

The effects of reheating methods on the quality characteristics of precooked ground pork patties with various salt and phosphate levels

J. Choi¹, J. Jeong², Y. Choi¹, S. Kim¹, T. Kim¹ & C. Kim^{1*}

¹Department of Food Science and Biotechnology of Animal Resources, Konkuk University, Seoul 143-701, South Korea.

²Department of Animal Science, University of Wisconsin-Madison, Muscle Biology and Meat Science Building, 1805 Linden Drive West, Madison, WI 53706, United States.

*E-mail: kimcj@konkuk.ac.kr.

Abstract

The objective of this study was to determine the effect of reheating methods on the quality characteristics of precooked ground pork patties with various salt and phosphate levels. Cooking and reheating methods used were the electric grill cooking and microwave oven cooking. All treatments were composed by 80% pork ham and 20% pork fat. Salt and phosphate level about each treatment are as follows; S1 - 1% salt, S1+P - 1% salt and 0.3% phosphate, S2 - 2% salt, S2+P - 2% salt and 0.3% phosphate. The pH value reheated during storage was affected by phosphate, but water content was influenced by reheating method and phosphate. Reheating time and rate were affected by phosphate and reheating method, and there was a highly negative relationship between reheating time and rate ($p<0.05$). Reheating methods had a more effect on reheating loss and reduction in diameter, compared with the addition of phosphate. Hardness was affected by reheating methods and phosphate, and there was a negative relationship between water content and hardness in reheating ($p<0.05$). Therefore, reheating methods were more influential on the reheating properties of ground pork patties than the salt and phosphate level.

Introduction

Commercial precooked meat products may be frozen uncooked, frozen cooked, or cooked and stored at refrigerator temperature. Consumers use many cooking methods for eating pre-cooked meat products such as patty and sausage. Studies about reheating have mostly reported the problem such as an off-flavor called “warmed-over flavor”. But several studies have also been studied on the tenderness of whole meat (Obuz *et al.*, 2003) and sausage (Egelandsdal *et al.*, 2007). In order to minimize the change of qualities by reheating, it is necessary to make a basic study on adequate reheating temperature and time for various cooking methods such as conventional and microwave cooking. The objective of this study, therefore, was to determine the effect of reheating methods on the quality characteristics of precooked ground pork patties with various salt and phosphate levels.

Materials and methods

The fresh pork hams (*M. biceps femoris*, *M. semitendinosus*, and *M. semimembranosus*) were purchased from a local processor at 48 h postmortem. Lean muscles were initially ground through Φ-13 mm plate and the pork back fat was ground through Φ-8 mm plate using a meat grinder (PM-70, Mainca, Barcelona, Spain). All treatments were composed by 80% pork ham and 20% pork fat. Salt and phosphate level about each treatment are as follows; S1 - 1% salt, S1+P - 1% salt and 0.3% phosphate, S2 - 2% salt, S2+P - 2% salt and 0.3% phosphate. The mixtures from each batch were mixed for 30 min at 4 °C using a meat mixer (RM-90, Mainca, Barcelona, Spain). Patty was formed into 120±1 g weight, 100 mm diameter, and 15 mm thickness using patty presses and then stored at 4 °C. The cooking methods used were electric grill cooking and microwave cooking. In the electric grill cooking method, patties were cooked by electric grill. Patties were cooked for 3 min on one side and for 3 min on the opposite side, and thereafter flipped over every 2 min until the targeted center temperature reached to 76.5 °C (Zimmermann, 1984) using a digital thermometer. In the microwave cooking method, patties were cooked in a household-type microwave oven with medium-high power (750 W). The center temperature of the patties was measured using a fiber optic system until reached to 76.5 °C. The precooked patties were stored at 4 °C for 3, 6, and 10 days, then were reheated. Electric grill and microwave oven reheating was conducted identically according to each cooking method. The precooked patties were reheated only until the internal temperature of patty reached to 74 °C (Cremer & Hartley, 1988).

The pH value was measured with a pH meter (Model 340, Mettler-Toledo GmbH, Schwerzenbach, Switzerland). The moisture content was determined by weight loss after 12 h of drying at 105 °C in a drying

oven (AOAC, 2000). Reheating time was defined as the time necessary to reach the desired temperature and reheating rate was calculated as differences in initial and final internal temperature divided by reheating time. Reheating loss and reduction in diameter were determined by calculating the weight and diameter differences of patties before and after reheating. The hardness of reheated patties was measured by a texture analyzer (TA-XT2i, Stable Micro Systems Ltd., Surrey, UK). For all the variables measured, ANOVA was performed on all the variables measured using the General Linear Model (GLM) procedure of the SAS statistical package (SAS Inst., 1999).

Results and discussion

The pH of the S1+P and S2+P reheated with phosphate had the highest values, but there was one exceptional result that after cooked by an electric grill and stored for 10 days, the S1+P and S2+P treatments reheated by an electric grill had lower pH values than those reheated by different methods. Treatments reheated by an electric grill had more water contents than those reheated by a microwave oven. Especially, treatments reheated by an electric grill after cooked by the electric grill showed the most water content ($P < 0.05$). The change of water content by reheating showed that treatments reheated had a significantly less water content than precooked. Treatments reheated by a microwave oven had even shorter reheating time than those cooked by a microwave oven and microwave reheating reheated 5.5 times faster than electric grill reheating ($P < 0.05$). A very interesting result is that while cooked and reheated by the same cooking method, the reheating time of the electric grill was longer than cooking time, but the reheating time of the microwave oven was shorter than cooking time. The reheating rate by microwave oven was 4 to 5 times faster than electric grill. The reheating rate of electric grill was slower than cooking rate of same method, but the reheating rate of microwave oven was faster than cooking rate of same method. There was a more reheating loss in treatments reheated by a microwave oven. Especially, microwave oven cooking and reheating methods resulted in the most reheating loss, but the least reheating loss was caused by electric grill cooking and reheating methods ($P < 0.05$). Phosphate added to raw patties reduced cooking loss, but when a raw patty was cooked, the binding structure was already destroyed and thus phosphate could not keep the patty from cooking drip loss during reheating and resulted in a large loss. Similar to the results of reheating loss, reduction in diameter after reheating was more than that of patties cooked. The hardness of treatments reheated by a microwave oven after microwave oven cooking showed the highest value of all the treatments. After storage for 3 days, the S2+P treatment was especially the highest hardness among the microwave oven cooking-microwave oven reheating treatments. The S1 treatment showed significantly lower hardness than treatments containing phosphate regardless of reheating method ($P < 0.05$).

Conclusions

In briefly, the results of this study showed that reheating methods were more influential on the reheating properties of ground pork patties than the salt and phosphate level.

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