**Supplementary materials**

**Table S1** Ingredients and nutrient composition of the diets(20).

|  |  |
| --- | --- |
| Item | Dietary energy concentration, MJ/kg DM |
| 8.21 | 9.33 | 10.45 | 11.57 |
| Ingredient, g/kg dry matter (DM) |
| Corn | 92.2 | 127.5 | 160.0 | 208.5 |
| Corn starch | 23.5 | 70.0 | 124.0 | 161.5 |
| Sucrose | 5.5 | 16.5 | 22.0 | 30.0 |
| Molasses | 5.5 | 16.5 | 21.5 | 30.0 |
| Wheat bran | 25.0 | 14.6 | 12.8 | 8.0 |
| Soybean meal | 12.0 | 16.5 | 15.4 | 13.2 |
| Cotton seed meal | 15.6 | 13.6 | 13.4 | 12.5 |
| Soybean oil | 0.60 | 4.20 | 10.0 | 15.0 |
| Calcium hydrophosphate | 6.3 | 6.6 | 6.0 | 5.3 |
| Calcium carbonate | 1.8 | 2.0 | 2.9 | 4.0 |
| Sodium chloride | 6.0 | 6.0 | 6.0 | 6.0 |
| Commercial premix2 | 6.0 | 6.0 | 6.0 | 6.0 |
| Highland barley straw | 800 | 700 | 600 | 500 |
| Chemical composition3, g/kg DM |
| DE, MJ/kg | 8.21 | 9.33 | 10.45 | 11.57 |
| CP | 69.7 | 69.6 | 69.1 | 70.2 |
| NDF | 684 | 602 | 520 | 444 |
| ADF | 370 | 325 | 281 | 238 |
| Ca | 5.21 | 5.13 | 5.20 | 4.92 |
| P | 2.71 | 2.71 | 2.62 | 2.54 |

1 Digestible energy on a dry matter basis(20).

2 The premix provided the following per kg of diets: VA 1700 IU; VD 190 IU; VE 18 IU; Co 0.30mg; Cu 17 mg; I 1.5mg; Fe 70 mg; Mn 38 mg; Se 0.28 mg; Zn 40 mg.

3 DE was calculated according to the Feeding Standard of Meat-producing Sheep and Goats of China, NY/T 816-2004 (Ministry of Agriculture, MOA, PRC, 2004). Others were the measured values. DM, dry matter; DE, digestible energy; CP, crude protein; NDF, neutral detergent fibre; ADF, acid detergent fibre.

**Table S2**. Sequences of oligonucleotide primers used for real-time quantitative reverse transcription PCR (Real-Time qRT-PCR)

|  |  |  |  |
| --- | --- | --- | --- |
| Target gene1 | Gene bank ID | Primer sequences2（5'→3'） | *Tm*3(ºC) |
| AgRP | AY596306 | F: GCTGAAGAGGATAACGGAGGAAR: CAGTAGCAGAAGGCGTTGAAGA | 58 |
| AMPKα2 | EU131097 | F: ATGATGAGGTGGTGGAGCAGAGGR: CCAGGCGAGGTGAGACAGAGG | 58 |
| CART | XM\_015101190 | F: TGGAACCTGGCTTTAGCAACR: TACTCTGCACATGCCGACAC | 60 |
| GIPR | S79852 | F: GAGCAGCAGGACACAGAGCTA R: AGGAGGGGTGTGGTGTGAA | 58 |
| GLP-1R | XM\_015102582.1 | F: TCTATGAGGACGAGGGCTGTTGR: GACCCGGACAAAGATGAGGAA | 58 |
| InsR | AY157728 | F: CGTGGCCTGTCGCAACTTCTACR: GGACGCACTTGTTGTTGTGAATGAC | 60 |
| LEPR | NM\_001009763 | F: CTTGTGTAATTCTTTCCTGGATGCTR: TTATCTTCGGTTTCCCTACTCCTTC | 58 |
| MC3R | XM\_012108878 | F: CGAAAGAAATAGGATGGGGATG R: GAAAGATGCCCTGTGTTGAATG | 58 |
| MC4R | NM\_001126370 | F: CGGGGTCTTTGTTGTCTGCT R: GCACACGCAGTAGGGGTTCT | 60 |
| NPY | NM\_001009452 | F: GCGACACTACATCAATCTCATCACR: TTTCCCGTGCTTTCTCTCATC | 60 |
| NPYIR | XM\_012179388 | F: TGGTGAGGCAATGTGCAAG R: GAGAAGAAGCCACAGCAAGGA | 60 |
| NPY5R | XM\_012179381.1 | F: GAGGAAGCGAAATCAGAAGACTACAR: TGAAAGGTGAGCAAAACAGCA | 58 |
| POMC | NM\_001009266 | F: GCTGCTGGTCTTGCTGCTTR: AGGTTACTTTCCGTGGTGAGGT | 60 |
| *β*-actin | U39357.1 | F: AGCCTTCCTTCCTGGGCATGGAR: GGACAGCACCGTGTTGGCGTAGA | 58 |

1 AgRP, agouti-related peptide; AMPKα2, adenosine monophosphate-activated protein kinase-alpha 2; CART, cocaine and amphetamine-regulated transcript; GIPR; glucose-dependent insulinotropic polypeptide receptor; GLP-1R; glucagon-like peptide-1 receptor; InsR: insulin receptor; LEPR, leptin receptor; MC3R, melanocortin 3 receptor; MC4R, melanocortin 4 receptor; NPY, neuropeptide Y; NPY1R, neuropeptideY Y1 receptor; NPY5R, neuropeptide Y Y5 receptor; POMC, proopiomelanocortin.

2 F, forward; R, reverse.

3 *Tm*, optimal PCR annealing temperature.

**Table S3** The body weight (BW) change of Tibetan (T) and Small-tailed Han (H) sheep offered different energy level diets during the 42 d experiment period.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Items | Breed | Dietary energy level, MJ/kg DM | SEM | *P*-value |
| 8.21 | 9.33 | 10.45 | 11.57 | Breed | Diet | Breed × Diet |
| Initial BW (Kg) | T | 48.2 | 48.7 | 48.5 | 48.8 | 0.890 | 0.296 | 0.924 | 0.950 |
|  | H | 49.3 | 49.5 | 48.7 | 49.3 |
| Final BW (Kg) | T | 47.8 | 49.9 | 50.3 | 51.3 | 0.853 | 0.009 | < 0.001 | 0.934 |
|  | H | 45.5 | 48.2 | 48.9 | 50.1 |
| BW change (Kg) | T | -0.377a | 1.17a | 1.75a | 2.50a | 0.300 | < 0.001 | < 0.001 | 0.0124 |
|  | H | -3.83b | -1.38b | 0.177b | 0.75b |

a,b Mean values within a column with unlike superscript letters were significantly different (*P* < 0·05).