Contents lists available at ScienceDirect

Meat Science

journal homepage: www.elsevier.com/locate/meatsci

Effects of feeding high protein or conventional canola meal on dry cured and conventionally cured bacon



K.L. Little, B.M. Bohrer, H.H. Stein, D.D. Boler *

Department of Animal Sciences, University of Illinois, Urbana, IL 61801, United States

ARTICLE INFO

$A \hspace{0.1in} B \hspace{0.1in} S \hspace{0.1in} T \hspace{0.1in} R \hspace{0.1in} A \hspace{0.1in} C \hspace{0.1in} T$

Article history: Received 1 September 2014 Received in revised form 10 November 2014 Accepted 19 December 2014 Available online 24 December 2014

Keywords: Bacon Canola High protein canola meal Bilateral symmetry Pig Sensory Objectives were to compare belly, bacon processing, bacon slice, and sensory characteristics from pigs fed high protein canola meal (CM-HP) or conventional canola meal (CM-CV). Soybean meal was replaced with 0 (control), 33, 66, or 100% of both types of canola meal. Left side bellies from 70 carcasses were randomly assigned to conventional or dry cure treatment and matching right side bellies were assigned the opposite treatment. Secondary objectives were to test the existence of bilateral symmetry on fresh belly characteristics and fatty acid profiles of right and left side bellies originating from the same carcass. Bellies from pigs fed CM-HP were slightly lighter and thinner than bellies from pigs fed CM-CV, yet bacon processing, bacon slice, and sensory characteristics were unaffected by dietary treatment and did not differ from the control. Furthermore, testing the existence of bilateral symmetry on fresh belly characteristics of the carcasses were slightly ($P \le 0.05$) wider, thicker, heavier and firmer than bellies from the left side of the carcass.

© 2015 Elsevier Ltd. All rights reserved.

1. Introduction

Canola meal is an alternative to soybean meal (SBM) as a protein supplement for pigs (Baidoo, Aherne, Mitaru, & Blair, 1987; Bell, 1975; Maison, 2013). Conventional canola meal (CM-CV) has less crude protein (35-40%) than SBM (48.5%) and about 3 times as much fiber, limiting the availability of essential amino acids and lowering the digestible energy in pig diets (Thacker, 1992). A new hybridized variety of high protein canola meal (CM-HP) contains less fiber and is thought to have a greater concentration of digestible energy than CM-CV. Antinutritional factors including sinapine, tannins, and phytic acid can affect feed intake, digestibility of protein, and absorption of minerals, respectively, in pigs fed canola meal (Bell, 1993). Sinapine acts as a substrate for trimethylamine production, which caused a "fishy" taint in eggs produced by laying hens fed canola meal (Griffiths, Fenwick, Pearson, Greenwood, & Butler, 1980; Mawson, Heaney, Zdunczyk, & Kozlowska, 1994; Pearson, Butler, & Fenwick, 1980). Previous research reported no effects on sensory characteristics of fresh pork loins from pigs fed CM-CV (Dransfield, Nute, Mottram, Rowan, & Lawrence, 1985). Results of studies feeding pigs other ingredients high in polyunsaturated fatty acids (PUFA) indicated that pigs fed diets with high concentrations of PUFA had soft bellies, which present challenges in bacon processing (Leick et al., 2010; Person et al., 2005). To our knowledge, no research has been reported on the effects of canola meal on processed pork quality characteristics, particularly fresh belly quality, bacon processing, and bacon sensory characteristics. Therefore, primary objectives were to compare fresh belly, bacon processing, bacon slice, and bacon sensory characteristics from pigs fed high protein canola meal (CM-HP) or conventional canola meal (CM-CV).

Bilateral symmetry describes the assumption that data collected on one side of the carcass is equally representative of the other side of the carcass (Breidenstein, Kauffman, Laplant, & Norton, 1964). Breidenstein et al. (1964) reported the difference between left and right sides of a carcass was approximately 8%, and these differences were attributed to experimental error. Historically, bellies originating from the same carcass were assumed to be symmetrical in composition (Schroder & Rust, 1974). New techniques are currently being used to analyze fresh belly quality (Seman, Barron, & Matzinger, 2013); less is known about bilateral symmetry when using these techniques. Therefore, secondary objectives were to test the existence of bilateral symmetry (effect of carcass side) on fresh belly characteristics and fatty acid profiles of right and left side bellies originating from the same carcass.

2. Materials and methods

Experimental procedures for the live phase portion of the experiment were reviewed and approved by the Institutional Animal Care and Use Committee at the University of Illinois.



^{*} Corresponding author. Tel.: + 1 217 300 4847. *E-mail address*: dboler2@illinois.edu (D.D. Boler).

2.1. Experimental design

One hundred forty bellies from 70 pork carcasses were obtained from the University of Illinois Meat Science Laboratory and sourced from a previous experiment (Little et al., 2014). A complete description of slaughter and fabrication procedures was provided in greater detail by Little et al. (2014). Briefly, a 3-phase feeding program (Tables 1, 2, and 3) was used with grower diets fed from d 0 to d 35, early finisher diets from d 35 to d 63, and late finisher diets from d 63 to d 91 of the growing-finishing period. There were 7 treatments within each phase consisting of a corn-SBM diet with no canola meal (control), 3 diets containing different levels of CM-HP (*Brassica napus* containing 45% CP), and 3 diets containing different levels of CM-CV (40% CP). Canola meal replaced 33, 66, or 100% of SBM with both sources of CM. All diets were formulated to meet current estimates for nutrient requirements for growing and finishing pigs (NRC, 2012).

Full details of diet composition were described in Little et al. (2014). There was greater crude protein in control diets (17.11%) compared with 33% CM-HP (15.15%), 66% CM-HP (15.72%), 100% CM-HP (16.13%), 33% CM-CV (15.74%), 66% CM-CV (15.65%), and 100% CM-CV

Table 1

Ingredient composition of experimental diets, phase 1 (d 0–35), as-fed basis.

$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Item	Diet						
0% 33% 66% 100% 33% 66% 100% Ingredients, X Com 6,8,33 67,93 67,48 66,96 66,08 63,72 1,13 Canola macl, normal, 48% CP 27,00 18,00 9,00 - 1,18,00 9,00 - 2,00 0,00		Control ^a	CM-HP ^a			CM-CV ^a		
Improducts X.Series<		0%	33%	66%	100%	33%	66%	100%
Corn63.367.9367.4866.9666.0863.7263.726.13Conds med, light potein <td>Ingredients, %</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	Ingredients, %							
Canola meal, finigh protein	Corn	68.33	67.93	67.48	66.96	66.08	63.72	61.33
Canda mad, conventional1.16823.3525.00Phytase premix ⁶ 27.0018.000.020.010.010.010.010.010.010.010.010.010.010.010.010.00 </td <td>Canola meal, high protein</td> <td>-</td> <td>9.57</td> <td>19.15</td> <td>28.72</td> <td>-</td> <td>-</td> <td>-</td>	Canola meal, high protein	-	9.57	19.15	28.72	-	-	-
Soyben meal, 43; CP7.70018.009.00-18.009.00-0.020.030.330.340.010.000.	Canola meal, conventional	-	-	-	-	11.68	23.35	35.00
Physics premix"0.020.010.010.010.010.010.010.010.010.010.010.010.000.0	Soybean meal, 48% CP	27.00	18.00	9.00	-	18.00	9.00	-
Soybean oil2,003,00 <td>Phytase premix^b</td> <td>0.02</td> <td>0.02</td> <td>0.02</td> <td>0.02</td> <td>0.02</td> <td>0.02</td> <td>0.02</td>	Phytase premix ^b	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Linescobe1.211.301.381.301.130.920.600Dickloim phosphate0.520.210.250.15t-Lysine HCI0.180.210.250.220.220.220.210.15t-Threonine0.020.020.020.020.020.010.010.010.01Sait0.400.400.400.400.400.400.400.400.400.30	Soybean oil	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Dicaliton phosphate0.520.250.151-lysine HC10.180.210.280.280.230.280.340.280.340.400.02Threonine0.020.020.020.010.010.010.010.010.010.00100.00<	Limestone	1.21	1.30	1.38	1.30	1.13	0.92	0.60
i-lysin P(C)0.180.210.250.280.230.240.030.34i-Methionine0020.020.020.020.020.020.040.400.510.400.400.510.4	Dicalcium phosphate	0.52	0.25	-	-	0.15	-	-
n.M.chinnine0.020.020.020.020.010.010.010.01Sait0.400.400.400.400.400.400.400.400.40Sait0.300.31 </td <td>L-Lysine HCl</td> <td>0.18</td> <td>0.21</td> <td>0.25</td> <td>0.28</td> <td>0.23</td> <td>0.28</td> <td>0.34</td>	L-Lysine HCl	0.18	0.21	0.25	0.28	0.23	0.28	0.34
i-Theomine0.020.020.020.020.010.010.01Salt0.300.300.300.300.300.300.300.30Total10.000100.00100.00100.00100.00100.00100.00000.00Andycet composition,88.9888.7889.3388.5287.6689.6489.34CP19.1020.5718.5918.6019.7420.1619.75ADF4.444.706.387.245.257.018.27NDF6.729.1410.5012.530.600.400.52Ca0.760.740.950.600.400.5115.71.121.31Chernessible A1.151.071.721.321.451.521.151.611.531.541.531.541.551.5	DL-Methionine	0.02	-	-	-	-	-	-
Sait0.400	L-Threonine	0.02	0.02	0.02	0.02	0.01	0.01	0.01
Vitamin-mineral premix*0.300.300.300.300.300.300.300.300.300.30Total100.00 <td< td=""><td>Salt</td><td>0.40</td><td>0.40</td><td>0.40</td><td>0.40</td><td>0.40</td><td>0.40</td><td>0.40</td></td<>	Salt	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Total100.00100.00100.00100.00100.00100.00Analyeet composition,DM8.8788.93.38.85.28.66.49.96.49.34CP19.1020.5718.5918.6819.7420.1619.75ADF4.444.706.387.245.257.018.27Ca0.760.700.740.950.600.400.68P0.760.700.740.450.410.501.53Infspensable AA1.171.131.000.450.410.430.51Itsipensable AJ0.800.770.700.660.780.780.71Itsipensable AJ0.930.450.450.430.450.450.450.45Itsipensable AJ0.660.780.780.780.711.501.531.551.551.551.551.551.551.551.551.551.551.551.551.551.551.561.661.680.780.711.501.631.651.55	Vitamin-mineral premix ^c	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Analyzed composition,DM88.9888.7889.3388.5287.6689.6489.34CP19.1020.5718.5918.6819.7420.1619.75ADF4.444.706.387.245.257.018.27NDF8.729.1410.501.2310.4512.2713.12Ca0.760.700.740.950.600.400.68P0.430.440.440.450.410.430.52Indisensable AArg1.171.131.000.951.151.121.03His0.490.490.450.450.490.510.49Ile0.800.770.700.660.780.780.71Lu1.741.641.531.501.631.671.55Lys1.061.080.950.981.121.08Met0.300.320.310.330.320.330.35Thr0.220.730.670.680.710.750.73Tha0.220.330.360.910.961.090.95Val0.890.900.850.910.961.090.95Thr0.811.631.341.151.221.750.23Val0.290.330.360.390.320.330.34Chen0.220.330.360.99	Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
AnalysianDM88.9888.7889.3388.5287.6689.6489.34CP19.1020.5718.5918.6819.7420.1619.75ADF44.444.706.387.245.231.0451.2.271.31.2Ca8.729.1410.501.2.331.0451.2.271.31.2Ca0.430.440.440.450.600.400.68P0.430.440.440.450.410.330.52Indigensable AA1.171.131.000.951.151.121.04His0.490.490.450.450.490.510.490.41Ile0.800.770.700.660.780.771.551.9	An alward annualities							
DM 88.58 88.78 83.73 88.52 67.08 85.04 83.74 83.74 87.00 83.74 87.00 83.74 87.00 83.74 87.00 87.74 97.74 97.95 0.60 0.40 0.68 P 0.43 0.70 0.74 0.95 0.61 0.43 0.52 Indispensable AA 1.77 1.13 1.00 0.95 1.15 1.12 1.03 His 0.49 0.49 0.45 0.49 0.49 0.45 0.49 0.49 0.41 0.49 Ile 0.48 0.49 0.45 0.49 0.51 0.43 0.75 1.55 1.55 1.55 1.55 1.55 1.55 1.55	Analyzea composition,	00.00	00.70	00.22	00.50	97.00	90 C 4	00.24
Cr 19.10 20.37 18.39 18.08 19.74 20.10 18.73 ADF 444 470 63.88 7.24 5.25 7.01 8.72 NDF 8.72 9.14 10.50 1.253 10.45 12.27 13.12 Ca 0.76 0.70 0.74 0.95 0.41 0.43 0.52 Indispensable AA 1.17 1.13 1.00 0.95 1.15 1.12 1.03 His 0.49 0.49 0.45 0.49 0.51 0.57 1.57 1.57 1.	DM	88.98	88.78	89.33	88.52	87.00	89.64	89.34
ADr 4.44 4.70 6.38 7.24 5.25 7.01 8.27 NDF 8.72 9.14 10.50 1.253 10.45 1.27 13.12 Ca 0.76 0.70 0.74 0.95 0.60 0.40 0.68 P 0.43 0.44 0.44 0.45 0.41 0.43 0.52 Indispensable AA		19.10	20.57	18.59	18.08	19.74	20.16	19.75
NDr 8.72 9.14 10.30 12.33 10.45 12.27 13.12 Ca 0.76 0.774 0.955 0.60 0.40 0.68 P 0.43 0.44 0.44 0.45 0.41 0.43 0.52 Indigensable AA .	ADF	4.44	4.70	0.38	7.24	5.25	7.01	8.27
Ca 0.76 0.70 0.74 0.95 0.60 0.40 0.88 P 0.43 0.44 0.44 0.45 0.41 0.43 0.52 Indispensable AA	NDF	8.72	9.14	10.50	12.53	10.45	12.27	13.12
P 0.43 0.44 0.43 0.43 0.43 0.52 Indispensable AA	Ca	0.76	0.70	0.74	0.95	0.60	0.40	0.68
Arg1.171.131.000.951.151.121.03His0.490.490.450.450.490.510.71Leu0.800.770.700.660.780.780.71Leu1.741.641.531.501.631.671.55Lys0.660.780.320.310.330.320.330.35Pher0.300.320.310.330.320.330.35Pher0.720.730.670.680.710.750.73Thr0.720.730.620.880.910.950.95Total8.328.167.457.358.198.257.851.631.341.151.641.491.24A140.900.850.869.190.950.950.85Dispensible A41.631.341.151.641.491.24A151.641.491.631.341.151.641.491.24Cys0.290.330.360.390.320.380.360.860.86Cys0.770.870.760.790.860.860.860.860.860.86Cys0.770.870.760.790.860.860.860.860.860.86Cys0.770.870.760.79<	P	0.43	0.44	0.44	0.45	0.41	0.43	0.52
Arg1.171.131.000.951.151.121.03His0.490.490.450.490.490.510.49Ile0.800.770.700.660.780.780.71Leu1.741.641.531.501.631.671.55Lys1.061.080.950.981.121.051.08Met0.300.320.310.320.320.350.57Phe0.930.870.770.730.870.860.76Thr0.720.730.670.680.710.750.73Val0.220.230.220.210.230.23Val0.890.900.850.860.910.950.92Total8.328.167.457.558.198.257.85Dispensible AI1.511.541.641.491.24Cys0.290.330.360.390.320.380.43Glu1.811.631.341.151.641.491.24Cys0.970.800.770.730.800.860.86Glu0.770.800.760.790.800.860.86Glu0.770.800.760.790.800.860.86Pro1.161.181.551.221.551.271.27Ser0.830.780.	Indispensable AA							
His0.490.490.490.450.450.490.510.49lle0.800.770.700.660.780.780.71Leu1.741.641.531.501.631.671.55Lys1.061.080.950.981.121.051.08Met0.300.320.310.330.320.330.35Phe0.930.870.770.730.870.750.73Trp0.220.230.220.210.210.230.22Val0.890.900.850.660.910.950.92Total8.328.167.457.358.198.257.85Dispensable AA11.631.341.511.641.491.24Cys0.290.330.360.390.320.380.43Glu1.641.631.341.541.641.491.24Cys0.290.330.360.390.320.380.43Glu3.423.883.053.333.413.26Fro1.661.181.151.221.151.251.27Ser0.830.780.770.730.530.500.530.500.530.50Total9.879.598.798.649.559.699.222.14AlA1.611.181.521.59 <t< td=""><td>Arg</td><td>1.17</td><td>1.13</td><td>1.00</td><td>0.95</td><td>1.15</td><td>1.12</td><td>1.03</td></t<>	Arg	1.17	1.13	1.00	0.95	1.15	1.12	1.03
Ile 0.80 0.77 0.70 0.66 0.78 0.78 0.71 Leu 1.74 1.64 1.53 1.50 1.63 1.67 1.55 Lys 1.06 1.08 0.95 0.98 1.12 1.05 1.08 Met 0.30 0.32 0.31 0.33 0.32 0.33 0.35 Phe 0.30 0.87 0.77 0.73 0.87 0.86 0.71 0.73 0.73 0.77 0.73 0.87 0.73 0.23 0.23 0.21 0.21 0.23 0.23 0.21 0.21 0.23 0.23 0.23 0.23 0.21 0.21 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.24 1.24 0.24 0.24 0.24 0.24 0.24 0.24 0.24 0.25 0.25 0.25	His	0.49	0.49	0.45	0.45	0.49	0.51	0.49
Leu1.741.641.531.501.631.671.55Lys1.061.080.950.981.121.051.08Met0.300.320.310.320.330.35Phe0.930.870.770.730.870.860.76Thr0.720.730.670.680.710.750.73Tp0.220.230.220.210.210.230.23Total8.328.167.457.358.198.257.85Dispensable AAAsp1.611.631.941.941.24Cys0.230.330.360.310.950.33Glu1.811.631.941.950.320.330.36Glu3.423.383.083.053.333.413.26Glu3.423.380.760.790.800.860.86Pro1.161.181.151.221.151.251.27Ser0.830.770.800.760.780.770.530.50Pro1.661.811.151.221.151.251.27Ser0.830.780.770.660.780.790.530.50Total9.879.598.798.649.559.699.22All AA1.751.62415.991.741.941.54C	Ile	0.80	0.77	0.70	0.66	0.78	0.78	0.71
Lys1.061.080.950.981.121.051.08Met0.300.320.310.330.320.330.35Phe0.930.870.730.770.730.870.860.76Thr0.720.730.670.680.710.750.73Trp0.220.230.220.210.210.230.23Val8.328.617.457.358.198.257.85Dispensable AAAla1.000.960.910.961.000.95Asp1.811.631.341.151.641.491.24Cys0.320.330.360.390.320.380.43Glu0.420.380.360.390.320.380.43Cys0.340.360.390.320.380.43Cys0.770.800.760.790.800.860.86Glu0.770.800.760.790.800.860.86Pro1.161.181.151.221.151.251.27Tyr0.590.530.490.470.570.530.50Total0.870.798.649.559.699.22All AA1.591.541.591.541.541.541.54Tyr0.590.530.490.570.530.500.53 <td>Leu</td> <td>1.74</td> <td>1.64</td> <td>1.53</td> <td>1.50</td> <td>1.63</td> <td>1.67</td> <td>1.55</td>	Leu	1.74	1.64	1.53	1.50	1.63	1.67	1.55
Met 0.30 0.32 0.31 0.33 0.32 0.33 0.35 Phe 0.93 0.87 0.77 0.73 0.87 0.86 0.75 Thr 0.72 0.73 0.62 0.71 0.23 0.23 0.23 Trp 0.22 0.23 0.22 0.21 0.21 0.23 0.23 Val 0.89 0.90 0.85 0.86 0.91 0.95 0.92 Total 8.32 8.16 7.45 7.5 8.19 8.25 7.85 Dispensable AA 1.00 0.96 0.91 0.96 1.00 0.91 Asp 1.81 1.63 1.34 1.55 1.64 1.49 1.42 Cys 0.29 0.33 0.36 0.39 0.32 0.38 0.43 Glu 3.42 3.88 3.08 3.05 3.33 3.41 3.26 Gly 0.77 0.80 0.76 0.79 </td <td>Lys</td> <td>1.06</td> <td>1.08</td> <td>0.95</td> <td>0.98</td> <td>1.12</td> <td>1.05</td> <td>1.08</td>	Lys	1.06	1.08	0.95	0.98	1.12	1.05	1.08
Phe0.930.870.770.730.870.860.76Thr0.720.730.670.680.710.750.73Trp0.220.230.220.210.210.230.22Val0.890.900.850.860.910.950.85Total8.328.167.457.358.198.257.85Dispensable AAAla1.000.960.910.961.000.95Asp1.811.631.341.151.641.491.24Cys0.290.330.360.390.320.380.43Glu3.423.883.083.053.333.413.26Pro1.161.181.151.221.151.251.27Ser0.830.780.700.660.780.770.50Pro1.631.441.491.241.241.24Cly0.770.800.760.790.800.860.76Pro0.830.780.760.790.800.500.50Pro1.161.181.151.221.151.251.27Ser0.830.780.790.660.780.770.50All AA1.8191.751.6241.5991.741.941.70Production1.8191.751.6241.5991.741.94	Met	0.30	0.32	0.31	0.33	0.32	0.33	0.35
Thr 0.72 0.73 0.67 0.68 0.71 0.75 0.73 Trp 0.22 0.23 0.22 0.21 0.21 0.23 0.23 Val 0.89 0.90 0.85 0.86 0.91 0.95 0.92 Total 8.2 8.16 7.45 7.35 8.19 8.25 7.85 Dispensable AA 1 1.00 0.96 0.91 0.96 1.00 0.95 Asp 1.81 1.63 1.34 1.15 1.64 1.49 1.24 Cys 0.29 0.33 0.36 0.39 0.32 0.38 0.43 Glu 3.42 3.83 3.05 3.33 3.41 3.26 Gly 0.77 0.80 0.76 0.79 0.80 0.86 Pro 1.16 1.18 1.15 1.22 1.15 1.25 1.27 Ser 0.83 0.78 0.49 0.47 0.57 0.53 0.99 9.22 All AA 1.819 1.75 16.24	Phe	0.93	0.87	0.77	0.73	0.87	0.86	0.76
Trp0.220.230.220.210.210.230.23Val0.890.900.850.860.910.950.92Total8.328.167.457.358.198.257.85Dispensable AAAla1.000.960.910.910.961.000.95Asp1.811.631.341.151.641.491.24Cys0.290.330.360.320.380.43Glu3.423.383.083.053.333.413.26Gly0.770.800.760.790.800.860.86Pro1.161.181.151.221.151.251.27Ser0.830.780.700.660.780.710.51Tyr0.590.530.490.470.570.530.51Total9.879.598.798.649.559.699.22All AA18.1917.7516.2415.9917.7417.9417.07Calculated compositionNE, kcal/kg249624712444241424252502574Glucosinolates, µmol/g-0.981.952.932.234.666.69	Thr	0.72	0.73	0.67	0.68	0.71	0.75	0.73
Val0.890.900.850.860.910.950.92Total8.328.167.457.358.198.257.85Dispensable AAAla1.000.960.910.910.961.000.95Asp1.811.631.341.151.641.491.24Cys0.290.330.360.390.320.380.43Glu3.423.883.083.053.333.413.26Gly0.770.800.760.790.800.860.86Pro1.161.181.151.221.151.251.27Ser0.830.780.700.660.780.700.50Total9.879.598.798.649.559.699.22All AA18.1917.7516.2415.9917.7417.9417.07Calculate compositionNE, kcal/kg249624712444241424252350274Glucosinolates, µmol/g-0.981.952.932.234.466.69	Trp	0.22	0.23	0.22	0.21	0.21	0.23	0.23
Total 8.32 8.16 7.45 7.35 8.19 8.25 7.85 Dispensable AA Ala 1.00 0.96 0.91 0.91 0.96 1.00 0.95 Asp 1.81 1.63 1.34 1.15 1.64 1.49 1.24 Cys 0.29 0.33 0.36 0.39 0.32 0.38 0.43 Glu 3.42 3.38 3.08 3.05 3.33 3.41 3.26 Gly 0.77 0.80 0.76 0.79 0.80 0.86 0.86 Pro 1.16 1.18 1.15 1.22 1.15 1.25 1.27 Ser 0.83 0.78 0.70 0.66 0.78 0.77 0.71 Tyr 0.59 0.53 0.49 0.47 0.57 0.53 0.50 Total 9.87 9.59 8.79 8.64 9.55 9.69 9.22 All AA 18.19	Val	0.89	0.90	0.85	0.86	0.91	0.95	0.92
Dispensable AA1.000.960.910.961.000.95Asp1.811.631.341.151.641.491.24Cys0.290.330.360.390.320.380.43Glu3.423.383.083.053.333.413.26Gly0.770.800.760.790.800.860.86Pro1.161.181.151.221.151.251.27Ser0.830.780.700.660.780.770.71Tyr0.590.530.490.470.570.530.50Total9.879.598.798.649.559.699.22All AA18.1917.7516.2415.9917.7417.9417.07Calculated compositionNE, kcal/kg2496247124442414242523502274Glucosinolates, µmol/g-0.981.952.932.234.466.69	Total	8.32	8.16	7.45	7.35	8.19	8.25	7.85
Ala1.000.960.910.910.961.000.95Asp1.811.631.341.151.641.491.24Cys0.290.330.360.390.320.380.43Glu3.423.383.083.053.333.413.26Gly0.770.800.760.790.800.860.86Pro1.161.181.151.221.151.251.27Ser0.830.780.700.660.780.770.71Tyr0.590.530.490.470.570.530.50Total9.879.598.798.649.559.699.22All AA18.1917.7516.2415.9917.7417.9417.07Calculated compositionNE, kcal/kg2496247124442414242523502274Glucosinolates, µmol/g-0.981.952.932.234.466.69	Dispensable AA							
Asp1.811.631.341.151.641.491.24Cys0.290.330.360.390.320.380.43Glu3.423.383.083.053.333.413.26Gly0.770.800.760.790.800.860.86Pro1.161.181.151.221.151.27Ser0.830.780.700.660.780.770.71Tyr0.590.530.490.470.570.530.50Total9.879.598.798.649.559.699.22All AA18.1917.7516.2415.9917.7417.9417.07Calculated compositionNE, kcal/kg2496247124442414242523502274Glucosinolates, µmol/g-0.981.952.932.234.466.69	Ala	1.00	0.96	0.91	0.91	0.96	1.00	0.95
Cys0.290.330.360.390.320.380.43Glu3.423.383.083.053.333.413.26Gly0.770.800.760.790.800.860.86Pro1.161.181.151.221.151.251.27Ser0.830.780.700.660.780.770.71Tyr0.590.530.490.470.570.530.50Total9.879.598.798.649.559.699.22All AA18.1917.7516.2415.9917.7417.9417.07Calculated compositionNE, kcal/kg2496247124442414242523502274Glucosinolates, µmol/g-0.981.952.932.234.466.69	Asp	1.81	1.63	1.34	1.15	1.64	1.49	1.24
Clu3.423.383.083.053.333.413.26Cly0.770.800.760.790.800.860.86Pro1.161.181.151.221.151.251.27Ser0.830.780.700.660.780.770.71Tyr0.590.530.490.470.570.530.50Total9.879.598.798.649.559.699.22All AA18.1917.7516.2415.9917.7417.9417.07Calculated compositionNE, kcal/kg2496247124442414242523502274Glucosinolates, µmol/g-0.981.952.932.234.466.69	Cvs	0.29	0.33	0.36	0.39	0.32	0.38	0.43
Gly 0.77 0.80 0.76 0.79 0.80 0.86 0.86 Pro 1.16 1.18 1.15 1.22 1.15 1.25 1.27 Ser 0.83 0.78 0.70 0.66 0.78 0.77 0.71 Tyr 0.59 0.53 0.49 0.47 0.57 0.53 0.50 Total 9.87 9.59 8.79 8.64 9.55 9.69 9.22 All AA 18.19 17.75 16.24 15.99 17.74 17.94 17.07 Calculated composition 17.97 2450 2350 2274 NE, kcal/kg 2496 2471 2444 2414 2425 2350 2274 Glucosinolates, µmol/g - 0.98 1.95 2.93 2.23 4.46 6.69	Glu	3.42	3.38	3.08	3.05	3.33	3.41	3.26
Pro1.161.181.151.221.151.251.27Ser0.830.780.700.660.780.770.71Tyr0.590.530.490.470.570.530.50Total9.879.598.798.649.559.699.22All AA18.1917.7516.2415.9917.7417.9417.07Calculated compositionNE, kcal/kg2496247124442414242523502274Glucosinolates, µmol/g-0.981.952.932.234.466.69	Gly	0.77	0.80	0.76	0.79	0.80	0.86	0.86
Ser 0.83 0.78 0.70 0.66 0.78 0.77 0.71 Tyr 0.59 0.53 0.49 0.47 0.57 0.53 0.50 Total 9.87 9.59 8.79 8.64 9.55 9.69 9.22 All AA 18.19 17.75 16.24 15.99 17.74 17.94 17.07 Calculated composition NE, kcal/kg 2496 2471 2444 2414 2425 2350 2274 Glucosinolates, µmol/g - 0.98 1.95 2.93 2.23 4.46 6.69	Pro	1.16	1.18	1.15	1.22	1.15	1.25	1.27
Tyr 0.59 0.53 0.49 0.47 0.57 0.53 0.50 Total 9.87 9.59 8.79 8.64 9.55 9.69 9.22 All AA 18.19 17.75 16.24 15.99 17.74 17.94 17.07 Calculated composition NE, kcal/kg 2496 2471 2444 2414 2425 2350 2274 Glucosinolates, µmol/g - 0.98 1.95 2.93 2.23 4.46 6.69	Ser	0.83	0.78	0.70	0.66	0.78	0.77	0.71
Total 9.87 9.59 8.79 8.64 9.55 9.69 9.22 All AA 18.19 17.75 16.24 15.99 17.74 17.94 17.07 Calculated composition	Tvr	0.59	0.53	0.49	0.47	0.57	0.53	0.50
All AA 18.19 17.75 16.24 15.99 17.74 17.94 17.07 Calculated composition NE, kcal/kg 2496 2471 2444 2414 2425 2350 2274 Glucosinolates, µmol/g - 0.98 1.95 2.93 2.23 4.46 6.69	Total	9.87	9.59	8.79	8.64	9.55	9.69	9.22
Calculated composition 2496 2471 2444 2414 2425 2350 2274 Glucosinolates, µmol/g - 0.98 1.95 2.93 2.23 4.46 6.69	All AA	18.19	17.75	16.24	15.99	17.74	17.94	17.07
Calculated composition NE, kcal/kg 2496 2471 2444 2414 2425 2350 2274 Glucosinolates, µmol/g - 0.98 1.95 2.93 2.23 4.46 6.69								
NE, kcal/kg 2496 2471 2444 2414 2425 2350 2274 Glucosinolates, µmol/g - 0.98 1.95 2.93 2.23 4.46 6.69	Calculated composition							_
Glucosinolates, µmol/g – 0.98 1.95 2.93 2.23 4.46 6.69	NE, kcal/kg	2496	2471	2444	2414	2425	2350	2274
	Glucosinolates, µmol/g	-	0.98	1.95	2.93	2.23	4.46	6.69

^a Percentage of high protein canola meal (CM-HP) and conventional canola meal (CM-CV) as a replacement for soybean meal.

^b Optiphos 2000; Enzyvia, Sheridan, IN.

^c Provided the following quantities of vitamins and micro minerals per kilogram of complete diet: vitamin A as retinyl acetate, 11,136 IU; vitamin D₃ as cholecalciferol, 2,208 IU; vitamin E as DL-alpha tocopheryl acetate, 66 IU; vitamin K as menadione dimethylprimidinol bisulfite, 1.42 mg; thiamin as thiamine mononitrate, 0.24 mg; riboflavin, 6.59 mg; pyridoxine as pyridoxine hydrochloride, 0.24 mg; vitamin B₁₂, 0.03 mg; D-pantothenic acid as D-calcium pantothenate, 23.5 mg; niacin, 44.1 mg; folic acid, 1.59 mg; biotin, 0.44 mg; Cu, 20 mg as copper sulfate and copper chloride; Fe, 126 mg as ferrous sulfate; I, 1.26 mg as ethylenediamine dihydriodide; Mn, 60.2 mg as manganese sulfate; Se, 0.3 mg as sodium selenite and selenium yeast; and Zn, 125.1 mg as zinc sulfate.

Download English Version:

https://daneshyari.com/en/article/2449818

Download Persian Version:

https://daneshyari.com/article/2449818

Daneshyari.com