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Abstract

Liquid smoke (LS) effectiveness in controlling lipid oxidation and warmed-over flavor (WOF) in beef was investigated. Aroma scores, "Î±-thiobarbituri c acid (TBA) numbers, and pH values were lower (P<.05) in LS-treated beef patties than in patties without LS. LS has useful antioxidative properties in precooked ground beef patties at the normally recommended percentage of 1.5%. That should reduce undesirable flavor development and product loss.

Keywords

Cattlemen's Day, 1997; Kansas Agricultural Experiment Station contribution; no. 97-309-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 783; Beef; Liquid smoke; Warmed-over flavor; Precooked beef patties

ANTIOXIDANT PROPERTIES OF LIQUID SMOKE IN PRECOOKED BEEF PATTIES

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Summary

Liquid smoke (LS) effectiveness in controlling lipid oxidation and warmed-over flavor (WOF) in beef was investigated. Aroma scores, α-thiobarbituric acid (TBA) numbers, and pH values were lower (P<.05) in LS-treated beef patties than in patties without LS. LS has useful antioxidative properties in precooked ground beef patties at the normally recommended percentage of 1.5%. That should reduce undesirable flavor development and product loss.

(Key Words: Liquid Smoke, Warmed-Over Flavor, Precooked Beef Patties.)

Introduction

Ground beef, in addition to food safety concerns, is susceptible to developing warmed-over flavor (oxidative rancidity). Although WOF can develop in fresh meat, it most commonly occurs in meats that are cooked or in which the cellular membranes are broken by processes such as restructuring or grinding. Antioxidants can effectively control or retard lipid oxidation in meat products.

Smoking of food, an effective antioxidant process, contributes substantially to preservation. Like natural smoke, liquid smoke solutions act as antioxidants, primarily because of phenol compounds. They prevent fat oxidation by stabilizing free radicals and are effective in retarding or preventing the development of oxidative off-flavors. Our objective was to evaluate the antioxidative properties of liquid smoke (LS) when used at the normally recommended level in precooked beef patties.

Experimental Procedures

Nine kg of fresh beef gooseneck round (2 weeks old), ground successively through 1/2 in., 3/16 in., and 1/8 in. plates, was formulated to yield 20% fat. One half of the meat block was treated with 1.5% LS, and the other half was used as a control. The treatment and the control each were blended in a mixer for 2 min. The ground beef was made into 1/4 lb patties (1/2 in. thick), using a patty machine (Hollymatic Corp., Countryside, IL). The study was repeated three times.

Patties were cooked according to American Meat Science Association (AMSA) Cookery Guidelines on a preheated (325°F) electric skillet to 160°F internally. To obtain uniform heat distribution, patties were turned every 1.5 min. After 4.5 min of cooking, patties were turned every 30 sec. Individual patties were removed when they reached 155 to 160°F, monitored by a needle probe connected to a temperature recorder. Patties were packaged individually aerobically in heat-sealed plastic bags and immediately frozen at 5°F. Patties evaluated on day 0 were not frozen.

A five-member, sensory panel from the KSU Department of Animal Sciences and Industry evaluated WOF intensity of the beef patties. Frozen precooked beef patties were thawed at 40°F for 24 hr. Samples were reheated to an internal temperature of 160°F and kept warm in an oven. Taste panel evaluations were made on 1/4 patty portions that were reheated and placed in glass petri dishes. Panelists used a 5-point scale (1= no, 2 = slight, 3 = moderate, 4 = very, and 5= extreme WOF). Five sensory sessions (0, 30, 60, 75, and 90 days) were held in individual booths with combined red and green light and free from

outside noise and odor. Patties were evaluated immediately following presentation and again after 15 min of cooling. Twelve samples (4 samples/ replicate) were presented at each session. TBA was determined as a measure of fat rancidity.

Measurements of pH were taken from duplicate thawed cooked beef patties at each time of evaluation. Ten g of sample and 40 ml of deionized distilled water were combined in a stomacher bag and blended for 1 min before pH was measured.

Results and Discussion

Liquid smoke treated beef patties had lower ($P<.05$) aroma scores (less warmed over) compared to nontreated beef patties, both immediately after warming and after 15 min of cooling. The aroma of LS-treated beef patties evaluated immediately after presentation did not change ($P>.05$) from day 0 to day 90 (data not shown). Aroma scores for nontreated beef patties evaluated immediately after presentation increased after day 0 and again after day 60. Aroma scores for beef patties after a 15-min cooling period were similar to the scores obtained immediately after presentation. However, aroma scores for LS-treated beef patties after the 15 min cooling increased ($P<.05$) by day 90. Some panelists gave higher scores to cold samples.

The TBA numbers were lower ($P<.05$) from LS-treated beef patties than from controls on all sampling days (Figure 1) . The TBA numbers clearly demonstrated that 1.5% LS in precooked beef patties possessed antioxidative properties. The TBA values for untreated precooked beef patties increased during the initial 60 days of frozen storage, then decreased by 75 days, and increased again at 90 days. The TBA values for treated precooked beef patties decreased ($P<.05$) during the first 30 days, then increased, but decreased again after 60 days. The increase and/or decrease in TBA values at different storage times could be explained by the instability of the malonaldehyde produced and/or by the oxidation and further breakdown of different lipid populations at different times. The correlation coefficient between TBA numbers and WOF intensity scores was 0.84 ($P<.05$). Hence, TBA and aroma results were very similar.

The pHs of precooked beef patties before (0 day) and after days 30, 60, 75, and 90 are shown in Figure 2. The pH was higher ($P<.05$) in control than in LS-treated patties at all sampling days. These results were expected, because the pH of the LS was 2.0. Higher meat pH has the disadvantage of causing longer cooking time and/or higher final internal temperature required for complete protein denaturation. Thus, a high pH inhibits formation of brown cooked meat color. Also, muscle with higher pH is more susceptible to microbial problems. Conversely, oxidation of meat pigment is favored by lower pH.

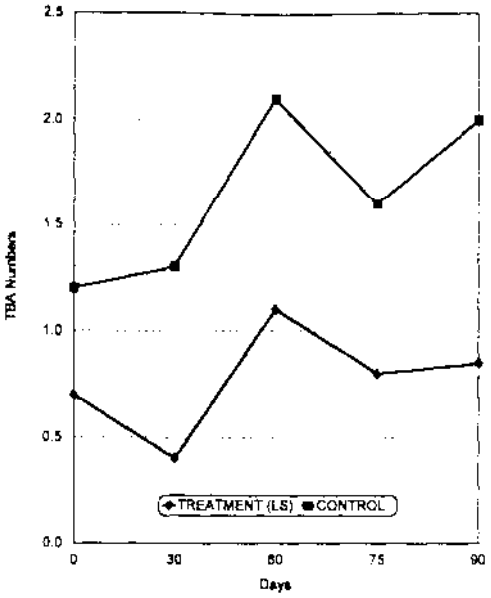

Figure 1. TBA Values for Precooked Beef Patties Treated with 1.5% Liquid Smoke (Treatment) or Not Treated (Control) at Day 0, 30, 60, 75, and 90 of Storage at -15°C. S.E. = .07. ab = Means with same letter are not different (P>.05).

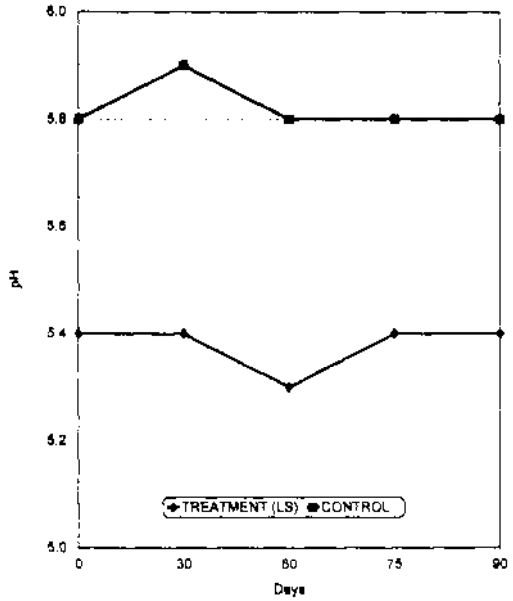

Figure 2. pH of Precooked Beef Patties Treated with 1.5% Liquid Smoke (Treatment) or Not Treated (Control) at Day 0, 30, 60, 75, and 90 of Storage at -15°C. S.E. -.22. ab = Means with same letter are not different (P > .05).