EFFECT OF REHEATING METHODS ON PHYSICOCHEMICAL AND SENSORY PROPERTIES OF PRECOOKED TAIWANESE EMULSIFIED MEATBALLS (KUNG-WAN)

Ya-Shiou Chang[1*], Jeng-Hung Liu[2], Rodrigo Tarté[3],

Yi-Wen Chen[1], Su-Jung Hsu[4], Ding-Wei Chen[1]

[1]Department of Animal Science, Chinese Culture University, Taiwan

[2]College of Natural & Applied Sciences, University of Guam, United States

[3]Department of Animal Science, Iowa State University, United States

[4]School of Pharmacy, Taipei Medical University, Taiwan

*Corresponding author email: zyx21@ulive.pccu.edu.tw

I. INTRODUCTION

Taiwanese-style emulsified pork meatball, also known as “Kung-wan”, is one of the popular precooked meat products in Taiwan. Although consumers prefer juicy and springy Kung-wan products [1], cooking methods may have detrimental effects on the quality attributes of this products [2]. Nowadays, microwave (MW) cooking method is more efficient use of energy, compared with time-consuming and much higher footprint conventional cooking processes such as boiling (BL), steaming (SC) and roasting (RT). The aim of this work was to study the effect of different reheating methods (BL, SC, RT and MW) on physicochemical and sensory properties of Kung-wan.

II. MATERIALS AND METHODS

The Kung-wan meatballs (N = 192; 31.36±0.49 g in average) used in this study were manufactured in a local meat processor in Taiwan. Lean ham muscles (m. semimembranosus, m. semitendinosus) (75% of meat block) were trimmed of visible connective tissue, ground through a 8.0-mm plate, mixed with 10% ice flakes, 0.2% phosphate, 1.8% salt, 1.5% sugar, and 0.05% white pepper powder prior and emulsified with pork back fat which had been previously ground through a 6.0-mm plate (25% of meat block). The meatballs were shaped, directly cooked in water at 80 °C for 20 minutes after an internal temperature of 72 °C was achieved, the meatballs were packaged in polyethylene bags and stored at -18 °C for a month. The frozen meatballs were removed from the bag prior to reheating (BL was sealed in a bag and cooked in a water bath at 90 °C for 15 min, SC at 90 °C for 27 min, RT at 230 °C for 12 min, and MW at 500 W for 40 s) to an internal temperature of 72 °C reached and hold for 20 sec. Boiling (BL) was the control group of this study. Reheating loss (%) measurements [3], objective colour features (L*, a* and b*), and sensory evaluation [4] were performed on the reheated samples. This study was replicated three times. Treatments were compared by analysis of variance, using the GLM procedure. Mean values were compared using Tukey’s test (SAS 9.3, SAS Institute, Inc., Cary, NC); P values lower than 0.05 were considered statistically significant.

III. RESULTS AND DISCUSSION

Reheating loss (Table 1) was significantly ($P < 0.05$) higher for MW than for BL, SC and RT ($P < 0.05$) treatments. MW is a rapid cooking process and could negatively affect gel structural homogeneity and water/fat holding properties of emulsified meat product [5]. The lightness (Table 1) of BL samples (59.0±1.0) was higher ($P < 0.05$) than that of SC, RT and MW samples. The RT samples resulted in higher redness (8.5±0.5) and yellowness (13.0±0.8) values than SC and MW samples, showing that the colour development of RT samples may be attributed to the formation of brown polymers or melanoidins [6]. Consistent with reheating loss, sensory juiciness score (Figure 1) was higher for BL

(8.7±0.4) and SC (8.7±0.4) samples than for RT (7.7±0.3) and MW (6.8±0.4) samples. The hardness score was not different between cooking methods ($P > 0.05$). The overall sensory acceptance score was lower ($P < 0.05$) in MW (6.0±0.5) samples than in BL (8.7±0.7), SC (8.4±0.8) and RT (8.0±0.4) samples.

Table. 1. External L* (Lightness), a* (redness) and b* (yellowness) values and reheating loss of frozen precooked Taiwanese-style emulsified pork meatballs reheated by boiling, steaming, roasting, and microwaving.

	Boiling	Steaming	Roasting	Microwave	SEM	P value
L* (Lightness)	59.0^{b}	54.4^{a}	56.6^{ab}	53.2^{a}	0.940	0.021
a* (Redness)	7.09^{a}	6.87^{a}	8.52^{b}	7.47^{a}	0.242	0.045
b* (Yellowness)	10.9^{ab}	11.5^{ab}	13.0^{b}	8.45^{a}	0.561	<0.001
Reheating loss, %	1.58^{a}	4.50^{b}	5.69^{b}	10.44^{c}	0.582	<0.001

$^{a-c}$ Means with different letters within a row differ significantly ($P < 0.05$).
SEM = Standard error of the mean.

Figure 2. Sensory analysis parameters of frozen precooked Taiwanese-style emulsified pork meatball reheated by boiling, steaming, roasting and microwaving. $^{a-b}$Means with different letters within the same indication differ significantly ($P < 0.05$). Meatballs evaluated on a 15-cm hedonic scale (1 = like the least, 15 = like the most). Bar = Standard Error.

IV. CONCLUSION

Textural properties and reheating yield of precooked Kung-wan meatballs were detrimentally affected by microwave cooking more than by other conventional reheating methods (boiling, steaming or roasting). Defects of microwave reheating might be avoided by further modifications of the meatball formulation. Formula modification, by adding polysaccharides or protein hydrolysates, to avoid reheating defect of microwave, for precooked emulsified meat product could be further investigated.

REFERENCES

1. Wu, Y. B., & Lin, K. W. (2011). Influences of xylooligosaccharides on the quality of Chinese-style meatball (kung-wan). Meat Science 88: 575-579.
2. Domínguez, R., Gómez, M., Fonseca, S., & Lorenzo, J. M. (2014). Effect of different cooking methods on lipid oxidation and formation of volatile compounds in foal meat. Meat Science 97: 223-230.
3. Prestat, C., Jensen, J., Robbins, K., Ryan, K., Zhu, L., McKeith, F. K., & Brewer, M. S. (2002). Physical and sensory characteristics of precooked, reheated pork chops with enhancement solutions. Journal of Muscle Foods 13: 37-51.
4. Powell, M. J., Sebranek, J. G., Prusa, K. J., & Tarté, R. (2019). Evaluation of citrus fiber as a natural replacer of sodium phosphate in alternatively-cured all-pork Bologna sausage. Meat Science 157: 107883.
5. Liu, W., & Lanier, T. C. (2016). Rapid (microwave) heating rate effects on texture, fat/water holding, and microstructure of cooked comminuted meat batters. Food Research International 81: 108-113.
6. Starowicz, M., & Zieliński, H. (2019). How Maillard reaction influences sensorial properties (color, flavor and texture) of food products?. Food Reviews International 35: 707-725.