash, and Ile contents were measured. Available phosphorus, ω-3 and ω-6 contents calculated according to NRC (2011).

**Table S2**The primers and annealing temperature (AT) used for real-time quantitative PCR.

|  |  |  |  |
| --- | --- | --- | --- |
| Gene name | Primer sequences (5′-3′) | AT (°C) | Genebank ID |
| *CuZnSOD*-QF | TCACTTCAACCCCCACAACA | 63.3 | KX455916.1 |
| *CuZnSOD*-QR | CGGCAGTCACATTACCCAGAT |  |  |
| *CAT*-QF | ACACCGATGAGGGAAACTGG | 58.0 | KX455919 |
| *CAT*-QR | GTGGATGAAGGACGGGAACA |  |  |
| *GPX1a*-QF | GTGAATGGGAAAGACGCTC | 61.7 | MG773203 |
| *GPX1a*-QR | GCACACAGGACTCCAGATGA |  |  |
| *GST*-QF | CGGATGGGAAATGGAACG | 58.0 | XM\_027154055.1 |
| *GST*-QR | GGATAATGCTCCTGACTCAACC |  |  |
| *GCLC*-QF | GACAAACGGAGGAAGGAGG | 58.2 | KX455918 |
| *GCLC*-QR | TCATCAGGAAAGAAGAGGGACT |  |  |
| *Keap1*-QF | GCATCCTCTTCACCTGTCT | 61.7 | MG773201 |
| *Keap1*-QR | CGTGTAGGCGAACTCTATC |  |  |
| *Nrf2*-QF | CGGAACAAGATGGAGAAGCC | 64.0 | KX455917 |
| *Nrf2*-QR | ACAGGGAGGAATGGAGGGA |  |  |
| *IGF1*-QF | ATCTGGGTAATGTGACTGCCGA | 56.8 | KX434878 |
| *IGF1*-QR | TTCATCATCTCCGCCCTTGC |  |  |
| *IGF2*-QF | GTGGAGGAATGCTGTTTTCGGAG | 61.4 | JN378897 |
| *IGF2*-QR | AACTTTCTGGAGCGGAGGATGG |  |  |
| *IGF1R*-QF | ACACCGATGAGGGAAACTGG | 56.6 | MG773202 |
| *IGF1R*-QR | GTGGATGAAGGACGGGAACA |  |  |
| *PCNA*-QF | GTTGATGGACTTGGATGTGGA | 60.1 | MK281343 |
| *PCNA*-QR | CGTTGCTGGTTTGGGAGA |  |  |
| *Myf5*-QF | CTCCAGTCCTTCATCATCCACC | 64.9 | MK253547 |
| *Myf5*-QR | CACTCGCACTCTGACCTTCGT |  |  |
| *Myod*-QF | CCTAATCAGAGGCTTCCCA | 55.5 | HM363525 |
| *Myod*-QR | TCACCGCTGTATTGTTCCA |  |  |
| *Myog*-QF | TACTTTTTCCCCGAACAGC | 57.6 | HQ246723 |
| *Myog*-QR | TCCAGTCCTACATTGCCAGA |  |  |
| *Mrf4*-QF | CAGACTGTCAGAGGACGGGG | 52.8 | MK281342 |
| *Mrf4*-QR | CAGCCTTCTCTTTGGTGGGA |  |  |
| *MyHC*-QF | GCAATGAAGGAGAACTATG | 60.0 | MK440319 |
| *MyHC*-QR | TCACACTTTCCTCAGCGT |  |  |
| *MSTN*-QF | ACGCCACTACCGAGACCG | 64.6 | DQ767967 |
| *MSTN*-QR | CTCAATACCCCAGTTTGTTTCC |  |  |
| *PI3K*-QF | GTGAATGGGAAAGACGCT | 62.6 | MG773208 |
| *PI3K*-QR | GCACACAGGACTCCAGATGA |  |  |
| *AKT*-QF | ACACGACCGCTTGTGCTTC | 61.7 | KX131157.1 |
| *AKT*-QR | TCCGTCCGTTATGCCCTCT |  |  |
| *TOR*-QF | GACAAACGGAGGAAGGAGG | 58.2 | MG773199 |
| *TOR*-QR | TCATCAGGAAAGAAGAGGGACT |  |  |
| *S6K1*-QF | GCAAACTGAATCTCCCACCC | 61.7 | MG773195 |
| *S6K1*-QR | AGGCTTGAAAGGCGGCTC |  |  |
| *4E-BP1*-QF | ACGCCACCCAGTTGCCTA | 62.6 | MG773207 |
| *4E-BP1*-QR | GGATGCTTTTGCTGCCGAC |  |  |
| *FOXO3a*-QF | GACTTCCGCTCTCGCACTAA | 60.5 | MK562423 |
| *FOXO3a*-QR | ATCATCAGCAACCTCATCCACT |  |  |
| *MAFBX*-QF | AACCTCTGTCACTACCACTTCACT | 54.8 | MK812970 |
| *MAFBX*-QR | GGTCGCTGTACTGCTCTTTATG |  |  |
| *MURF-1*-QF | CCGTTTTGAGGTGGTGCT | 53.6 | MK756118 |
| *MURF-1*-QR | TGTTCTCCAGTTGTTGCTTGTA |  |  |
| *18S*-QF | CCTGAGAAACGGCTACCACATCC | 57.1 | KP938527 |
| *18S*-QR | AGCAACTTTAATATACGCTATTGGAG |  |  |
| *β-actin*-QF | CCTAAAGCCAACAGGGAAAA | 59.0 | EU161066 |
| *β-actin*-QR | ATGGGGCAGAGCATAACC |  |  |

**Fig. S1** The final body weight (a), feed intake (b), percent weight gain (c), specific growth rate (d), protein efficiency ratio (e), and feed efficiency (f) of hybrid bagrid catfish fed diets with graded levels of Ile for 8 weeks. Data represent means ± SEM, of three replicates. Values having different letters are significantly different (*P* < 0.05).

**f**

**e**

