Nutritional Changes in Fresh Pork Cuts between 1991-2005

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Abstract: In order to monitor changes in pork composition between 1991 and 2005, a collaborative study was conducted by scientists at USDA, University of Wisconsin, University of Maryland and the National Pork Board. The objectives of this study were: To compare analytical nutrient data from 1991 to that of 2005 in 3 high market-share pork products; To update the nutrient profile of various fresh pork cuts in the USDA National Nutrient Database for Standard Reference (SR). Shoulder blade steaks (SBS), tenderloins (TEN) and top loin chops (TLC) were randomly purchased from 12 retail outlets using the USDA's National Food and Nutrient Analysis Program sampling plan. Nutrient values for proximates, vitamins, minerals, and fatty acids were determined for raw pork cuts by a commercial laboratory. Analytical quality assurance methods included duplicate sampling, and use of in-house controls and standard reference materials. Nutrient values from 1991 and 2005 were compared statistically using a two-tailed T-test (Critical value =p<0.05). Moisture increased (p<0.001) and total fat decreased (p<0.001) in all 3 cuts. The 2005 cuts reflected an average decrease of 32% in total fat content when compared to the previous values. Values for total saturated fatty acids reflected the changes in total fat. Cholesterol decreased in SBS (p<0.05), was unchanged in TEN, and increased in TLC (p<0.001). Riboflavin increased, but not significantly, in SBS and TEN. Total phosphorus was substantially increased in all 3 cuts. Niacin was increased in TEN and TLC, which may reflect added dietary niacin in pork feed. Sodium, iron, potassium, vitamins B6 and B12 were also examined but the results were not statistically significant. This research demonstrates significant changes in pork meat quality over time and provides researchers, consumers, health professionals and government agencies with the necessary information for establishing nutrition policy and recommendations concerning pork's role in a healthful diet.

Introduction

Nutrient information on fresh pork cuts in the USDA National Nutrient Database for Standard Reference (SR) was last updated in 1991. Since then, the meat industry has responded to consumer demand for leaner products through better breeding/feeding practices and increased trimming of external fat (www.hormel.com)[1]. Recent trends of adding nutrients such as Vitamin C and dietary niacin to animal feed has also improved meat quality (Goodband R.D.)[2]. A collaborative study was conducted by scientists at USDA, University of Wisconsin, University of Maryland, and the National Pork Board to update nutrient data for pork.

Objectives

•To update the nutrient profiles for 9 high-market-share pork products in the USDA National Nutrient Database for Standard Reference (SR): shoulder blade steak (SHB), tenderloin roast (TEN), top loin chop (TLC), loin chop (LCH), rib chop (RCH), top loin roast (LRS), sirloin roast (SIR), country-style ribs (CSR), and spare ribs (RIB).

•To compare analytical nutrient data from 1991 to those generated in 2005.

Methodology

•Sampling: Nine fresh raw pork products were purchased from 12 retail outlets (3 per region) using the nationwide sampling plan developed for the USDA National Food and Nutrient Analysis Program[3].

•Preparation: Using similar preparation methods as before, separable fat and connective tissues were removed, and the lean portions were composited by cut and region for homogenization and nutrient analysis.

•Analyses: Nutrient values for proximates (ash, moisture, nitrogen, fat), fatty acids, and selected vitamins were determined by a commercial laboratory using standard AOAC methodology; minerals were analyzed by ICP methodology.

•Quality Control: Quality assurance was monitored through the use of commercial reference materials, in-house control materials, and random duplicate sampling.

•Statistics: Data were evaluated using the two-tailed *t*-test. The critical value was set at p<0.05.

Table 1: Change in proximate nutrient content of fresh pork cuts Comparison between 1991 and 2005 data[1]

Cut	Nutrient Content - 2005						% Change compared to 1991					
	Water	*Ash*	*Prot*	*Total Fat*	*Sat Fat*	*Chol*	*Water*	*Ash*	*Prot*	*Total Fat*	*Sat Fat*	*Chol*
	g/100g					mg/100g	% 1991 value / Actual value change					
TLC (Chops)	72.92 ±0.53	1.00 ±0.026	22.83 ±0.35	3.42 ±0.60	1.21 ±0.24	66 ±20.52	101[2] 1.10	102 0.02	102 0.61	64 -1.89	65[3] -0.63	120 11.31
LRS (Roast)	73.28 ±0.60	1.01 ±0.02	22.39 ±0.40	4.06 ±0.37	1.24[4]	62	101 1.36	103 0.03	102 0.59	76 -1.22	68 -0.58	112 7.0
TEN (Roast)	76 ±0.35	1.02 ±0.03	20.94 ±0.55	2.17 ±0.13	0.69 ±0.09	65 ±5.19	101 1.06	57 -0.74	99 -0.05	63 -1.24	58 -0.49	99 -0.02
SIR (Roast)	74.03 ±5.10	1.00 ±0.03	21.64 ±0.46	4.01 ±0.35	1.22	69	102 1.5	91 -0.09	102 1.02	69 -1.75	61 -0.77	109 6.0
LCH (Chops)	73.61 ±0.44	1.01 ±0.04	21.98 ±0.59	3.71 ±0.25	1.09	67	101 1.06	91 -0.09	99 -0.06	73 -1.33	62 -0.65	106 4.0
SHB (Steak)	74.30 ±0.30	0.88 ±0.03	18.73 ±0.39	5.71 ±0.30	1.99 ±0.12	60.0 ±4.52	102 2.11	86 -0.14	96 -0.64	71 -2.29	72 -0.77	89 -7.19
RCH (Chops)	72.40 ±0.30	1.01 ±0.04	21.79 ±0.47	4.80 ±0.37	1.46	56	102 1.57	101 0.01	103 -0.32	79 -1.21	70 -0.63	101 1.0
Ribs (Roast)	58.42 ±1.64	0.68 ±0.04	15.66 ±0.55	23.40 ±1.67	7.0	80	102 1.54	74 -0.23	91 -1.43	99 -0.21	84 -1.41	102 2.0
CSR	72.84 ±0.63	1.01 ±0.03	20.75 ±0.34	5.64 ±0.68	1.68	74	101 1.04	101 0.01	107 1.48	68 -2.61	59 -1.15	115 10.0

[1]Values represent means ±S.E.M: N=12. Prot – Protein, Sat fat – Saturated fat, Chol – Cholesterol.
[2]Statistically significant differences at p<0.05 (two-tailed *t*-test) are denoted in red.
[3]When SEM for 1991 data was unavailable, equal variances and a minimum number of observations (n=1) were assumed for statistical purposes and are denoted by italics.
[4]Imputed values are denoted in blue.

Table 2: Change in mineral content of fresh pork cuts Comparison between 1991 and 2005 data[1]

Cut	Nutrient Content - 2005						% Change compared to 1991					
	Na	*Ca*	*Fe*	*Zn*	*P*	*K*	*Na*	*Ca*	*Fe*	*Zn*	*P*	*K*
	mg/100g						% 1991 value / Actual value change					
TLC (Chop)	49 ±3.1	5 ±0.1	0.50 ±0.0	1.59 ±0.0	234 ±3.8	387 ±6.0	109 4.32	24[2] -15.8	65 -0.26	96 -0.05	108 19.0	91 -33.9
LRS (Roast)	49 ±1.6	5 ±0.1	0.54 ±0.0	1.8 ±0.1	225 ±3.1	374 ±3.4	108 3.97	24 -15.9	71 -0.22	109 0.16	104 9.9	88 -47.5
TEN (Roast)	47 ±6.1	5 ±0.2	0.98 ±0.0	1.88 ±0.1	246.5 ±7.71	408 ±14.2	94 -3.0	99 -0.05	79 -0.25	92 -0.15	109 20.5	111 42.0
SIR (Roast)	59 ±1.2	10 ±1.3	0.83 ±3.1	2.05 ±0.1	219 ±2.5	353 ±4.0	116 8.4	80 -2.57	95 -0.04	110 0.2	100 0.5	95 -17.5
LCH (Chop)	58 ±1.3	18 ±1.9	0.65 ±0.0	1.86 ±0.0	220.0 ±2.8	362 ±7.4	87 -8.0	85 -3.0	78 -0.18	111 0.19	106 13.0	99 -0.4
SHB (Steak)	65 ±1.5	14 ±1.4	1.19 ±0.0	3.36 ±0.1	202 ±3.7	339 ±5.6	93 -4.8	64 -7.75	95 -0.06	99 -0.02	107 14	99 -2.6
RCH (Chop)	60 ±1.4	24 ±3.2	0.61 ±0.0	2.0 ±0.1	216 ±3.5	359 ±0.4	133 15.0	114 3.0	80 -0.15	121 0.36	100 0.7	85 -61.8
Ribs (Roast)	81 ±3.0	15 ±0.1	0.91 ±0.0	2.50 ±0.0	141 ±5.0	241 ±8.3	107 54.0	48[3] -15.8	91 -0.08	92 -0.2	58 -98	93 -17.5
CSR	67 ±1.6	21 ±2.1	0.90 ±0.0	2.99 ±0.2	204 ±3.5	338 ±4.7	99 -0.4	91 -1.9	88 -0.12	101 0.04	106 12.9	99 -2.0

[1]Values represent means ±S.E.M : N=12.
[2]Statistically significant differences at p<0.05 (two-tailed *t*-test) are denoted in red.
[3]When SEM for 1991 data was unavailable, equal variances and a minimum number of observations (n=1) were assumed for statistical purposes and are denoted by italics.

Table 3: Change in B-vitamin content of fresh pork cuts Comparison between 1991 and 2005 data[1]

Cut	Nutrient Content - 2005					% Change compared to 1991				
	Thia	*Ribo*	*Nia*	*B6*	*B12*	*Thia*	*Ribo*	*Nia*	*B6*	*B12*
	mg/100g			mcg/100g		% 1991 value / Actual value change				
TLC (Chop)	0.69 ±0.05	0.19 ±0.01	8.26 ±0.50	0.75 ±0.01	0.51 ±0.01	81 -0.16	73 -0.07	164[2] 3.23	153 0.25	96 -0.02
LRS (Roast)	0.44[3]	0.18	5.74	0.74	0.51	51 -0.41	69 -0.08	114 0.71	157 0.27	94 -0.03
TEN (Roast)	0.99 ±0.09	0.34 ±0.02	6.68 ±0.33	0.77 ±0.02	0.51 ±0.02	102[4] 0.02	121 0.06	151 2.26	148 0.25	62 -0.3
SIR (Roast)	0.51	0.29	6.34	0.80	0.52	47 -0.57	0.00 0.00	144 1.94	126 0.17	75 -0.17
LCH (Chop)	0.50	0.19	6.93	0.81	0.53	41 -0.71	86 -0.03	135 1.8	150 0.27	91 -0.05
SHB (Steak)	0.55 ±0.03	0.38 ±0.01	4.38 ±0.23	0.52 ±0.01	0.91 ±0.02	61 -0.34	118 0.06	110 0.42	148 0.17	97 -0.02
RCH (Chop)	0.48	0.18	6.68	0.72	0.48	49 -0.49	72 -0.07	114 0.87	153 0.25	73 -0.17
RIB (Roast)	0.31	0.25	4.66	0.43	0.77	50 -0.3	92 -0.02	95 -0.2	102 0.01	87 -0.11
CSR	0.33	0.20	4.03	0.77	0.50	41 -0.47	74 -0.07	93 -0.29	155 0.27	59 -0.34

[1]Values represent means ±S.E.M. N=12 for Thiamin (Thia), Riboflavin (Ribo), and Niacin (NIA); N=4 for B6 and B12.
[2]Statistically significant differences at p<0.05 (two-tailed *t*-test) are denoted in red.
[3]Imputed values are denoted in blue.
[4]When SEM for 1991 data was unavailable, equal variances and a minimum number of observations (n=1) were assumed for statistical purposes and are denoted by italics.

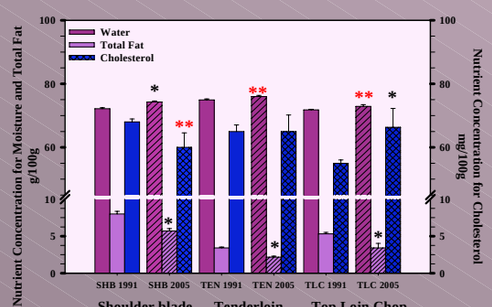

Fig 1. Comparison of nutrient values for fresh pork cuts between 1991 and 2005. Statistical analysis of two–tailed *t*-test: *Denotes a statistically significant difference from its 1991 counterpart at p≤0.001.**Denotes statistically significant difference from its 1991 counterpart at p<0.05.

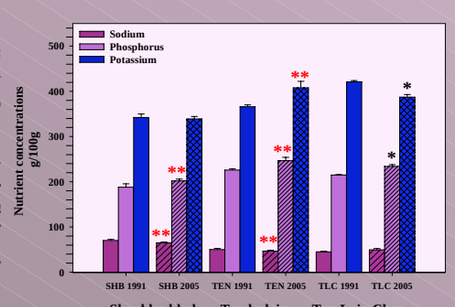

Fig 2. Comparison of mineral nutrient values for fresh pork cuts between 1991 and 2005. Statistical analysis of the data using two–tailed *t*-test. *Denotes a statistically significant difference from its 1991 counterpart at p≤0.001.**Denotes statistically significant difference from its 1991 counterpart at p<0.05.

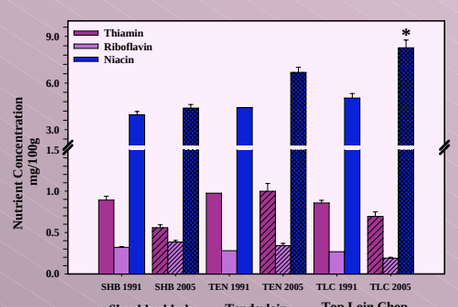

Fig 3. Comparison of B-vitamin nutrient values for fresh pork cuts between 1991 and 2005. Statistical analysis of two–tailed *t*-test.*Denotes a statistically significant difference from its 1991 counterpart at p≤0.001.**Denotes statistically significant difference from its 1991 counterpart at p<0.05

Results

Results are expressed relative to data from the 1991 cuts:

–Moisture concentration increased and total fat levels decreased in all cuts except for spare ribs. These changes were statistically significant for SHB, TEN, TLC (p<0.05) (Fig 1; Table 1).

–Cholesterol significantly decreased in one cut (SHB; p<0.05) was unchanged in one cut (TEN), and increased in one cut (TLC; p≤0.001) (Fig 1).

–Calcium concentrations were substantially decreased in four of the nine cuts: TLC, SHB LRS, and RIB (Table 2). Sodium concentrations were significantly lower in two cuts (SHB and TEN; p<0.05) (Fig 2). Phosphorus values were elevated 4%-10% in three cuts (SHB, TEN and TLC; p<0.05), unchanged in two cuts (RCH and SIR), and decreased by 42% in one cut (RIB) (Fig 2; Table 2). Potassium was decreased 5%-15% in four of the nine cuts (TLC, LRS, SIR and LCH), but elevated 11% in one cut (TEN) (Fig 2; Table 2).

–Niacin levels indicated a substantial increase in all the 2005 cuts, but was only significant in one cut (TLC; p≤0.001) (Fig 3).

Conclusion

•These new data developed in 2005 indicate that eight of the nine pork cuts are significantly leaner than in 1991.

•Reduction in calcium levels for top loin chop, shoulder blade steak, loin roast, and spare ribs ranged from 36% to 76% when compared to 1991 values.

•Changes in sodium, phosphorus, and potassium content varied among the cuts.

•Elevation of niacin levels may be attributed to supplementing pork feed with niacin.

•With the release of these results, consumers will have the necessary information to identify and select leaner pork cuts.

References

1. Hormel Food Corporation. 2005. Home page. Available: www.hormel.com.
2. Goodband R.D. 2005. A Practical Look at Nutritional Attempts to improve Pork Quality. Home page. Available: www.engormix.com.
3. Perry CR, Pehrsson PR, and Holden J. 2003. A Revised Sampling Plan for Obtaining Food Products for Nutrient Analysis for the USDA National Nutrient Database. 2003. Proceedings of the American Statistical Association, Section on Survey Research Methods [CD-ROM], Alexandria, VA: American Statistical Association, San Francisco, CA.