RELATIONSHIP BETWEEN FAT LEVEL AND QUALITY CHARACTERISTICS OF GROUND PORK PATTIES COOKED BY MICROWAVE ENERGY

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Introduction

Microwave cooking has provided several benefits in terms of speed and convenience, but its full potential has not been realised because of disadvantages, such as non-uniformity of heating, edge overheating, soggy texture, and lack of browning (Datta *et al.*, 2005; Ryynanen *et al.*, 2004). Many factors, such as composition, cooking methods, and physical properties influence the product quality in ground meat patties during cooking (Ikediala *et al.*, 1996; Troutt *et al.*, 1992). In particular, it is well documented that the amount of fat plays an important role in the quality of ground meat products. Numerous studies have evaluated the effect of fat levels on the sensory and physicochemical properties of ground meat products (Colmenero, 2000; Hoelscher *et al.*, 1987). Fat levels and cooking methods of patties are the most important factors, influencing the quality of cooked patties (Cannell *et al.*, 1989). Depending on cooking methods, patties are often overcooked, leading to a deterioration in textural quality. Microwave cooking has been shown to produce patties with the least amount of fat and calories compared to other cooking methods and reduced fat retention in beef patties (Berry and Leddy, 1984). Jeong *et al.* (2004) found that as fat levels of microwaved ground pork patties increased, cooking loss increased, while conversely, shear force decreased. It is therefore important to understand the interrelationships between these factors on fat content because of their relationship to the ultimate quality of the cooked patties. Therefore, this study was carried out to elucidate the relationship between different levels of fat and the quality characteristics of ground pork patties cooked to reach 75°C in a microwave oven.

Materials and Methods

Fresh pork hams were purchased from a local market at 48h post mortem. Pork back fat was also collected. Lean materials were initially ground through a 13 mm plate and the pork back fat was ground through an 8 mm plate. The fat was added to the lean meat to create patties with fat levels of 5%, 10%, 15%, 20%, and 25%. The mixtures from each batch were mixed by hand for 3 min and twice ground to through a 3mm plate. The ground mixtures were hand-mixed and then formed into patties (90g each) using sterile 15 × 90mm Petri dishes. Patties were then packaged with Nylon/PE film, frozen, and stored at -25°C until testing.

Samples were cooked in a household-type microwave oven (Model RE-M400, Samsung Electronics Co. Ltd., Suwon, Korea) with full power (700W). Patties from all fat levels were held at 1°C for 24-36h prior to cooking. Each patty was placed in microwave-safe plastic containers, located in the centre of the oven, and cooked until the centre of the patty reached the designated end-point temperature (75°C). The container was rotated inside the microwave chamber during the cooking period. The internal temperature of the cooked samples was obtained by inserting an iron-constantan thermocouple probe into the geometric centre of the patty immediately after removal from the oven. Preliminary time-temperature trials were conducted to determine the length of cooking time needed to reach the designated internal temperature. The heating times necessary for each type of patty were: 5% fat = 103 sec; 10% fat = 100 sec; 15% fat = 96 sec; 20% fat = 93 sec; 25% fat = 86 sec. The oven was turned off before an internal temperature of 75°C was reached, and a short period was allowed for the temperature to rise. After the temperature was achieved, the container including the patty and then the patty alone were immediately weighed to determine cooking loss. Cooking rates were calculated as differences in initial and final internal temperature divided by cooking time. Total cooking loss was determined for twenty patties per fat level by calculating the weight differences of patties before and after cooking. Each patty was cut with a knife into 2.5 cm-wide sections and the sections were sheared in two separate locations with a Warner-Bratzler blade set attached to a texture analyser (TA-XT2*i*, Stable Micro System Ltd., Surrey, UK). Data were analyzed in a one-way analysis of variance through the analysis of variance (ANOVA) procedure of the SAS statistical package (SAS Institute Inc., USA). The procedure CORR of the SAS package was used to calculate correlations between fat level and quality characteristics of ground pork patties cooked by microwave energy.

Results and Discussion

The relationship between fat level and cooking rate of ground pork patties cooked by microwave energy was highly significant ($p<0.001$) and showed a non-linear regression. The correlation coefficient between the two measurements had a high positive value ($r=0.72$). The relationship between fat level and total cooking loss of ground pork patties cooked by microwave energy showed a non-linear regression, and the determination coefficient was $R^2=0.9178$. The

correlation coefficient between the two measurements was a very high positive value (r=0.89). Total cooking loss increased with increasing fat levels in the patties ($p<0.001$). As fat level of ground pork patties increased, shear force after cooking decreased. The correlation coefficient between the two measurements was a very high negative value (r=-0.86). The relationship between fat level and shear force of ground pork patties cooked by microwave was highly significant ($p<0.001$) and showed a non-linear regression (R^2=0.954). The cooking rate was positively correlated with total cooking loss (r=0.64, $p<0.001$), but negatively correlated with shear force (r=-0.06, $p<0.001$). Total cooking loss correlated negatively with shear force (r=-0.93, $p<0.001$).

Table 1: Coefficients of correlation among measurements of quality in ground pork patties with different added fat levels cooked by microwave energy.

Measurements	Fat level	Cooking rate	Total cooking loss	Shear force
Fat level	1	0.72***	0.89***	-0.86***
Cooking rate		1	0.64***	-0.60***
Total cooking loss			1	-0.93***
Shear force				1

* $p<0.05$; ** $p<0.01$; *** $p<0.001$.

Conclusions

Fat level was significantly and highly correlated with cooking properties of ground pork patties cooked by microwave. Fat level correlated positively with cooking rate, total cooking loss, and cooking drip loss. On the other hand, fat level correlated negatively with evaporation loss and shear force. To improve the quality characteristics of ground pork patties cooked by microwave energy, more studies of the fat level, and the addition of other ingredients in ground meat patties are necessary.

References

Berry, B.W. and Leddy, K.F. (1984). Effects of fat level and cooking method on sensory and textural properties of ground beef patties. Journal of Food Science, 49, 870-875.

Cannell, L.E., Savell, J.W., Smith, S.B., Cross, H.R. and John, L.C.S.T. (1989). Fatty acid composition and caloric value of ground beef containing low levels of fat. Journal of Food Science, 54, 1163-1168.

Colmenero, F.J. (2000). Relevant factors in strategies for fat reduction in meat products. Trends Food Science Technology, 11, 56-66.

Datta, A.K., Geedipalli, S.S.R., Almeida, M.F. (2005). Microwave combination heating. Food Technology, 59, 1,36-40.

Hoelscher, L.M., Savell, J.W., Harris, J.M., Cross, H.R. and Rhee, K.S. (1987). Effect of initial fat level and cooking method, cholesterol content and caloric value of ground beef patties. Journal of Food Science, 52: 883-885.

Ikediala, J.N., Correia, L.R., Fenton, G.A. and Ben-Abdallah, N. (1996). Finite element modeling of heat transfer in meat patties during single-sided pan-frying. Journal of Food Science, 61: 796-802.

Jeong, J.Y., Lee, E.S., Paik, H.D., Choi, J.H. and Kim, C.J. (2004). Microwave cooking properties of ground pork patties as affected by various fat levels. Journal of Food Science, 69, C708-C712.

Ryynanen, S., Risman, P.O. and Ohlsson, T. (2004) Hamburger composition and microwave heating uniformity. Journal of Food Science, 69, M187-M196.

SAS Institute (1999). SAS User's Guide. Statistical Analysis Systems Institute, Cary, NC, USA.

Troutt, E.S., Hunt, M.C., Johnson, D.E., Claus, J.T., Kostner, C.L., Kropt, D.H., Stroda, S. (1992). Chemical, physical and sensory characterization of ground beef containing 5 to 30 percent fat. Journal of Food Science, 57, 25-29.