**Table S1.** Proximation composition of α-cassava starch (CS) and de-branched starch (DS).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   | Amylose (%) | Amylopectin (%) | Digestible starch (%) | Resistant starch (%) |
| CS | 21·70 | 77·73 | 94·04 | 3·56 |
| DS | 28·21 | 65·46 | 78·86 | 14·22 |

**Table S2.** Formulation and chemical composition of experimental diets (% dry matter).

|  |  |
| --- | --- |
| Ingredients | Starch sources |
| α-cassava starch | De-branched starch |
| Diet | CS4 | CS8 | CS12 | DS4 | DS8 | DS12 |
| White fish meal\* | 42·00 | 42·00 | 42·00 | 42·00 | 42·00 | 42·00 |
| Wheat gluten meal\* | 3·00 | 3·00 | 3·00 | 3·00 | 3·00 | 3·00 |
| Blood meal\* | 4·00 | 4·00 | 4·00 | 4·00 | 4·00 | 4·00 |
| Shrimp meal\* | 5·00 | 5·00 | 5·00 | 5·00 | 5·00 | 5·00 |
| Fermented soybean meal\* | 9·00 | 9·00 | 9·00 | 9·00 | 9·00 | 9·00 |
| Corn gluten meal\* | 11·00 | 11·00 | 11·00 | 11·00 | 11·00 | 11·00 |
| Squid viscera meal\* | 2·00 | 2·00 | 2·00 | 2·00 | 2·00 | 2·00 |
| Brewer’s yeast meal\* | 2·00 | 2·00 | 2·00 | 2·00 | 2·00 | 2·00 |
| Soybean phospholipid | 2·50 | 2·50 | 2·50 | 2·50 | 2·50 | 2·50 |
| Chromic oxide | 0·50 | 0·50 | 0·50 | 0·50 | 0·50 | 0·50 |
| Vitamin mixture† | 1·00 | 1·00 | 1·00 | 1·00 | 1·00 | 1·00 |
| Mineral mixture‡ | 1·00 | 1·00 | 1·00 | 1·00 | 1·00 | 1·00 |
| Ca(H2PO3)2  | 1·00 | 1·00 | 1·00 | 1·00 | 1·00 | 1·00 |
| Soybean oil | 4·00 | 4·00 | 4·00 | 4·00 | 4·00 | 4·00 |
| α-cassava starch | 4·00 | 8·00 | 12·00 | - | - | - |
| De-branched starch | - | - | - | 4·00 | 8·00 | 12·00 |
| Zeolite powder | 8·00 | 4·00 | - | 8·00 | 4·00 | - |
| Proximate analysis (%, on a dry weight basis) |  |  |  |  |
| Crude protein | 51·63 | 51·16 | 51·38 | 51·64 | 51·70 | 51·70 |
| Crude lipid | 11·38 | 11·47 | 11·54 | 11·55 | 11·39 | 11·27 |
| Ash | 18·09 | 15·12 | 9·76 | 18·15 | 14·98 | 9·65 |
| Crude fiber | 0·72 | 0·74 | 0·75 | 0·73 | 0·75 | 0·76 |
| Amylose | 1·38 | 2·31 | 3·37 | 1·59 | 2·86 | 4·01 |
| Amylopectin | 5·01 | 8·32 | 11·73 | 4·97 | 7·75 | 10·83 |
| Digestible starch | 6·08 | 9·96 | 14·32 | 5·68 | 9·26 | 13·56 |
| Resistant starch | 0·45 | 0·97 | 1·35 | 1·21 | 1·59 | 2·05 |
| Nitrogen free extract | 10·78 | 14·46 | 18·37 | 10·69 | 14·58 | 18·45 |
| Gross energy (MJ/kg) | 17·75 | 18·40 | 19·06 | 17·63 | 18·31 | 19·01 |

\*Supplied by Nonghao Feed Corporation (Shanghai, China): white fish meal, crude protein, 72·59%, crude lipid, 9·50%; wheat gluten meal, crude protein, 83·52%, crude lipid, 1.21%; blood meal, crude protein, 78·90%, crude lipid, 2.13%; shrimp meal, crude protein, 69·62%, crude lipid, 8·06%; fermented soybean meal, crude protein, 56·27%, crude lipid, 0·56%; corn gluten meal, crude protein, 68·34%, crude lipid, 8·21%; squid viscera meal, crude protein, 50·03%, crude lipid, 37·08%; brewer’s yeast meal, crude protein, 48·02%, crude lipid, 0·52%;

†Vitamin Premix (IU or mg/kg diet): vitamin A, 16000 IU; vitamin D3, 8000 IU; vitamin K3, 14·72; vitamin B1, 17·80; vitamin B2, 48; vitamin B6, 29·52; vitamin B12, 0·24; vitamin E, 160; vitamin C, 800; niacinamide, 79·20; calcium-pantothenate, 73·60; folic acid, 6·40; biotin, 0·64; inositol, 320; choline chloride, 1500; L-carnitine, 100.

‡Mineral Premix (mg/kg diet): Cu (CuSO4), 2·00; Zn (ZnSO4), 34·40; Mn (MnSO4), 6·20; Fe (FeSO4), 21·10; I (Ca (IO3)2), 1·63; Se (Na2SeO3), 0·18; Co (COCl2), 0·24; Mg (MgSO4·H2O), 52·70.

**Table S3.** Primers used in the present study.

|  |  |  |  |
| --- | --- | --- | --- |
| Gene | Forward sequence (5’-3’) | Reverse sequence (5’-3’) | Accession numbers |
| *IR* | CATTTTGAGGGAACTGGGTC | CTTGATGATGTCTTTAGCGA | MT431533 |
| *IRS1* | TAGTGGTGGTGTCAGCGGT | GGAGGTGGAAGTAAAGGAT | MT431531 |
| *PI3KR1* | AAGACCTTCCTCATCACGAC | CCTTCCACTACAACACTGCA | MT431530 |
| *AKT1* | CTTAATTTACCGCCGAAAC | CCTCCTTGACAATCACCAC | MG993041 |
| *GK* | GGGTTTTACCTTCTCCTTTC | GGTGGCTACTGTGTCATTCA | MT431528 |
| *PFKL* | CTGGCTGAGCTCGTAAAG | GTGCCGCAGAAGTCGTTG | MT431527 |
| *PK* | CTCTTTCATCCGCAAAGC | AATTCCCAGGTCACCACG | MT431526 |
| *PEPCK* | GGAAACGGCCAACATTCT | GCCAACCAGCAGTTCTCAT | MT431525 |
| *FBP1* | GCGATTGGCGAATTTATC | ACTCTGTGACGGCGGGTT | MT431524 |
| *G6PC* | AGAAAGCACAGAAGTGGTG | CTTGGTCTCGGTGTAGAGG | MT431523 |
| *β-actin* | AAAGGGAAATCGTGCGTGAC | AAGGAAGGCTGGAAGAGGG | XM020651307 |

*IR*, insulin receptor; *IRS1*, insulin receptor substrate 1; *PI3KR1*, phosphatidylinositol-3-kinase p85 alpha; *AKT1*, serine/threonine kinase 1; *GK*, glucokinase; *PFKL*,phosphofructokinase liver type; *PK*, pyruvate kinase; *G6PC*, glucose-6-phosphatase catalytic subunit; *FPB1*, fructose-1,6-bisphosphatase-1; *PEPCK*, phosphoenolpyruvate carboxykinase.