**TABLE 1** Chemical composition and granule size distribution of ground corn, ground cassava and pineapple stem starch

|  |  |  |  |
| --- | --- | --- | --- |
| Item | Starch source | | |
| Ground corn | Ground cassava | Pineapple  stem starch |
| Dry matter, % | 88.6 | 90.6 | 95.1 |
| Crude protein, % DM | 8.1 | 1.8 | 1.4 |
| Ether extract, % DM | 4.37 | 0.49 | 0.06 |
| NDF, % DM | 18.3 | 10.6 | 8.3 |
| ADF, % DM | 3.7 | 6.0 | 4.1 |
| AIA, % DM | 0.01 | 0.10 | 0.08 |
| Crude ash, % DM | 1.5 | 2.9 | 1.4 |
| Starch, % DM | 72.5 | 66.6 | 86.7 |
| Granule size distribution, µm | 5 - 43 | 5 - 34 | 2 - 20 |

NDF = neutral detergent fiber; ADF = acid detergent fiber; AIA = acid-insoluble ash.

**TABLE 2** Ingredients and nutrient composition of concentrates and roughage (% DM)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Item (% DM) | | Concentrate | | | Roughage | | |
| GC | CS | PS | Napier grass silage | Rice straw | |
| **Ingredient** | | | | |  |  | |
| Ground corn | | 40.24 | — | — |  |  | |
| Ground cassava | | — | 40.28 | — |  |  | |
| Pineapple stem starch | | — | — | 40.23 |  |  | |
| Soybean meal | | 6.75 | 6.62 | 6.99 |  |  | |
| Rice bran | | — | 13.38 | 13.35 |  |  | |
| Defatted rice bran | | 16.25 | 2.81 | 2.81 |  |  | |
| Defatted palm kernel meal | | 26.06 | 25.55 | 25.50 |  |  | |
| Molasses | | 7.83 | 7.68 | 7.66 |  |  | |
| Urea | | 0.16 | 1.04 | 1.20 |  |  | |
| |  | | --- | | Vitamin and mineral mixture\* | | | 0.53 | 0.52 | 0.52 |  |  | |
| Sulfur | | 0.11 | 0.10 | 0.10 |  |  | |
| Salt | | 0.32 | 0.31 | 0.31 |  |  | |
| Dicalcium phosphate | | 1.24 | 1.21 | 1.21 |  |  | |
| Sodium bicarbonate | | 0.52 | 0.51 | 0.50 |  |  | |
| **Nutrient composition** | | | | |  |  | |
| Dry matter (%) | 87.06 | | 87.46 | 87.74 | 20.42 | 91.30 |
| Crude protein | 16.79 | | 16.34 | 16.28 | 6.32 | 5.90 |
| Ether extract | 3.13 | | 3.25 | 3.17 | 1.71 | — |
| Ash | 6.91 | | 8.68 | 6.60 | 11.37 | — |
| NDF | 40.81 | | 38.45 | 37.74 | 73.20 | 74.00 |
| ADF | 31.07 | | 27.99 | 27.54 | 55.03 | 44.50 |
| Calcium | 0.84 | | 0.90 | 0.63 | 0.27 | — |
| Phosphorus | 0.80 | | 0.63 | 0.63 | 0.24 | — |
| Total carbohydrates | 73.17 | | 71.73 | 73.95 | — | — |
| Starch | 37.54 | | 38.63 | 38.70 |  |  |

\*Agromix beef No. 46: vitamin A = 2,160,000 IU, vitamin B3 = 100,000 IU, vitamin E = 5,000 IU, Mn = 8.5 g, Zn = 6.4 g, Cu = 1.6 g, Mg = 16 g, Co = 320 mg, I = 800 mg, Se = 32 mg (Agromix beef No.46: A.I.O. Co. LTD, Nakhon Pathom, Thailand)

GC = ground corn; CA = ground cassava; PS = pineapple stem.

Total carbohydrates = 100 – (% crude protein + % ether extract + % crude ash) (Sniffen *et al*. 1992)

**TABLE 3** Effect of starch source on growth performance and feed intake of fattening cattle

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter |  | Treatment  t |  | SEM | *P*-value |
| GC | CA | PS |
| Initial body weight, kg | 455.6 | 454.2 | 453.3 | 8.32 | 0.99 |
| Final body weight, kg | 623.0 | 630.3 | 641.1 | 8.67 | 0.74 |
| Weight gain, kg | 161.5b | 169.9ab | 182.5a | 2.60 | <0.01 |
| ADG, kg/day | 0.78b | 0.82ab | 0.89a | 0.01 | <0.01 |
| DMI, kg/day | 10.6 | 10.6 | 10.2 | 0.13 | 0.53 |
| Concentrate, kg/day | 8.1 | 8.0 | 7.6 | 0.14 | 0.42 |
| Roughage, kg/day | 2.5 | 2.6 | 2.6 | 0.04 | 0.63 |
| FCR, kg gain/kg intake | 13.1a | 12.4ab | 11.3b | 0.30 | 0.04 |

a,bMeans (n=12) with different superscripts within a row are significantly different (*P* < 0.05)

GC = ground corn; CA = ground cassava; PS = pineapple stem starch; FCR = feed conversion ratio.

**TABLE 4** Effect of starch source of concentrate on blood cholesterol, triglycerides, HDL, LDL and VLDL (mg/dL) of fattening cattle (at 4h post feeding).

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | Treatment | | | | | |  | |  |
| Parameter | | GC | | CA | | PS | | SEM | | *P*-value |
| Cholesterol, mg/dL | |  | |  | |  | |  | |  |
| 74th day | | 108.7 | | 100.0 | | 110.8 | | 7.34 | | 0.40 |
| 147th day | | 102.7 | | 127.7 | | 111.8 | | 5.19 | | 0.08 |
| 206th day | | 89.2 | | 111.0 | | 97.2 | | 4.90 | | 0.10 |
| Triglyceride, mg/dL | |  | |  | |  | |  | |  |
| 74th day | | 26.5 | | 29.7 | | 31.7 | | 1.61 | | 0.42 |
| 147th day | | 21.0 | | 24.8 | | 22.7 | | 1.21 | | 0.45 |
| 206th day | | 21.1 | | 26.0 | | 26.0 | | 1.07 | | 0.12 |
| HDL, mg/dL | |  | |  | |  | |  | |  |
| 74th day | 52.4 | | 63.5 | | 64.6 | | 2.20 | | 0.06 | |
| 147th day | 67.7 | | 79.0 | | 74.5 | | 2.73 | | 0.24 | |
| 206th day | 59.7 | | 69.7 | | 69.0 | | 2.77 | | 0.27 | |
| LDL, mg/dL |  | |  | |  | |  | |  | |
| 74th day | 9.0b | | 14.3a | | 12.0ab | | 0.85 | | 0.02 | |
| 147th day | 10.8b | | 17.3a | | 11.7b | | 1.01 | | <0.01 | |
| 206th day | 9.8b | | 14.5a | | 9.0b | | 0.80 | | <0.01 | |
| VLDL, mg/dL | |  | |  | |  | |  | |  |
| 74th day | | 5.3 | | 6.0 | | 6.3 | | 0.34 | | 0.51 |
| 147th day | | 4.3 | | 4.7 | | 4.7 | | 0.23 | | 0.81 |
| 206th day | | 4.6 | | 5.2 | | 5.3 | | 0.23 | | 0.46 |

a,bMeans (n=12) with different superscripts within a row are significantly different (*P* < 0.05)

GC = ground corn; CA = ground cassava; PS = pineapple stem starch.

HDL = high density lipoprotein; VLDL = very low density lipoprotein; LDL = low density lipoprotein

**TABLE 5** Effect of starch source of concentrate on rumen fermentation profile of fattening cattle (at 4h post feeding).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | | Treatment | | | |  |  |
| Ruminal parameter | | GC | | CA | PS | SEM | *P*-value |
| pH |  | | |  |  |  |  |
| 74th day | 6.42 | | | 6.36 | 6.26 | 0.07 | 0.67 |
| 147th day | 6.26 | | | 6.10 | 6.21 | 0.07 | 0.62 |
| 206th day | 6.54 | | | 6.58 | 6.61 | 0.06 | 0.89 |
| Total SCFA, mmol/L | |  | |  |  |  |  |
| 74th day | | 82.8b | | 87.0b | 112.6a | 4.82 | <0.01 |
| 147th day | | 82.9b | | 87.4b | 103.1a | 2.91 | <0.01 |
| 206th day | | 81.4b | | 82.5b | 97.9a | 2.41 | <0.01 |
| Acetate, molar % | | |  |  |  |  |  |
| 74th day | | | 64.6 | 64.0 | 65.2 | 0.65 | 0.79 |
| 147th day | | | 66.7 | 65.5 | 66.6 | 0.55 | 0.50 |
| 206th day | | | 65.3 | 65.0 | 64.2 | 0.80 | 0.85 |
| Propionate, molar % | | |  |  |  |  |  |
| 74th day | | | 17.0 | 18.0 | 17.3 | 0.42 | 0.64 |
| 147th day | | | 16.2 | 17.7 | 16.1 | 0.38 | 0.32 |
| 206th day | | | 17.1 | 17.7 | 17.2 | 0.49 | 0.92 |
| Butyrate, molar % | | |  |  |  |  |  |
| 74th day | | | 18.4 | 18.0 | 17.6 | 0.64 | 0.85 |
| 147th day | | | 17.1 | 16.0 | 16.8 | 0.52 | 0.68 |
| 206th day | | | 17.6 | 17.3 | 18.7 | 0.46 | 0.51 |
| NH3-N, mg/dl |  | | |  |  |  |  |
| 74th day | 10.8 | | | 9.7 | 11.8 | 0.57 | 0.39 |
| 147th day | 16.5 | | | 12.2 | 13.4 | 1.10 | 0.35 |
| 206th day | 21.6 | | | 18.2 | 20.7 | 1.16 | 0.50 |
| Lactate, mmol/L |  | | |  |  |  |  |
| 74th day | 2.4 | | | 2.3 | 2.5 | 0.12 | 0.99 |
| 147th day | 2.0 | | | 2.2 | 1.9 | 0.21 | 0.78 |
| 206th day | 1.6 | | | 1.7 | 1.7 | 0.09 | 0.96 |

a,bMeans (n=12) with different superscripts within a row are significantly different (*P* < 0.05)

GC = ground corn; CA = ground cassava; PS = pineapple stem starch.