PURINE CONTENT AND RETENTION IN SELECTED BEEF RETAIL CUTS*

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* Research supported by the Italian Ministry of University and Scientific and Technological Research ("40%" Funds, F. Y. 1994)

Background and Objectives

Hyperuricemia and associated clinical conditions such as gout, renal stones, Lesch-Nyhan syndrome, diabetic acidosis and myeloproliferative diseases may be due to an imbalance in the endogenous production or excretion of uric acid. Although hyperuricemia is exacerbated by diets high in fat, protein or nucleic acids, the purine nucleic acid intake has the greatest dietary influence on serum uric acid levels. Among the four purine bases, adenine and hypoxanthine have been reported to be more uricogenic than guanine and xanthine (**14**). Changes in the levels of purine bases have been reported to occur during cooking of meat, poultry and fish products (**3, 4, 7, 17, 18**). The objectives of this study were to determine the effects of four cooking methods on the levels and retention values of purine bases in selected beef cuts.

Methods

Ten beef carcasses (Charolais heifers of similar nutritional background) were selected from a local slaughtering plant. The animals ranged from 18–20 months of age, 303–356 kg in hot carcass weight. All carcasses were aged 13–14 days at 2–3°C prior to being fabricated into retail cuts. The following single muscle cuts were retained from both sides for further processing: *m. infraspinatus* (IF), boneless *m. longissimus lumborum* (first three lumbar vertebrae, LL), and *m. semitendinosus* (ST). All cuts were trimmed of surface adipose tissue. IF and LL were sized to about 1 kg weight by discarding their distal and caudal ends, respectively. The raw cuts from one side of each carcass were prepared for analysis. The anatomically matched cuts from the opposite side of the carcass were cooked and then prepared for analysis. The cuts to be cooked before analysis came from the left and right side by turns. A roast about 1 kg weight was obtained as the centre section from each ST. Two further cross-sectional slices were taken from both the proximal and distal ends of each ST and were retained as the raw reference for each roast, while the tapering ends were discarded. The cooking method most commonly used by the consumers was adopted for each cut: boiling for IF, broiling for LL, oven roasting and microwaving for ST. IF was cooked in boiling water. Both meat and water temperatures were monitored with iron-constantan thermocouples connected to a digital potentiometer. Boiling was discontinued when meat temperature equalled water temperature (after about 3 h). Two adjacent steaks approximately 3 cm in thickness were cut from the cranial end of LL. Both steaks were placed on the rack of a preheated electric grill (220°C), and broiled for 6 min (3 min/side, final internal temperature of 65°C). Paired ST roasts from the left and right sides of each carcass were assigned in turn to a "conventional" oven or a microwave oven. Conventional roasting was performed at 180°C in a preheated forced air convection oven. An iron-constantan thermocouple inserted in the centre of the roast was used to determine when an end-point temperature of 75°C was reached. Each roast had been turned halfway through cooking. For microwave roasting (2450 MHz, 1000 Watts variable power oven equipped with a revolving plate), the power control was set at "high" (700 W) for the first 10 min, then at "roast" (350 W) for the following 15 min, and finally at "roast+grill" (350 W+grill) for the last 5 min. Such a cooking procedure was developed during preliminary tests to attain a final internal temperature of 75°C, as checked with a digital thermometer upon removal from the oven. Each microwaved roast was allowed an uncovered 20-min standing period after cooking. The separable lean dissected from each raw cut (or portion) and the controlateral (or adiacent) cooked one was homogenised and analysed for moisture, protein, and ash (**1**), total lipids (**6**), and individual purine bases (**3**). Percent true retention of nutrients was calculated by a method described by Murphy *et al.* (**10**). Analysis of variance and, when appropriate, Duncan's multiple range test (acceptable level of probability = 5%) were conducted by using the Statistica/Mac™ software package, release 3.0 (StatSoft, Inc., Tulsa, OK, USA).

Results and Discussion

As expected, true retention values for moisture and ash were the lowest for boiling, the highest for broiling, with oven roasting and microwaving between the two (Table 1). Likewise, protein retention values were in agreement with published data (**11, 12**). The fairly low fat retention values could be attributed to a combination of low marbling and total trimming of subcutaneous fat, as suggested by some authors (**2, 5, 8, 9, 13, 16**). Purine content of raw and cooked cuts (Table 2) were substantially within the range of literature data available for beef muscles (**3, 4, 15**). A 100-g portion of boiled IF gave the lowest amount of hypoxanthine and the highest amounts of adenine, guanine and xanthine. Conversely, a portion of broiled LL had the highest content of hypoxanthine (almost double that of IF). As to true retention values, no statistically significant differences among cooking methods were observed only for guanine. Broiling showed the highest retention values for adenine, xanthine and hypoxanthine, boiling instead had the lowest, which recalls what has been observed for moisture and ash retentions. True retention values for oven roasting and microwaving were between those for boiling and broiling. Only for hypoxanthine retention, oven roasting and microwaving were significantly different, the latter having a higher value.

Conclusions

True retention values of purine bases for boiling were decidedly different from those for broiling; oven roasting and microwaving gave intermediate results. Boiling was able to give the lowest retention values of the most uricogenic bases (adenine and hypoxanthine).

References

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Table 1 - Proximate composition of raw and cooked beef muscles, with retention values (g/100 g lean, except where noted)[a]

Constituent[b]	*M. infraspinatus* (boiling)	*M. longissimus lumborum* (broiling)	*M. semitendinosus* (oven roasting)	*M. semitendinosus* (microwaving)
Moisture				
raw	72.54 ± 0.65 c	73.81 ± 0.19 b	74.97 ± 0.11 a	74.85 ± 0.17 a
cooked	58.68 ± 0.58 c	66.91 ± 0.29 a	62.89 ± 0.26 b	63.49 ± 0.34 b
true retention (%)	48.00 ± 0.64 d	70.94 ± 0.97 a	52.11 ± 0.53 c	54.24 ± 0.48 b
Protein				
raw	19.09 ± 0.20 b	21.65 ± 0.12 a	21.52 ± 0.12 a	21.53 ± 0.12 a
cooked	29.34 ± 0.43 b	27.48 ± 0.33 c	32.14 ± 0.28 a	31.42 ± 0.20 a
true retention (%)	91.11 ± 0.66 b	99.23 ± 0.47 a	92.71 ± 0.50 b	93.32 ± 0.69 b
Lipids				
raw	7.10 ± 0.66 a	3.28 ± 0.19 b	2.39 ± 0.10 c	2.60 ± 0.20 c
cooked	11.09 ± 0.80 a	4.19 ± 0.25 b	3.87 ± 0.21 b	4.09 ± 0.34 b
true retention (%)	94.09 ± 3.24 a	100.58 ± 3.25 a	100.31 ± 2.72 a	100.22 ± 2.33 a
Ash				
raw	0.95 ± 0.01 c	1.08 ± 0.01 b	1.14 ± 0.01 a	1.13 ± 0.01 a
cooked	0.76 ± 0.01 c	1.21 ± 0.02 a	1.16 ± 0.01 b	1.16 ± 0.01 b
true retention (%)	47.76 ± 0.83 c	87.30 ± 1.34 a	63.19 ± 0.89 b	65.64 ± 0.92 b

[a]Values are mean ± standard error of the mean.
[b]Means on the same row followed by different letters differ significantly ($P \leq 0.05$).

Table 2 - Purine content of raw and cooked beef muscles, with retention values (mg/100 g lean, except where noted)[a]

Constituent[b]	*M. infraspinatus* (boiling)	*M. longissimus lumborum* (broiling)	*M. semitendinosus* (oven roasting)	*M. semitendinosus* (microwaving)
Adenine				
raw	13.73 ± 0.27 a	13.88 ± 0.40 a	12.77 ± 0.42 a	12.83 ± 0.34 a
cooked	17.00 ± 0.47 a	15.85 ± 0.37 b	15.77 ± 0.37 b	15.75 ± 0.39 b
true retention (%)	73.38 ± 0.97 c	89.77 ± 1.90 a	76.95 ± 1.34 bc	78.57 ± 1.01 b
Guanine				
raw	11.92 ± 0.20 a	10.80 ± 0.35 b	9.11 ± 0.28 c	9.09 ± 0.22 c
cooked	19.30 ± 0.37 a	13.22 ± 0.41 b	13.50 ± 0.37 b	13.26 ± 0.32 b
true retention (%)	96.06 ± 1.33 a	96.10 ± 1.37 a	92.16 ± 1.34 a	93.28 ± 0.79 a
Xanthine				
raw	10.15 ± 1.28 a	3.68 ± 0.41 b	5.53 ± 0.59 b	5.29 ± 0.57 b
cooked	8.45 ± 0.92 a	4.09 ± 0.48 b	5.52 ± 0.52 b	5.22 ± 0.46 b
true retention (%)	50.54 ± 2.63 c	87.04 ± 2.77 a	62.86 ± 2.02 b	64.50 ± 1.88 b
Hypoxanthine				
raw	50.75 ± 1.39 b	77.79 ± 1.43 a	77.44 ± 1.56 a	76.77 ± 1.27 a
cooked	45.72 ± 0.96 c	86.91 ± 1.33 a	81.77 ± 1.47 b	83.28 ± 1.39 ab
true retention (%)	53.55 ± 0.85 d	87.70 ± 1.26 a	65.66 ± 1.09 c	69.44 ± 1.17 b

[a]Values are mean ± standard error of the mean.
[b]Means on the same row followed by different letters differ significantly ($P \leq 0.05$).