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Comparison of flavor changes in cooked–refrigerated beef, pork and chicken meat patties

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Abstract

Beef and pork *longissimus dorsi* (LD) and *semimembranosus* (SM) and chicken breast (B) and thigh (T) muscles excised 24 h postmortem were ground by muscle/species group, formed into patties, pan-fried, refrigerated for 0, 3 or 6 days, and evaluated by a trained sensory panel for intensity of specific flavors. The rate of decline in species-specific natural meat flavor intensity and the rate of increase in "cardboard" (CBD) flavor intensity during the first half of the 6-day storage were fastest for beef, while such decline and increase during the entire storage period were slowest for chicken B. Overall trends of natural meat flavor and CBD intensity changes for chicken T appeared more like those for the red meats than chicken B. It was concluded that, while flavor deterioration can occur in cooked–stored meats from all the species, quantitative or the magnitude of differences between species would depend on muscle types and sensory terms/method used.

Keywords: Comparison of flavor changes; Trained-panel sensory evaluation; Beef; Chicken; Pork

1. Introduction

Lipid oxidation has been considered the primary cause of flavor deterioration and the development of oxidized flavors (generally called "warmed-over flavor") in cooked–stored meat (Shahidi, 1994; St. Angelo & Bailey, 1987). However, the potential contribution of reactions involving protein degradation to such flavor changes cannot be ruled out (Byrne et al., 2001; Spanier, Edwards, & Dupuy, 1988; St. Angelo, Vercellotti, Dupuy, & Spanier, 1988).

We mentioned previously (Rhee, Anderson, & Sams, 1996) that, although there had been many studies (see Rhee et al. (1996) for citations) indicating that lipid oxidation potential might vary among meats from different animal species, the species-related differences had not been consistent among such studies. We also mentioned that the inconsistent species effect could have been due to differences in experimental variables/conditions, including postmortem muscle removal time, muscle tissue site, animal diet, sample handling, and analytical method, among others. With such hypothesis, our previous study (Rhee et al., 1996) compared lipid oxidation potential of beef, pork and chicken patties (raw and cooked) under carefully defined and controlled conditions. The present paper reports flavor changes during 4 °C storage of cooked patties from the same meats.

2. Materials and methods

Our previous report (Rhee et al., 1996) has provided detailed descriptions for preparation of meat samples,

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cooking and storage. Briefly, beef and pork LD and SM and chicken B and T muscles were excised 24 h postmortem from carcasses of marketweight grain-finished feedlot beef cattle, marketweight hogs on a typical finishing diet, and sexually immature male broilers (~8 weeks of age) on a commercial grain diet. For beef, three carcasses were used; each muscle from one carcass constituted an experimental unit, with a total of three units (3 batches; 5.5 kg/batch) produced to replicate the experiment three times. For pork, samples of each muscle from two carcasses were pooled to form an experimental unit (5.5 kg), with a total of six carcasses used to replicate the experiment three times. For chicken, ~50 birds were utilized to produce three units (5.5 kg/unit) of B or T. Immediately after excision from carcasses, each muscle batch was ground twice, formed into patties, pan-fried to an internal temperature of ~74 °C, and stored at 4 °C for 0, 3, or 6 days in 17.7 cm by 20.2 cm Ziploc® freezer bags (one patty/bag), as described previously (Rhee et al., 1996). Since the cooked–stored patties were to be used for sensory evaluation (taste testing), the maximum storage time was limited to 6 days to avoid any microbial spoilage of the patties under the aforementioned storage temperature/packaging condition.

The meat patties were evaluated for intensity of flavor attributes on a scale of 0 (=absent) to 15. Sensory panel consisted of five trained panelists at the sensory testing laboratory of the Texas A&M University Animal Science Department. The panelists had been selected and trained by the procedures of Meilgaard, Civille, and Carr (1991). For evaluation of cooked–stored–reheated meat for off-flavors, the panelists had been trained following the general principles outlined by Johnson and Civille (1986) who, with the use of an "expert panel," proposed a list of terms to describe the taste of warmed-over meat flavor. Our panelists had at least several years of experience in evaluation of meat products prior to this study. The panelists were retrained for this study in two sessions held over two days (1 session/day, ~2 h/session). Retraining samples included freshly cooked as well as cooked–refrigerated–reheated beef, pork and chicken patties. Appropriate descriptive terms for flavors (aromatic taste sensations) of the meats were decided during the retraining sessions. Experimental samples were evaluated in a total of nine sessions held over 3 days (3 sessions/day, with a 15-min break between sessions), and the three experimental units within a muscle/species group were evaluated on different days. On each evaluation day, the three species were randomly assigned to the three sessions. In each session, panelists received a species-specific ballot, and evaluated day-0, day-3 and day-6 samples of the two muscle types of a species two times within the session. Sample serving order in each session was randomized. Patties stored for 3 or 6 days were reheated in a microwave oven to an internal temperature of ~57 °C before serving. Day-0 patties were cooked immediately before serving. Each patty was cut into six wedges, and coded samples were served monadically. Unsalted crackers and distilled–deionized water at room temperature were provided to cleanse the palate between samples. Evaluation was performed in individual booths, under red-filtered incandescent lighting.

The Statistical Analysis System (SAS, 1997) program was used for data analysis. For the data presented in Table 1, the General Linear Models Procedure was used for analysis of variance, with meat batches and panelists included in the model. The Tukey's Studentized range test was used to separate means. Additionally, Correlation Procedure was used where appropriate (Table 2); correlation coefficients were computed for each species with both muscle types of the species included. Significance was established at $P \leqslant 0.05$ unless otherwise indicated.

3. Results and discussion

Average total fat contents of the cooked patties, as reported previously (Rhee et al., 1996), were 5.28% for beef (B)/LD, 4.21% for B/SM, 5.83% for pork (P)/LD, 4.75% for P/SM, 1.92% for chicken (C)/B, and 7.46% for C/T. Sensory scores for cooked–refrigerated patties are presented in Table 1. For B/LD, the storage time affected intensity of the species-specific natural/normal meat flavor "cooked beef" (decreased over storage), "grainy/cowy" (decreased), "cardboard" (CBD; increased), "painty" (increased), and "browned" (increased). For B/SM, storage had no significant effect on grainy/cowy and browned flavors. As for pork patties, storage decreased intensity of the species-specific natural meat flavor "cooked pork" and increased CBD intensity for P/LD; storage also increased intensity of the painty note for P/SM. For chicken patties, CBD and "soured" intensity increased with storage time for C/B, while "cooked chicken" intensity decreased and CBD intensity increased for C/T.

Fig. 1 illustrates relative storage effects on intensity of the natural meat flavors ("cooked beef," "cooked pork" and "cooked chicken" aromatics) and CBD, with day-3 and day-6 scores expressed relative to day-0 scores. Such data transformation allowed all the muscle/species groups to have a common intercept on Y axis, and facilitated the assessment and comparison of flavor deterioration rates of the six muscle/species groups. C/B exhibited the slowest rate of decrease in species-specific natural flavor intensity and the slowest rate of increase in CBD intensity. Perhaps, the CBD taste sensation might not have been the most relevant term to describe the oxidized flavor of cooked–stored chicken breast (white) meat. In a recent study (Byrne, Bredie, Mottram,