Does feeding high Oleic soybeans (TruSoya) in a swine finishing ration impact meat and carcass quality characteristics?

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Dietary sources of fatty acids present in swine diets will be represented in their muscle and lipid tissues, which may influence carcass and quality traits. In this study, replacing traditional soybean meal or conventional extruded soybeans with extruded high-oleic acid soybeans (TruSoya) during the finishing phase did not affect carcass composition, meat quality, or shelf-life of pork, but did modify the fatty acid profile of subcutaneous fat.

Summary

Seventy-two crossbred pigs (Landrace x Yorkshire, Duroc x Landrace x Yorkshire) were allotted to 18 pens and randomly assigned to one of three finishing diets: traditional control soybean-meal (CTRL), extruded conventional soybean (CONV), or extruded high-oleic acid soybean, TruSoya (TRU). Upon reaching 260 pounds, pigs were harvested, and compositional carcass measurements and pork quality traits were collected. A shelf-life study was performed to determine differences in pork chops to assess color change associated with diet. Subcutaneous fat samples were obtained to evaluate changes in fatty acid profile. Diet affected final live weight, and pre-rigor carcass weight (HCW), but did not impact fresh pork water holding capacity, pH, or color. Shelf-life evaluation found no differences for dietary impact or interaction with day of storage and (or) slaughter date. Minolta L* (lightness whereby 100 = white and 0 = black) increased, while a* (redness) and b* (yellowness) decreased over time in retail display across all diets. Most notably, TRU increased the percentage of oleic acid in subcutaneous fat; however, the increased presence of this monounsaturated fat did not impact belly firmness compared to other diets.

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Introduction

Diet composition can modify the balance of fatty acids in pork lean and fat depots. Dietary rations have been created to improve the content of the beneficial fatty acids (such as oleic, linoleic, and linolenic) in pork. However, changes in fatty acid concentration may be detrimental to palatability and technological characteristics (Fanalli et al., 2022). Oleic acid is the major monounsaturated fatty acid (MUFA) found in pig fat. Increased consumption of MUFA has been associated with reduced risk of stroke in humans and can improve dietary lipid deposition and physiological utilization. That said, it may impact color, marbling, and cooked flavor, and alter technological characteristics such as firmness, fat cohesiveness, and oxidative stability (Bee et al., 2002; Navarro et al., 2021).

TruSoya soybeans contain a higher content of oleic acid and lower content of saturated fatty acids compared to traditional or conventional soybeans. However, there is limited data evaluating the impact of soybeans possessing enhanced fatty acid composition on pig carcass traits and pork quality. Therefore, the objective of this experiment was to determine if a swine finishing ration that included a high concentration of TruSoya soybeans will impact carcass composition and meat quality characteristics.

Experimental Procedures

Crossbred pigs (Landrace x Yorkshire, Duroc x Landrace x Yorkshire; N = 72) were sorted by weight (initial weight 172 ± 20 pounds) and sex, then distributed within 18 pens. Each pen was randomly assigned to one of three experimental diets: traditional control soybean-meal (CTRL), an extruded conventional soybean (CONV), or an extruded high oleic acid soybean (TRU) as the main protein source. The diets were offered during the finishing period until reaching 260 (± 6) pounds. Six slaughter groups were created, harvesting 12 animals/group to ensure uniformity of finishing weight. Thus, animals were retained on test for 34, 37, 41, 42, 48, or 50 days. Animals were humanely harvested at the NDSU meat laboratory.

Final live weight, pre-rigor carcass weight (HCW) and dressing percent were recorded at harvest. After a 24-hour chill (36°F), loin eye depth, loin eye area, subcutaneous fat depth, loin eye color, and marbling scores were taken at the 10th/11th rib interface. The right-side carcass was fabricated into primal cuts (ham, belly, loin, boston butt, and picnic shoulder), which were weighed and expressed as percentage of chilled side weight. A one-inch-thick boneless pork chop was obtained adjacent to the 10th rib for shelf-life analysis. An additional chop was obtained adjacent the 11th rib, vacuum packaged, aged for seven days (36°F), and frozen (10°F) for later analysis. Subcutaneous fat samples were obtained adjacent to the first thoracic vertebra, frozen at 10°F, and saved for fatty acid analysis. Fresh belly firmness was determined by the belly flop test, which consisted of measuring the distance between caudal and cranial ends in a suspended belly on a V-shaped smokehouse stick. Shelf-life was evaluated in a simulated retail display for six days. Pork chops were overwrapped with a plastic film and placed in a retail cooler at 40°F. Minolta L*, b*, and a* measures were recorded daily using a Konica Minolta CR-400 Chroma Meter (Konica Minolta Inc. Ramsey, NJ) as indicators of pigment degradation and spoilage. Pork chops thawed for quality analysis were evaluated for pH, drip loss, subjective marbling, color score, cook loss, and tenderness. Color was recorded from pork chops after 30 minutes exposure to oxygen to allow surface "color blooming." Raw chop weight was obtained prior to cooking on clamshell grills until reaching an internal temperature of 140°F. The chops were then cooled to room temperature and re-weighed to determine cook loss. Tenderness was evaluated by Warner-Bratzler Shear Force (WBSF). Five round cores (0.5-inch diameter) were removed directionally parallel to the muscle fibers (AMSA, 2016). Each core was sheared by a V-notched cutting blade attached to the WBSF instrument (PPT Group UK Ltd, Slinfold, UK) to record the maximum force to cut through the sample. All data were analyzed using the MIXED procedure of SAS (SAS 9.4, SAS Institute Inc., Cary, NC). Repeated measures were used to analyze shelf-life. Differences were considered significant at $P \leq 0.05$ with pen as experimental unit.

Results and Discussion

Animals fed TRU had higher body weights, HCW, and dressing percentage compared to the other diets (Table 1). In contrast, loin eye area and depth, fat depth and the primal cut weights were not affected by the diet. The belly flop test suggested that bellies from the animals fed CONV were softer than CTRL and TRU (higher percentage change = softer belly).

Diet did not affect meat quality but differences for drip loss, L*, b*, and pH variation were associated with slaughter group (Table 2). No significant interactions were found between slaughter group, diet, or retail day during the shelf-life evaluation. However, numerical differences were found in L* and a* values. Pork chops from the TRU treatment were lighter (higher L*) and less red (lower a*) over time (Figure 1). Slaughter group and day of retail display influenced color change and rate of acceptable retail decline regardless of diet, showing a typical degradation curve for all treatments.

Fatty acid analysis revealed that TruSoya soybeans resulted in a greater percentage of subcutaneous oleic acid and less linoleic and saturated fatty acids (Figure 2). It is important to note that this modification did not affect belly firmness. Slaughter group

Table 1. Compositional carcass traits for pigs fed traditional soybean meal (CTRL), extruded conventional soybean (CONV), or extruded high-oleic acid soybean (TRU).

	Experimental diet*				*P* - value[1]				
Carcass trait	CONV	CTRL	TRU	SEM	Diet	Sex	Slaughter group	Slaughter group x diet	Slaughter group x sex
Final live weight, lb	260.84^{ab}	255.97^{a}	262.65^{b}	1.98	0.035	0.109	<0.001	0.012	0.028
HCW, lb	205.96^{ab}	202.36^{a}	208.37^{b}	1.82	0.034	0.108	<0.001	0.029	n.s
Dressing %	79.00	79.00	79.26	0	0.614	0.821	0.006	n.s	n.s
Loin eye depth, inch	2.62	2.60	2.63	0.08	0.894	0.016	0.027	n.s	0.012
Loin eye area, sq. inch	7.88	7.65	7.8	0.24	0.546	0.088	0.019	n.s	n.s
Fat depth 10th rib, inch	0.85	0.82	0.87	0.04	0.713	0.005	0.005	n.s	n.s
Cold Right carcass, lb	99.04	98.46	100.25	1.41	0.481	0.037	0.003	n.s	n.s
Ham, %	26.78	26.66	26.90	0.65	0.795	0.189	<0.001	n.s	n.s
Belly, %	15.85	16.15	15.89	0.59	0.746	0.609	0.001	n.s	n.s
Loin, %	22.57	23.31	22.83	0.58	0.349	0.663	0.001	n.s	n.s
Boston butt, %	7.59	7.15	7.25	0.38	0.304	0.936	0.075	n.s	n.s
Picnic shoulder, %	14.06	13.73	14.15	0.35	0.672	0.864	0.008	n.s	n.s
Belly flop, % of initial	73.47^{a}	59.95b	67.70^{ab}	2.55	0.007	0.038	0.079	n.s	n.s

[1]Values are significant at $P \leq 0.05$. n.s = non-significant for the interaction.
*Values with different letter indicate significance of the diet at $P \leq 0.05$

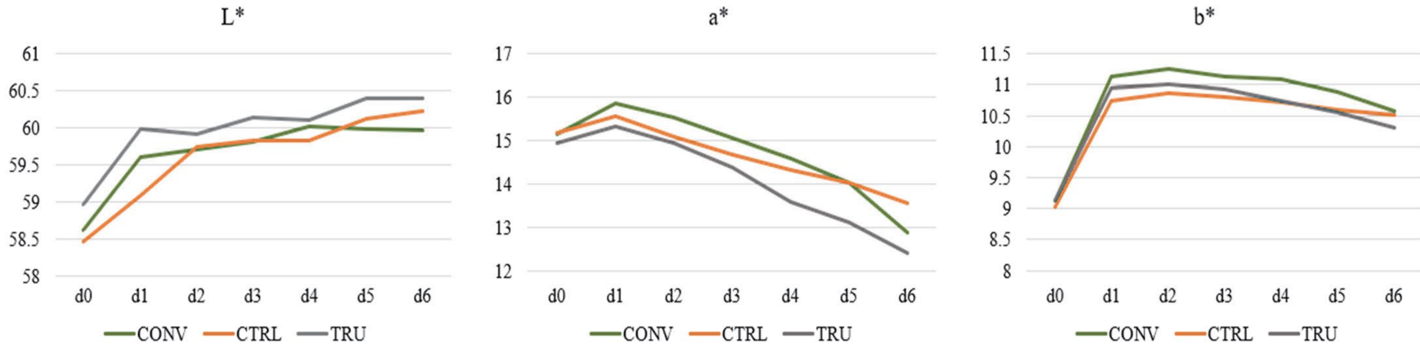

Figure 1. Shelf-life results for pigs fed traditional soybean meal (CTRL), extruded conventional soybean (CONV), or extruded high-oleic acid soybean (TRU).

Table 2. Pork quality traits of pigs fed traditional soybean meal (CTRL), extruded conventional soybean (CONV), or extruded high-oleic acid soybean (TRU).

	Experimental diet				*P* - value[1]		
Quality trait	CONV	CTRL	TRU	SEM	Diet	Sex	Slaughter Group
Drip loss, %	3.99	4.17	3.45	0.39	0.41	0.36	0.003
Cook loss, %	16.08	17.53	16.80	0.72	0.26	0.74	0.74
L*	56.02	56.79	56.20	1.42	0.67	0.02	0.007
a*	14.07	14.24	13.80	0.33	0.59	0.50	0.21
b*	9.974	10.36	10.20	0.58	0.55	0.02	0.007
Color score	2.5	2.4	2.5	0.2	0.71	0.67	0.09
Marbling score	2.1	2.1	2.2	0.2	0.79	0.23	0.20
pH	5.49	5.47	5.50	0.04	0.43	0.87	0.004
WBSF, N	21.32	20.78	23.10	1.35	0.19	0.68	0.10

[1]Values are significant at $P \leq 0.05$

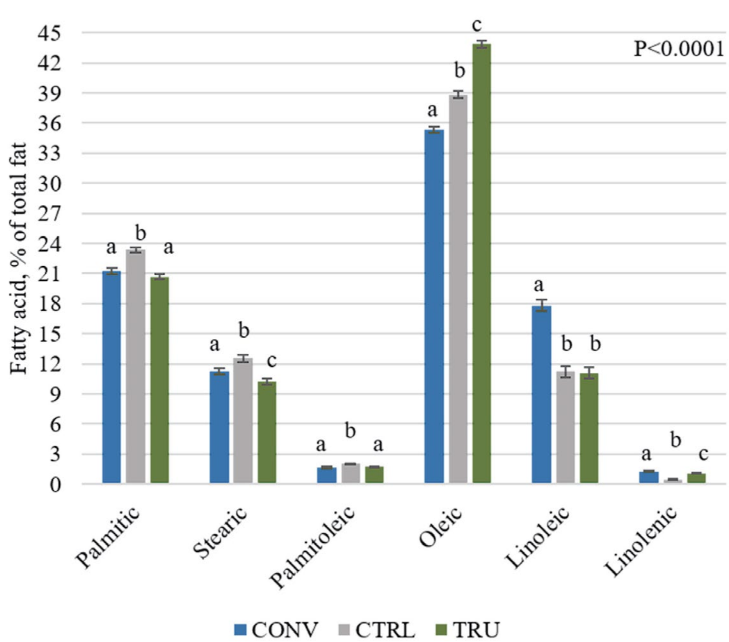

Figure 2. Fatty acid profile of pork subcutaneous fat from pigs fed traditional soybean meal (CTRL), extruded conventional soybean (CONV), or extruded high oleic acid soybean (TRU).

and sex had greater impact on carcass and quality traits than diet. For this reason, TruSoya soybeans could be considered as a dietary alternative to modify the fatty acid profile in pork, while keeping similar carcass and quality traits when fed during the finishing period.

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