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

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ABSTRACT

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 revealed that bellies originating from the right side of the carcasses were slightly ($P \leq 0.05$) wider, thicker, heavier and firmer than bellies from the left side of the carcass.

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.

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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.

Item	Diet						
	Control[a]	CM-HP[a]			CM-CV[a]		
	0%	33%	66%	100%	33%	66%	100%
Ingredients, %							
Corn	68.33	67.93	67.48	66.96	66.08	63.72	61.33
Canola meal, high protein	–	9.57	19.15	28.72	–	–	–
Canola meal, conventional	–	–	–	–	11.68	23.35	35.00
Soybean meal, 48% CP	27.00	18.00	9.00	–	18.00	9.00	–
Phytase premix[b]	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Soybean oil	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Limestone	1.21	1.30	1.38	1.30	1.13	0.92	0.60
Dicalcium phosphate	0.52	0.25	–	–	0.15	–	–
L-Lysine HCl	0.18	0.21	0.25	0.28	0.23	0.28	0.34
DL-Methionine	0.02	–	–	–	–	–	–
L-Threonine	0.02	0.02	0.02	0.02	0.01	0.01	0.01
Salt	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Vitamin–mineral premix[c]	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Analyzed composition,							
DM	88.98	88.78	89.33	88.52	87.66	89.64	89.34
CP	19.10	20.57	18.59	18.68	19.74	20.16	19.75
ADF	4.44	4.70	6.38	7.24	5.25	7.01	8.27
NDF	8.72	9.14	10.50	12.53	10.45	12.27	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							
Arg	1.17	1.13	1.00	0.95	1.15	1.12	1.03
His	0.49	0.49	0.45	0.45	0.49	0.51	0.49
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	0.93	0.87	0.77	0.73	0.87	0.86	0.76
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	8.32	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	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

[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 D_3 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 B_{12}, 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.