Research Note

Glutamic-Oxaloacetic Transaminase Activity in Commercially Processed Chicken: An Indicator of Product End-Point Temperature†

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ABSTRACT

Residual glutamic-oxaloacetic transaminase (GOT) activity in laboratory-prepared samples of white and dark chicken meat heat treated to end-point temperatures (EPTs) of 70 to 75°C were determined. Declines in activity with increasing EPTs occurred in both tissue types; activities were significantly higher \((P < 0.05)\) in dark meat samples at all EPTs except 75°C. Regression coefficients of GOT activities on EPTs of the laboratory prepared samples were rearranged to estimate EPTs for poultry products obtained from a commercial processing plant. Desired EPTs of the commercial products were 71 and 74°C for white and dark meat, respectively. Product EPTs estimated by measurement of residual GOT activities were 74 to 75°C. Measurement of residual GOT activity appears to be a rapid, accurate means to estimate EPTs in commercially produced poultry products of uniform size and thickness.

Key words: Chicken, end-point temperature, glutamic-oxaloacetic transaminase, GOT

Recent concerns regarding the safety of food products have prompted research to develop rapid, accurate means to verify proper handling and processing procedures for poultry and red meats. With poultry products, emphasis has been placed on detection and prevention of microbial contamination of freshly slaughtered birds and development of methodologies to determine end-point temperatures (EPTs) to which products have been cooked. Objective methods to determine EPTs in processed poultry have been based primarily on the analysis of residual enzyme activities remaining in the meat after heating. Notable studies utilizing this approach are those of Abouzied et al. (1), Collins et al. (3), Townsend and Thompson (8), Townsend et al. (9), Townsend and Davis (6), Townsend et al. (7), and Senter et al. (5), who developed procedures to measure residual glutamic-oxaloacetic transaminase (GOT) with a Sigma Diagnostics Procedure kit (No. 505, Sigma Chemical Co., St. Louis, MO). In the latter study, the potential of GOT analysis was indicated for use in determining the more specific EPTs recently recommended for poultry products (2).

The presently recommended internal EPTs for processed poultry, which are based on treatments that destroy Salmonella microorganisms (10), are 68.3 and 71.1°C for cured and/or smoked and uncured poultry products, respectively. A recent consensus of the U. S. Department of Agriculture’s Food Safety Inspection Service and the Food and Drug Administration for EPTs of cooked poultry, however, stipulates that products processed in federally inspected establishments should be cooked to an internal temperature of 71.1°C; those provided by food handlers and retailers, 73.8°C.

The present study was conducted to test the Sigma GOT analysis procedures for use as an indicator of EPTs in commercially produced poultry products.

MATERIALS AND METHODS

Laboratory heat treatment of nonfrozen samples

Two packs each of nonfrozen chicken breasts and thighs, each consisting of four split breasts or six thighs, were purchased from a local retailer on three separate occasions for replication of analyses. The samples were stored at 4°C for no longer than 24 h prior to preparation for heat treating and analysis. Meat from the two packages was maintained separately for duplication of analyses for both white and dark meats. Pieces were skinned and deboned and fat and connective tissue were removed before being diced and chopped for 3 min with a food processor. Fifty grams of each prepared composite were divided and equal quantities were then packed into 6 glass cooking tubes (29 by 200 mm). Samples were equilibrated to 0.6°C in an ice bath and then cooked to EPTs of either 70, 71, 72, 73, 74, or 75°C in a Neslab RT-220 water bath (Neslab Instruments, Inc., Portsmouth, NH) that was maintained within ±0.2°C of the desired setpoints. A Physitemp HT-1 copper-constantan thermocouple probe (Physitemp Instruments, ...)
Commercial samples
Prepared whole-muscle chicken breasts, formed breast patties, Julienne strips of breast meat, marinated (honey-mustard) breast patties, diced thigh meat, and a diced white-dark chicken meat mixture (50/50 by weight) were obtained from a major commercial poultry-meat processor. Samples within each type were of approximately uniform area and thickness. White- and dark-meat samples had been cooked to target EPTs of 71.1 and 73.9°C, respectively, in a continuous, single-pass, radiant-heating processing oven. Quality control personnel monitoring the cooking process noted that a 5°C temperature difference above the target EPT was commonplace. Approximately 2 kg of each sample was obtained at the postfreezing operation and maintained at -20°C until analyzed.

GOT analysis
Stored samples were thawed at 4°C. Twelve observations per heating treatment were made on the laboratory-prepared samples. TriPLICATE portions of 150 to 180 g, consisting of 3 whole-muscle breasts, 3 formed patties, or an equivalent quantity of strips or diced product, were taken from each of the commercial samples for analysis. Each sample was chopped with a Food Processor. Duplicate 10-g portions were taken for extraction and analysis and then blended with 20 ml of saline solution (0.9% wt/vol NaCl, pH 7.0) for 30 s with a Polytorn homogenizer (Brinkman Instrument Co., Westbury, CT) set at 70% maximum speed. Slurries were centrifuged at 15,000 × g and then filtered with no. 588 S&S filter paper (Schleicher and Schuell Inc., Keene, NH). Residual GOT activity was determined on either 0.2 or 0.4 ml of the extracts using a Sigma no. 505 Diagnostics Procedure kit (5). The volumes of extracts used for analysis depended on the dilution required to maintain measurable activity levels within 0.2 and 0.6 absorbance units at 505 nm.

Statistical analysis
An analysis of variance of data sets was performed with the general linear models procedure of SAS® (4). Mean values at the specified temperatures were compared by least significant difference (LSD) analysis at the 5% probability level and plotted using temperatures as the fixed-class effect. Regression analysis of the relationships between GOT concentrations for the white and dark meat and EPTs was performed so that unit activity in the commercially prepared samples could be used to estimate EPTs.

RESULTS
Residual GOT activities (as Sigma-Frankel units of activity per gram of tissue [SFUs/g]) decreased with increasing temperatures in both the white- and dark-meat samples. In the dark meat (Fig. 1), mean activities of 3543 ± 181, 3135 ± 255, 2382 ± 173, 1483 ± 259, 545 ± 87, and 364 ± 80 SFUs/g at EPTs 70, 71, 72, 73, 74, and 75°C, respectively, differed significantly at P < 0.05. Declines in the white meat followed similar trends (Fig. 1); values at the specified EPTs were 2096 ± 288, 1649 ± 205, 1159 ± 163, 649 ± 185, 393 ± 96, and 305 ± 73 SFUs/g, respectively. Values for the white and dark meats differed significantly (P < 0.05) except at EPTs 74°C and 75°C, where differences were not significant at the 5% level. Values for dark meat exceeded those for white meat at all EPTs except at 75°C, where values were not significant at P < 0.05. Variation within replicate samples was not significant (P > 0.05) at any EPT.

Residual GOT activities and estimated EPTs of the commercial samples analyzed are given in Table 1. Residual GOT activities ranged from 75 to 277 SFUs/g of tissue and were used to estimate EPTs from the regression equations established from analysis of the laboratory-prepared white- and dark-meat samples. These tests showed that all samples had been processed to an EPT of 74°C to 75°C.

DISCUSSION
Residual GOT activity appears to be an acceptable indicator of EPTs in commercially cooked poultry meat within the range of temperatures specified in this study. The

TABLE 1. Estimated end-point temperatures (EPTs) of commercially cooked chicken products using residual glutamic-oxaloacetic transaminase (GOT) activity

<table>
<thead>
<tr>
<th>Sample, meat type</th>
<th>SFUs/g</th>
<th>Estimated EPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole muscle, white</td>
<td>277</td>
<td>74.4</td>
</tr>
<tr>
<td>Formed patties, white</td>
<td>75</td>
<td>74.9</td>
</tr>
<tr>
<td>Julienne strips, white</td>
<td>227</td>
<td>74.5</td>
</tr>
<tr>
<td>Marinated, white</td>
<td>214</td>
<td>74.5</td>
</tr>
<tr>
<td>Diced thigh, dark</td>
<td>25</td>
<td>74.7</td>
</tr>
<tr>
<td>Diced white-dark (50/50)</td>
<td>203</td>
<td>74.8</td>
</tr>
</tbody>
</table>

* SFUs/g. Sigma Frankel units of residual activity per gram of tissue.
significant differences in residual activities between white and dark meat did not require modification of the analytical procedures; however, the low activities present in both types of meats processed to EPTs higher than 73°C did require the use of 0.4 ml of extract instead of the 0.2 ml routinely used at lower temperatures. The estimated EPTs that we determined (74 to 75°C) were in keeping with the physically measured temperatures taken at the processing plant. Limitation of the test appears to be related to consistency in the time-temperature relationship required to reach the desired internal temperature; consistency being related to the area and/or thickness of the product and the heating-source temperature. When products have this consistency, as in mass production, the measurement of residual GOT activity can be a rapid and reliable means to determine EPTs in commercially prepared poultry products.

REFERENCES


