
RESEARCH AND PROFESSIONAL BRIEFS

Sensory qualities and nutrient retention of beef strips prepared by different household cooking techniques

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The sensory qualities and nutritive content of foods, including meats, may be altered by household cooking techniques. Beef cuts are good sources of many nutrients that are frequently consumed in less than adequate quantities by Americans. These nutrients include vitamin B-6, iron, zinc, and perhaps magnesium (1,2). Consumption of the first three is a potential public health issue (2).

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Stir-fry and microwave cooking of meat strips are convenient and increasingly popular methods of food preparation. The purpose of this study was to determine the sensory qualities and retention of selected nutrients of beef strips cooked by household broiling, microwaving, and stir-frying methods.

METHODS

Beef top rounds, labeled US Department of Agriculture (USDA) Choice, were obtained from two sources and cut into 0.5x2.5x4-cm strips with no separable fat. Samples were stored at -4°C (25°F) for 24 to 48 hours before slicing and freezing.

Beef strips, thawed to 5°C (41°F), from each source were cooked on three different occasions by stir-frying, microwaving, or broiling to medium doneness as indicated by internal temperatures of 71°C (160°F) (3). Internal temperatures were measured using a probe placed in the

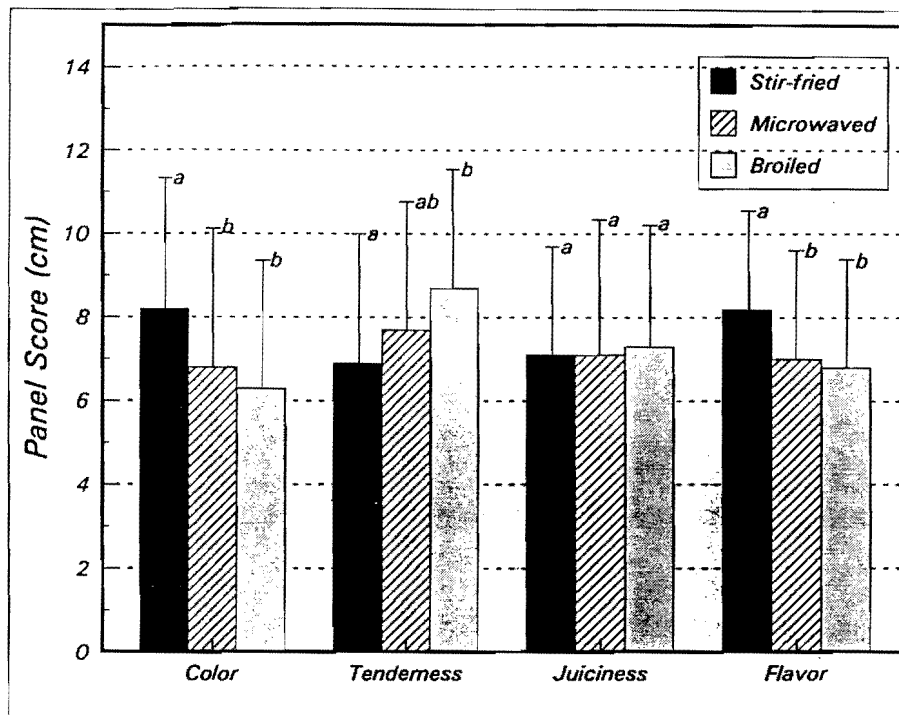


FIG 1. Sensory evaluation of beef strips after three methods of cooking as evaluated by a trained panel. Values represent means \pm standard deviations. The a-b values for each attribute not sharing a common superscript are significantly different at $P < 0.01$. Attributes were scored as follows: color—grayish-light brown to darker brown; tenderness—very tough to very tender; juiciness—very dry to very juicy; and flavor—absence of flavor to characteristic flavor (0 indicates lowest degree of attribute and 15 indicates highest).

middle of the strips. We cooked approximately 300 g, or three servings (typical American household size), at a time. All pans were wiped with 2.75 g vegetable oil. For stir-frying, a wok was preheated to the high temperature setting—about 204°C (400°F)—and strips were placed in the wok and stirred. For microwaving, the strips were put on a pan and put into the microwave at a power-level setting of medium-high. For broiling, strips were placed on the broiler pan and broiled at 232°C (450°F).

Cooked samples were cooled to room temperature. Half of each sample was used for sensory evaluations and the remainder (and the raw sample) was homogenized and frozen for future analyses.

Fourteen subjects, 11 women and 3 men, 26 to 40 years old, volunteered to be panelists. Panelists were trained (4,5) in evaluating cooked beef strips for differences in color, tenderness, juiciness, and flavor. Panelists evaluated the beef cooked by the three methods for color (grayish-light brown to darker brown), tenderness (very tough to very tender), juiciness (very dry to very juicy), and flavor (absence to characteristic flavor) using 15-cm, anchored line scales (in which 0 indicated the lowest degree of attribute and 15 indicated highest).

The vitamin B-6 (6), thiamin (7) as "index nutrient" or the most labile nutrient found in meats, iron (8), magnesium, zinc, moisture, and crude fat (7) contents of the raw and cooked meat samples were deter-

mined. Percentage recoveries of nutrients ranged from 92% to 98%. True retention values (9) were calculated.

Data were analyzed by strip-split plot analysis of variance (Strip-Split ANOVA, version 6.07, 1989, SAS Institute, Inc, Cary, NC). Cooking method was the strip and source was the split. Replications and panelists (sensory data only) and their interactions were included in the model. Differences were considered significant at $P < 0.05$.

RESULTS AND DISCUSSION

Cooking Time and Yield

Beef strips were cooked by the three methods to the same internal temperature of 71°C (160°F). Cooking times were 3.00 minutes for stir-frying; 3.25 minutes for broiling; and 3.50 minutes for microwaving. Mean yields were 70.2% for stir-frying, 63.9% for microwaving, and 61.8% for broiling.

Sensory Evaluation

In general, sensory qualities of beef samples from the two sources and the three cooking methods were similar. Panelists differed significantly ($P < 0.01$) as to their ratings for color, tenderness, and juiciness of beef cooked by the three methods; however, no panelist was a consistent outlier. Significant ($P < 0.05$) panelist-treatment interactions were observed for color and flavor.

Sensory evaluations of beef strips cooked by the three methods are given in Figure 1.

Beef strips cooked by stir-frying were significantly darker brown than those cooked by broiling or microwaving. Stir-fried beef was significantly tougher than broiled beef but not microwaved beef, and all had similar juiciness. Beef cooked by stir-frying had flavor significantly more characteristic of beef than microwaved or broiled beef.

Data on sensory evaluation of beef strips are lacking. Color, texture, and flavor ratings of beef roasts have been reported to be adversely affected by microwaving (10).

Nutrient Retention

The mean (\pm standard deviation) values of vitamin B-6, thiamin, iron, magnesium, and zinc content for raw beef strips used in this study were 0.596 \pm 0.012, 0.095 \pm 0.001, 1.852 \pm 0.059, 21.285 \pm 0.945, and 3.825 \pm 0.433 mg/100 g, respectively. USDA Handbook 8 (9) does not have values for raw or cooked top-round beef strips, but the vitamin B-6, iron, magnesium, and zinc contents of the strips were rather similar to those published for round steak (9). True retention values of all five nutrients were significantly higher in strips that were cooked by stir-frying than in those cooked by microwaving or broiling (Figure 2). Data about retention of these five nutrients in meat strips are lacking.

Vitamin B-6 retention values reported by others for various larger cuts of beef, roasted or braised, range from 42% to 88% (11-13), and Handbook 8 (9) gives 74% and 66% for broiled and roasted separable lean of beef products. Mean thiamin reten-

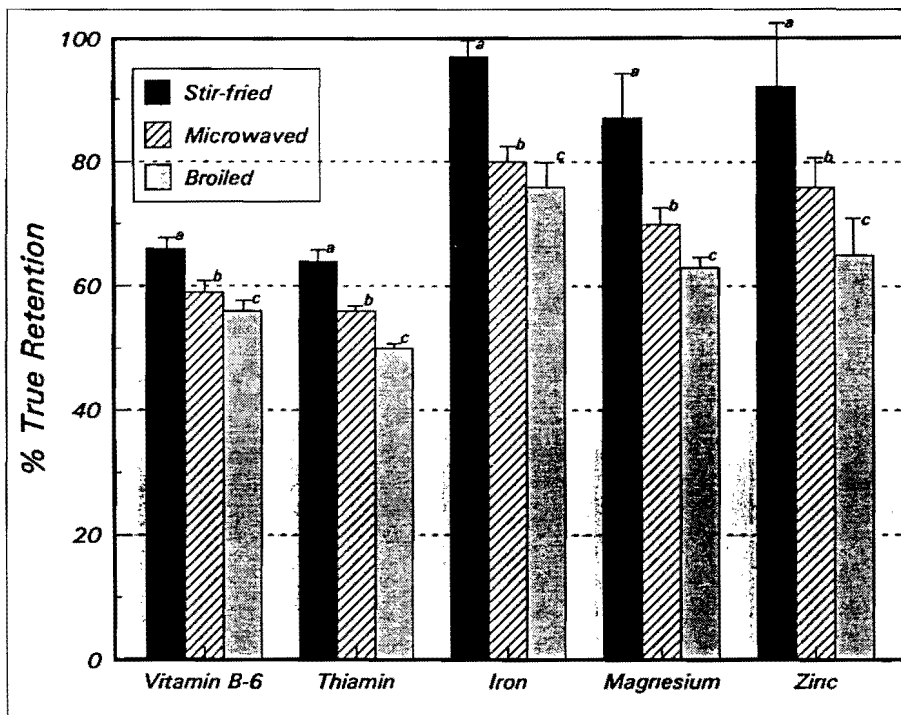


FIG 2. True retention values of selected nutrients in beef strips cooked by three different methods. Values represent mean \pm standard deviations. The a-c values for each nutrient not sharing a common superscript are significantly different at $P < .01$ or, for magnesium, $P < .05$.

tion values reported by others for beef roasts cooked by conventional oven methods were 83% (10) and 75% (14) and by microwave, 63% (10). Handbook 8 (9) gives values of 70% and 58% for broiled and roasted separable lean of beef products. We found that true retention values for vitamin B-6 and thiamin were lower than those given in Handbook 8 for the larger pieces of beef; however, more surface area was exposed in this study.

Our findings for true retention values for iron and magnesium in beef strips were similar to those reported for broiled and roasted separable lean of beef products in Handbook 8 (9), which ranged from 83% to 99%.

Moisture and crude fat content (mean \pm standard deviation = 59.5 ± 3.0 and 6.5 ± 1.9 g/100 g, respectively) of the strips cooked by the different methods were similar.

Regardless of cooking method used, beef strips were found to be good sources of four nutrients (vitamin B-6, iron, magnesium, and zinc) that Americans frequently consume in low quantities. Consumption of 100 g cooked beef strips provides approximately the following percentages of the 1989 Recommended Dietary Allowances (15) for men and women: 22% to 35% for vitamin B-6; 15% to 26% for iron; 6% to 9% for magnesium; and 27% to 41% for zinc.

APPLICATIONS

Beef strips may be cooked quickly and conveniently by stir-frying, microwaving,

and broiling. In this study, beef strips cooked by stir-frying were darker brown and had flavor more characteristic of beef than those cooked by microwaving and broiling. True retention values of vitamin B-6, thiamin, iron, magnesium, and zinc were higher in beef strips cooked by stir-frying than in those cooked by microwaving and broiling. Beef is a good source of nutrients that Americans frequently consume in low amounts. Stir-fried beef cooked to medium doneness (perhaps desirable from a food safety viewpoint) appears to be quickly and easily prepared, tasty, and high in nutrient content. ■

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