Nutrient Content of Single-Muscle Pork Cuts

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Abstract: To determine the nutrient profiles of four fresh pork cuts (fabricated from individual muscles extracted from subprimals) for dissemination in the USDA National Nutrient Database for Standard Reference (SR). To determine cooking yields and nutrient retention factors of these pork cuts. Materials and Methods: A total of twelve samples from the shoulder (Pectoralis profundi (PP), Teres major (TM)); leg (Gracilis(GR)); and knuckle (Vastus lateralis/Rectus femoris (VL)) were obtained from production plants in North Carolina and Iowa. Six paired cuts were fabricated from the left and right sides of the carcass. One member of each pair was prepared raw and the other cooked either by broiling (PP, TM, and GR) or braising (VL). After cooling, the cooked product was cubed, hand mixed and divided into individual samples or composites of two- or three-carcass samples. Proximate nutrients and cholesterol were determined on individual muscle samples, both raw and cooked. Fatty acids, choline, folate and amino acids were analyzed on three-carcass composites. Vitamins and minerals were analyzed on two-carcass composites. Results: VL, raw and cooked contained the highest level of protein and the lowest amount of fat when compared to the other cuts. Conversely, PP cooked contained the highest amount of fat and the lowest amount of moisture. Sodium was higher in GR (raw and cooked) and lower in VL (cooked) compared to other cuts. Niacin levels, raw and cooked, were the highest among all B-vitamins particularly for PP. Cooking yield was lowest (72%) for braising compared to broiling (82%). The highest nutrient retentions were obtained with braising when compared to broiling. Significance: The new pork cuts represent good sources of iron, zinc and B–vitamins, especially niacin. These nutrient profile single-muscle pork cuts were released in USDA National Nutrient Database for Standard Reference, version 21. Funded By The National Pork Board and USDA, ARS.

Introduction

- The pork industry has recently introduced new cuts of pork in retail markets, collectively known as single-muscle pork cuts.
- These cuts are fabricated from individual muscles derived from the shoulder and leg. These cuts are more tender and juicy than the multi-muscle cuts from which they originate.
- A new study was developed in collaboration with scientists at USDA, University of Wisconsin, and the National Pork Board (NPB) to determine the nutrient profiles of four, fresh, single-muscle pork cuts: Pectoralis profundi (Pork shoulder breast, boneless (PP)); Teres major (Pork shoulder petite tender, boneless (TM)); Gracilus (Pork leg cap steak, boneless (GR)) and Vastus lateralis/Rectus femoris (Pork leg sirloin tip roast, boneless (VL)).

Objectives

- To determine the effect of cooking, using methods recommended by industry (i.e., broiling or braising), on nutrient composition, cooking yields and nutrient retention factors.
- To determine the nutrient profiles of four single- muscle pork cuts for dissemination in the USDA National Nutrient Database for Standard Reference (SR).

Methodology

- Sampling: A total of twelve samples each from the shoulder (Pectoralis profundi (PP), Teres major (TM)), leg (Gracilis(GR)), and (Vastus lateralis/Rectus femoris (VL)) were obtained from six carcasses each at production plants in North Carolina and Iowa.
- Preparation: Six paired cuts were fabricated from the left and right sides of the carcass. One member of each pair was prepared raw; the other was cooked either by broiling PP, TM, and GR - in a George Foreman Indoor/Outdoor Electric Barbeque Grill ™ to a temperature of 160°F or braised VL - in a covered roasting pan with 100 ml distilled water in a preheated oven; cooked for 45 minutes or until tender to touch. Aliquots of each product were cubed, hand mixed and divided into individual samples or composites of two or three-carcass samples in preparation for homogenization and nutrient analyses.
- Analyses: Proximate nutrients, cholesterol and B-vitamins were determined on individual muscle samples, both raw and cooked using AOAC[1] methods. Mineral content was analyzed on the two-carcass composites by ICP[1] and Choline, was analyzed on the three-carcass composites using LC-ESI-IDMS[2].
- Quality Control: Quality assurance was monitored through the use of certified reference materials, in-house controls, and blind duplicate sampling.
- Statistics: Data were statistically evaluated for differences among individual muscle cuts and for effect of broiling using the Mixed Procedure of SAS[3]. Critical values were set at $p<0.05$.

Calculation for Cooking yields (CY): $CY = \frac{\text{cooked weight}}{\text{raw weight}} * 100$

Calculation for Nutrient retention factors (RF):

$RF = CY * \frac{\text{nutrient content per gram cooked food}}{\text{nutrient content per gram of raw food}}$

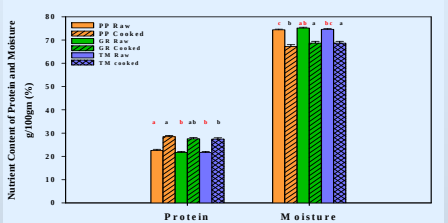

Fig 1. Protein and moisture concentrations in raw and broiled samples PP,GR, TM: Comparison of nutrient content in raw muscles (red superscripts) effect of broiling on nutrient concentrations (black superscript). Bars with similar superscript letters within a color scheme are not significantly different at $p<0.05$.

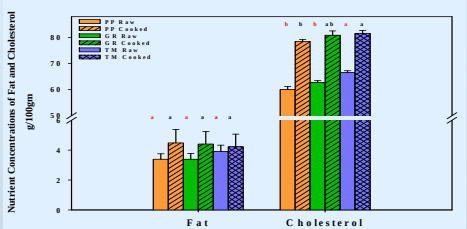

Fig 2. Fat and cholesterol concentrations in raw and broiled samples PP,GR, TM: Comparison of nutrient content in raw muscles (red superscripts) effect of broiling on nutrient concentrations (black superscript). Bars with similar superscript letters within a color scheme are not significantly different at $p<0.05$.

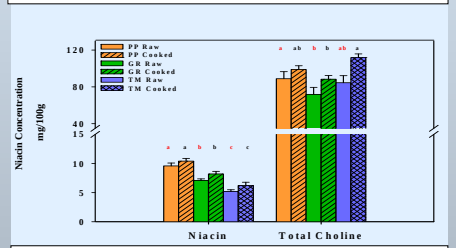

Fig 3. Niacin and choline concentrations in raw and broiled samples PP,GR, TM: Comparison of nutrient content in raw muscles (red superscripts) effect of broiling on nutrient concentrations (black superscript). Bars with similar superscript letters within a color scheme are not significantly different at $p<0.05$.

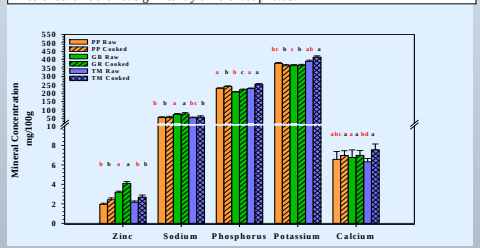

Fig 4. Mineral concentrations in raw and broiled samples PP,GR, TM: Comparison of nutrient content in raw muscles (red superscripts) effect of broiling on nutrient concentrations (black superscript). Bars with similar superscript letters within a color scheme are not significantly different at $p<0.05$.

Table1. Cooking yields and retention factors for selected nutrients in single-muscle pork cuts.

Muscle:	PP	GR	TM	VL
Cooking yield (%)	80	82	82	72
Moisture loss (%)	21	19	18	27
Fat gain (%)	.16	.19	.45	.13
Retention factors				
Calcium (mg/100g)	77	80	91	70
Potassium (mg/100g)	70	78	81	59
Sodium (mg/100g)	70	81	81	56
Phosphorus (mg/100g)	76	83	85	67
Riboflavin (mg/100g)	67	71	59	93
Niacin (mg/100g)	79	90	92	70
Total choline (mg/100g)	81	96	101	86

Table2. Nutrient content of Vastas Lateralis single-muscle pork cut.

Nutrients		Preparation	
		Raw	Braised
Ash (%)	12	1.2±0.1	1.2±0.7
Moisture (%)	12	75.9±0.3	66.1±0.3
Protein (%)	12	22.9±0.5	31.1±0.5
Total Fat (%)	12	1.8±0.9	2.5±0.1
Cholesterol (mg/100g)	12	62.4±1.4	84.3±1.1
Sodium (mg/100g)	12	49.9±4.8	7.7±0.7
Phosphorus (mg/100g)	12	231.5±2.9	237.0±5.7
Potassium (mg/100g)	12	398.7±4.9	362.7±6.6
Calcium (mg/100g)	12	4.8±0.2	5.1±0.2
Zinc (mg/100g)	12	2.0±0.1	2.9±0.1
Niacin (mg/100g)	12	7.2±0.7	7.7±0.7
Choline (mg/100g)	12	88.9±7.6	106.6±2.4

Results

- There were significant differences among three raw muscles for protein PP>GR=TM whereas, differences in moisture were the greatest among all three cooked muscles as a result of broiling (Fig 1).
- Fat content was similar among the three raw cuts (PP, GR, TM), whereas PP had significantly less cholesterol than TM (for both raw and broiled states) ($p<0.001$) (Fig 2).
- VL had significantly less fat ($p<0.001$) in comparison to all other muscles: In raw muscles, PP=3.40, GR=3.39, TM=3.91 and VL=1.71; and in cooked muscles, PP=4.49, GR=4.41, TM=4.23 and VL=2.56 (Fig1;Table 2).
- Niacin was significantly different ($p<0.001$) both in raw and broiled states: PP>GR>TM. In the raw state PP contained more choline content than GR. After broiling the highest concentration of choline was seen in TM (Fig 3).
- Zinc and sodium were significantly higher in GR (raw and broiled states) ($p<0.001$) compared to other muscles. Among cooked muscles, TM had the highest concentration of phosphorus and potassium ($p<0.001$). In the broiled samples, there was no impact on calcium concentration whereas in the raw samples, GR contained significantly higher levels of calcium than TM (Fig 4).
- Cooking yields were lowest for VL (braising) compared to other muscles (PP, GM, and TM) (broiling) (Table 1).

Discussion

- The concentration of all nutrients increased with cooking when compared to the raw regardless of the cooking method. The impact of cooking on the muscles is reflective of moisture and fat loss.
- Differences among broiled cuts were reflective of the natural mineral contents of the raw cuts.
- Braising resulted in the lowest nutrient retentions compared to broiling (except for riboflavin).
- VL is the leanest single-muscle pork cut with the lowest sodium content compared to all other muscles in the study.
- While nutrient levels such as protein in the pork cuts maybe different from a statistical view point, the nutritional impact does not appear to be significant.
- The addition of these new data in SR will provide specific and current product information on the nutrient composition of single-muscle cuts. These data are used by researchers and those responsible nutrition monitoring, research, food policy development, and dietary counseling of individuals, particularly those with sodium and potassium health related issues.
- Dissemination of these data on the website http://www.ars.usda.gov will provide consumers with access to current data on a variety of meat cuts.

References

[1] **Official Methods of Analysis of AOAC International (2000) 17th ED., AOAC International, Gaithersburg, MD USA.**

[2] **Koc, H., Mar, M.H., Ranasinghe, A., Swenberg, J.A., and Zeisel, S.H. (2002). Quantitation of choline and its metabolites in tissues and foods by liquid chromatography/electrospray ionization-isotope dilution mass spectrometry. Anal Chem 74, 4734-4740.**

[3] **The SAS System (version 9.1), SAS Institute, Cary, NC-27513.**