Effect of cooling temperature and time on physicochemical and organoleptic properties of commercial cooked sausages

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1. Introduction

Sausages are made by the assemblage of proper ingredients with meat in the right proportion coupled with a structured cylindrical design and undergoing a controlled process. Cooked sausages are ready-to-serve products and the required cooking process is done by using an oven, grill, and deep fry after filling (Essien, 2003).

The sausage industry has been facing to increasing cost of raw ingredients (Jochen et al., 2010). Incorporation of non-meat ingredients such as dairy, eggs, plants, and microorganisms into the meat products to reduce the cost of products (Xiong, 2012; Yadav et al., 2013). Mechanically deboned poultry meat, usually used in sausage production due to fine texture, functional properties, and low-cost ingredients. But gives a negative effect on the texture giving a soft or mushy texture to the final cooked products (Daros et al., 2005; Pereira et al., 2011).

After the cooking of the sausages undergoes the cooling process. Water immersion is a traditional cooling method widely used in the processing of cooked meat products (Feng et al., 2014b). The cooling process reduces the product temperature as quickly as possible and helps to prevent shrinkage and wrinkling of the product casing (USDA, 1999).

The primary objective is to determine the effective water immersion cooling temperature for the commercial cooked sausages to reduce the weight of damages, to determine effective water immersion holding times to reduce the weight of damages and also to investigate the effect of water immersion cooling temperature and holding times on the sausages physicochemical properties and organoleptic properties.

2. Materials and Methods

Cooked sausages were made using Mechanically Separated Meat (MSM), Bread crumbs, Wheat flour, Skin and vegetable oil, ice, salt, and spices. MSM and Skin were minced. Ingredients were bowled chopped by 3750rpm in 4^0C for 5minutes according to the recipe. Stuff, filled into the 15mm cellulose casing. Sausages were cooked in oven 5^0C and 50% humidity and for 35–45 minutes until core temperature reach the 72^0C–73^0C temperatures and 95% humidity.

A field experiment Complete Randomized Design (CRD) was conducted replicating each treatment three times and samples were prepared according to the method described above.

Ten batches were separated before cooling and one batch of the weight of the sausage is 100 Kilograms. Four different treatment temperatures (5 ^{0}C, 10 ^{0}C, 15 ^{0}C, 20 ^{0}C) water and two immersion periods (10 minutes, 15 minutes) were used for the cooling of the sausages. Room temperature water (25-26 ^{0}C) was used as the control for all treatments. Each treatment is performed at two different water immersion cooling periods (10 minutes, 15 minutes).

The moisture content was determined by the oven-dry method (AOAC, 1990). In this three cylindrical gel (Φ15mm×10mm) from one representative sausage that has been used in the

measurement of moisture content. The water holding capacity (WHC) of the cooked sausages was determined by the modified centrifugal method described by (Cheng & Sun, 2006b). Damaged sausages were separated and weight expresses as per batch (100 Kg). Thirty untrained panellists were used for the evaluation of sensory parameters including appearance, colour, smell, flavour, texture, and overall acceptability. Nine points hedonic scale method used to rank for organoleptic attributes.

3. Results and Discussion

Water holding capacity (WHC) of commercial cooked sausages with the 10 minutes and 15 minutes immersion time

The following figure illustrated that five water immersion temperatures treatments (5^0C, 10^0C, 15^0C, 20^0C, 25^0C) against the water holding capacity of the commercial cooked sausages. And also two water immersion times (10 minutes, 15 minutes) are used to treat the commercial cooked sausages.

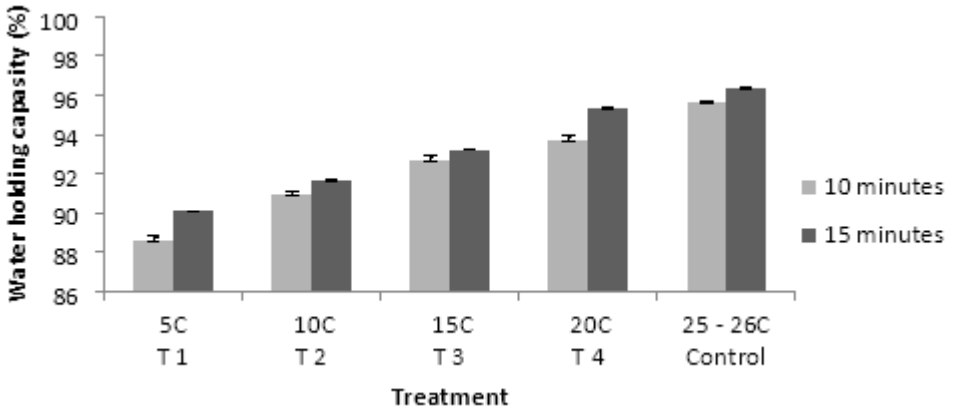

Figure1. Water holding capacity (WHC) of cooked sausages with immersion time

If comparing the water holding capacity of all 10 minutes treatments with all 15 minutes treatments, except T5 10 minutes and T4 15 minutes all other treatments significantly differ on water holding capacity.

Water immersion time and temperature were significantly affected ($p<0.05$) to the water holding capacity of the commercial cooked sausages. There is an interaction effect from the water immersion cooling temperature and time in the water holding capacity. Ma et al., (2020), have reported that the water holding capacity of the sodium-reduced pork sausages treated with 15-20^0C water immersion cooling temperature is significantly higher ($p<0.05$) than that cooled by 0-10^0C treated sausages.

The moisture content of the commercial cooked sausages with the 10 minutes and 15 immersion time

The following table indicates the figures of moisture contentment and weight of damaged (Kg) per 100Kg batch of the commercial cooked sausages treated with five temperatures including control (5^0C, 10^0C, 15^0C, 20^0C, 25^0C) and two water immersion times (10 minutes, 15 minutes).

Table 01. Moisture content and Weight of damages per 100 Kg of the commercial cooked sausages with the 10 minutes and 15 minutes immersion time

Treatment with Immersion time		Moisture content (W/W) %	Weight of damages(Kg) per 100Kg batch
T1 (5^0C)	10min	50.65 ± 0.8909	2.328 ± 0.0196
	15min	52.88 ± 0.4833	1.870 ± 0.0368
T2 (10^0C)	10min	53.15 ± 0.6585	2.284 ± 0.0529
	15min	49.82 ± 0.8095	2.481 ± 0.0344
T3 (15^0C)	10min	53.87 ± 0.4888	3.7467 ± 0.0508
	15min	54.25 ± 0.3174	3.270 ± 0.0225
T4 (20^0C)	10min	54.47 ± 0.2730	5.046 ± 0.0475
	15min	55.39 ± 0.2922	4.438 ± 0.0640
Control (RT)	10min	54.12 ± 0.3161	5.405 ± 0.0332
	15min	54.39 ± 0.4741	5.825 ± 0.0278

T1 10 minutes immersion time and T2 15 minutes immersion time samples were not significantly different ($p>0.05$). T1 10 minutes immersion time moisture content was significantly different ($p<0.05$) from the T1, T3, T4, and Control. Moisture content has no significant difference ($p>0.05$) between T1 10 minutes immersion time and T2 15 minutes immersion time.

The water immersion cooling temperature was significantly affected ($p<0.05$) to the moisture content of the cooked sausages. Feng (2013) reported that there is no significant effect from the moisture content to the cooling method of jumbo plain sausages. But the water immersion time was not significantly ($p>0.05$) affected the moisture content of the cooked sausages. There is a significant effect ($p<0.05$) from the interaction of water immersion cooling temperature and time according to the experiment.

The weight of the damaged cooked sausages per batch (100Kg) with the immersion time

Water immersion cooling temperature and time have significantly affected ($p<0.05$) the weight of damaged cooked sausages per batch (100 Kg). There is no significant effect of the interaction of the water immersion cooling temperature and time on the weight of the cooked sausages.

There is a positive Correlation between water holding capacity and the weight of damaged cooked sausages ($p<0.05$) with 10 minutes of water immersion time. The correlation is +0.96209. The intercept of the linear regression is +84.861.

There is a positive correlation between water holding capacity and the weight of the damaged cooked sausages with 15 minutes immersion time is +0.97713. The linear regression interception is +87.61.

Impact of water immersion cooling temperature with immersion time on the organoleptic properties of the cooked sausages

In the comparison of water immersion cooling temperature with 10 minutes and 15 minutes immersion time with the control, the appearance and color of the samples were significantly affected ($p<0.05$).

In the comparison of water immersion cooling temperature treatment with 10 minutes and 15 minutes, immersion times on the smell, flavour, texture, and overall acceptability with the samples were not significantly affected ($p>0.05$) by any of the water immersion cooling temperature treatments.

4. Conclusions

Overall findings express that, water holding capacity and weight of damages of commercial cooked sausages per 100 Kg batch were reduced when the reducing water immersion cooling temperature. According to the experiment increasing water immersion time is increasing the weight of damages per 100 Kg batch and water holding capacity. Reduction of water immersion cooling temperature was improved the organoleptic characters such as appearance, colour, texture, and overall acceptability except for smell and flavour. 5^0C water immersion temperature and 10 minutes immersion time treated commercial cooked sausages sample was performed lowest damages and most preferred sample in the sensory evaluation.

5. References

Essien, 2003. *Sausage manufacture*. Woodhead Publishing.

Feng, C. H., Sun, D. W., Martín, J. F. G., & Zhang, Z. H. (2013). Effects of different cooling methods on shelf-life of cooked jumbo plain sausages. *LWT-Food Science and Technology*, *54*(2), 426-433.

Ma, F., Wang, W. Y., Wang, W., Cai, K. Z., Shang, Y. F., Chen, C. G., & Xu, B. C. (2020). Effects of water-immersion cooling temperatures on the moisture retention of sodium-reduced pork sausages. *Journal of Food Science and Technology*, *57*(7), 2516-2523.

McKee, S. (2001). Chilling difference. *Watt Poultry USA*, *12*, 18-24.

Xiong, Y. L. (2012). Nonmeat ingredients and additives. *Handbook of Meat and Meat Processing*, 573-588.