**Towards a methodology to formulate sustainable diets for livestock: accounting for environmental impact in diet formulation – Supplementary material**

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**Supplement S1 – Co Product Allocation**

**Table S1** Allocation factors used for multioutput processes in the feed supply chain

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Multioutput system | By products | Mass yield (%) | Price Ratio † | Allocation (%) |
| **Soybean Oil extraction**(1) | Soybean meal | 77.3 | 1 | 43.7 |
|  | Soybean Oil | 22.7 | 2.64 | 56.3 |
| **Canola Oil extraction**(1) | Canola Meal | 57.3 | 1 | 32.8 |
|  | Canola Oil | 42.6 | 2.76 | 67.2 |
| **Bioethanol production from corn**(2) | Ethanol |  |  | 97.6 |
|  | Corn DDGS |  |  | 2.4 |
| **Wheat Flour mill**(3) | Flour | 73 | 1†† | 89.8 |
|  | Wheat Shorts | 12.5 | 0.22 | 3.4 |
|  | Wheat Bran | 12 | 0.44 | 6.5 |
|  | Wheat Germ | 2.0 | 0.11 | 0.27 |
| **Industrial Bakery ‡** | Bread | 92 | 10 | 99 |
|  | Bakery waste | 8 | 1 | 1 |
| **Fat Rendering**(4) | Fat | 57.7 | 1.22 | 62.6 |
|  | Meat Meal | 42.3 | 1 | 37.4 |

† Price data average Canadian (not regionalised) prices for 2013 provided by Trouw Nutrition based on Statistics Canada price data (5)

‡ Expert advice from Sugarich (specialist producers of animal feed using bakery waste products, 2015

†† Flour price was estimated using the principle that sales of flour provide around 90% of the gross margin for typical wheat flour milling operations (6).

**Supplement S2 – Regional price ratios used for diet formulation**

**Table S2** price ratios used for diet formulation, all prices scaled to the price of wheat which = 1 per tonne. Average ingredient prices and availability in Ontario and Manitoba for 2015 were provided by Trouw Nutrition (derived from Statistics Canada data (7)).

|  |  |  |
| --- | --- | --- |
| Ingredient | Price Ratio – Eastern Canada | Price Ratio – Western Canada |
| Barley | 0.79 | 1.01 |
| Bakery meal | 1.00 | NA |
| Canola meal | 1.46 | 1.56 |
| Corn | 0.75 | NA |
| Corn DDGS | 0.98 | 1.21 |
| Field Peas | N/A | 1.17 |
| Meat (pork) meal | 2.46 | 2.88 |
| Soya meal | 1.93 | 2.43 |
| Wheat | 1.00 | 1.19 |
| Wheat Bran | 1.46 | 1.90 |
| Wheat shorts | 0.73 | 0.89 |
| Animal-vegetable fat blend | 3.25 | 3.43 |
| Canola oil | 13.9 | NA |
| Soy Oil | 4.22 | 4.42 |
| HCL-Lysine | 8.17 | 10.5 |
| L-Threonine | 17.7 | 25.7 |
| FU-Methionine | 18.0 | 30.2 |
| L-Tryptophan | 89.3 | 121 |
| Sodium Chloride | 0.31 | 0.72 |
| Dicalcium Phosphate | 2.71 | 3.39 |
| Limestone | 0.44 | 0.64 |

**Supplement S3 – Ingredient inclusion limits**

**Table S3** The maximum inclusion limits (g/kg as fed) of the ingredients for each feeding phase when formulating grower/finisher diets in this study. These limits were based on guidance for pig farmers provided by OMAFRA (8) as well as peer reviewed studies in the case of some important co-products (5).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Ingredient | Starter | Grower | Finisher | Late finisher |
| Barley | 800 | 800 | 800 | 800 |
| Bakery meal | 50 | 100 | 100 | 100 |
| Canola meal | 100 | 100 | 100 | 100 |
| Corn | 800 | 800 | 800 | 800 |
| Corn DDGS | 150 | 200 | 200 | 200 |
| Field Peas | 100 | 100 | 100 | 100 |
| Meat (pork) meal | 50 | 50 | 50 | 50 |
| Soya meal | 250 | 250 | 250 | 250 |
| Wheat | 700 | 700 | 700 | 700 |
| Wheat Bran | 50 | 50 | 50 | 50 |
| Wheat shorts | 200 | 300 | 300 | 200 |
| Animal-vegetable fat blend1 | 50 | 50 | 50 | 50 |
| Canola oil1 | 20 | 20 | 20 | 20 |
| Soy Oil1 | 20 | 20 | 20 | 20 |
| HCL-Lysine | 10 | 10 | 10 | 10 |
| L-Threonine | 10 | 10 | 10 | 10 |
| FU-Methionine | 10 | 10 | 10 | 10 |
| L-Tryptophan | 10 | 10 | 10 | 10 |
| Sodium Chloride | 10 | 10 | 10 | 10 |
| Dicalcium Phosphate | 50 | 50 | 50 | 50 |
| Limestone | 50 | 50 | 50 | 50 |

1 Total fat supplementation was restricted to 50 g/kg as fed in all diets

**References (Supplementary Material)**

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