The effect of heating process using electric and gas ovens on sensory properties of cooked smoked-meat

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Abstract. Study of the potential of kenari (Canarium indicum L.) shell as a raw material in liquid smoke production to increase the sensory quality of the cooked smoke-meat has been done. To achieve this study, a heating method using electric and gas ovens on the properties of the cooked smoke-meat have been carried out. The characterization of sensory properties (color, aroma flavor, tenderness, and acceptability) cooked smoke-meat were analyzed using the non-parametric Kruskal-Wallis. The results showed that the parameter sensory properties of color, tenderness, aroma, flavor, and acceptability of cooked smoked-meat are heated using an electric oven is no different from using a heated gas oven.

1. Introduction

The researchers about the sensory properties of cooked smoke-food smoke has been done, organoleptic properties of smoked fish [1], sensory of smoke trout (Salmo gairdneri) [2], sensory properties of kenari (Canarium indicum L.) shell liquid smoke-immersed-beef [3], sensory evaluation of Smoked Stingray (Dasyatis Bleekeri) [4], smoke powder on sensory quality of Balinese beef and buffalo meatballs [5]. The utilization of liquid smoke on meat to replace the smoking leads of the volatile compounds to be deposited on the surface and the meat does not obtain enough heat, thus it is still raw. Based on those points of view, the further treatments, such as heating, should be conducted so the smoked meat could be readily eaten [6]. Low temperature and longtime heating at ≤ 110°C could be the alternative process to heat the meat [7]. The temperature of 80°C is the ideal and popular one as the meat would have appropriate tenderness on the quality assay [8].

Heating process using electrical and gas ovens could be done by low-moderate society. Heating using both electric and gas ovens at the same temperature was expected to produce the same characteristics of cooked meat. The question would be whether the heating time of raw meat using an electric oven and gas oven would be the same. The heat source of electric oven was rod element equipped on the top and bottom sides of the oven. The element will smolder if the oven is turned on. The employed element is only the bottom one. The heat propagation on the electric oven is conduction (heat transfer from heat source to tray) and convection (heat transfer from the surface to the inside of meat).
The heat source of gas oven is gas fuel. The fire from a gas stove is put at the bottom of oven. The heat propagation is conduction (heat transfer from the oven chamber to tray) and convection (heat transfer from the surface to the inside of meat) [6]. A Sensory property of cooked smoked meat that is prepared by using an electric oven is predicted to be the same as that using a gas oven. The physical properties of meat are closely related to the chemical properties, particularly water and protein contents of meat.

2. Material and methods

2.1. Preparation of liquid smoke
Production of liquid smoke was done by pyrolysis. Pyrolysis furnace was equipped with a 1500 watt electric heater encircling reactor with a diameter of 20 cm and a height of 40 cm which could be charged with as much as 4 kg of materials. Reactor cover was connected by pipeline to the cooling tubes used to condense the fumes and generate the liquid smoke. After all, materials inserted into the furnace, it was then closed, the condenser was set and the cooling tube was streamed with cold water. Pyrolysis was carried out at a temperature of 420 °C for 100 minutes [9]. The obtained liquid smoke was centrifuged in 4000 rpm for 20 minutes. Kenari shell liquid smoke was diluted 1 part of liquid smoke: parts of aquabidest [6]

2.2. Preparation of meat
*Longissimus dorsi* beef was separated from the carcass and packed using a vacuum with polypropylene plastic then stored in the freezer for 48 hours. After that, the beef was stored in a cold room (3° - 4°C) then was cut into a small piece of about 5 cm x 5 cm x 2 cm |6. Pieces of *Longissimus dorsi* beef which had been prepared was placed in submersion container which was then added with a solution of liquid smoke with different dilution levels until all the meat samples were immersed (the ratio of liquid smoke and meat samples = 1:1). The submersion was performed for 15 minutes. After the submersion had been done, the meat was drained until no longer dripping solution.

2.3. Preparation oven
Preparation oven was carried out as follows: the electric and gas ovens were assembled with modified thermo control. Thermo control was connected with an electric oven and a power source, while the thermocouple is inserted into the electric oven. In principle, the assembly of gas oven was similar to that of electric oven. In gas oven, there was only an additional tool (solenoid valve) mounted on the gas hose to regulate the size of the gas flow automatically. Electric and gas ovens were heated to 110°C. Having finished the preparation of liquid smoke, meat and oven, the immersion on diluted liquid smoke was performed for 15 minutes and drained. Raw smoked meat was put into the oven at temperature of 110°C. Calculation of the heating time began at 110°C and the temperature was monitored every 15 minutes until ± 80°C. Each treatment was done in 6 (six) replicates.

2.4. Data collection
The sensory properties test involved 30 panelists not trained and assessed the sensory properties of cooked smoke-meat based on the assessment score scale, ranging 1-5, indicating that 1 is dark chocolate, very not flavorful and taste smoke, very rough, very disliked and 6 is Bright chocolate, very flavorful and taste smoke, very smooth, very liked.

2.5. Data analysis
The sensory properties were analyzed using the non-parametric *Kruskal-Wallis* [10].
3. Results and discussion

The parameters measured by sensory properties (scores of color, aroma, flavor, tenderness, and acceptability of cooked smoke-meat. Sensory properties of raw meat and raw smoked-meat were presented in table 1.

| Variable   | Heating            |
|------------|--------------------|
|            | Electric Oven      | Gas Oven        |
| Color      | 2.75±0.66          | 3.06±0.66       |
| Aroma      | 3.36±0.32          | 3.48±0.14       |
| Flavor     | 3.26±0.34          | 3.39±0.19       |
| Tenderness | 2.97±0.20          | 3.08±0.14       |
| Acceptability | 2.71±0.10      | 2.77±0.19       |

The results of testing the sensory properties of the color of cooked smoked-meat indicate that the obtained score is range 2.75-3.06 (chocolate). The main pigment of cooked meat is brown hemichromoglobin and the heating process of meat causes the globin to be denaturation, but the hematin nucleus remains normal. Cooking temperature affects the color of the cooking meat. For example, the interior color of beef cooked at 60°C is a bright red color, at a temperature of 70-80°C or higher in gray-brown color [8]. The aroma and taste of cooked smoked meat involve volatile liquid smoke compounds and penetrated into the meat, and new compounds formed during the heating process. The new compound is predicted to produce Maillard's reaction and heat-induced oxidation.

The score of aroma sensory properties of cooked smoked-meat which heated in an electric oven is 3.36 (slightly flavorful smoked) and which is heated with a gas oven is 3.48 (slightly flavorful smoked). Scores of sensory properties of cooked smoke-meat that are heated with an electric oven are 3.26 (rather smoked) and heated with a gas oven which is 3.39 (rather smoked). Flavor involves aroma, taste, texture, temperature, and pH. Evaluation of aroma and taste depends on the taste panel. The flavor of meat develops during cooking which is influenced by the length and temperature of the heating. Meat fat also affects meat flavor. The aroma and taste of cooked meat are found by many precursors that are soluble in water and fat, and the release of volatile substances (volatiles) contained in meat [8].

The sensory testing of cooked smoke meat which heated using an electric oven was no different from a gas oven. This is because the temperature used is the same; the tenderness was affected by the heating temperature [11]. The results were similar to the results on beef roast [12] which states that in testing using Warner-Bratzler (WBSF), of between cooked and smoke meat using different from using a gas oven which was heated on the same internal temperature. The sensory properties of cooked smoked meat tenderness which heated with a gas oven are 2.97 and electric oven is 3.08, meaning that the cooked smoked meat is rather hard. In principle, cooking can increase or decrease meat tenderness, and secondly, the effect of cooking depends on time or temperature. Furthermore, it is explained that the cooking time affects the softening of collagen, while the cooking temperature more affects to the myofibrillary delinquency [8].

The panelist's acceptance includes all the sensory parameters tested. Panels rather like cooked smoked meat heated in an electric oven and heated with a gas oven. The score of panelists' acceptance of smoked meat samples heated in electric ovens was 2.71 and those heated with the gas oven was 2.77. The acceptance of panelists who are still low on cooked smoked meat may be due to panelists have not been familiar with smoked products.
4. Summary
Parameter sensory properties of color, tenderness, aroma, flavor, and acceptability of cooked smoked-meat are heated using an electric oven is no different from using a heated gas oven.

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