The Effect Of Marinated Duck Meat Using Turmeric With Modified Cassava Flour As An Encapsulant

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Abstract.

Duck meat is a type of food that is quite popular in the public because the texture of the meat is quite soft and tastes delicious. The availability of duck meat is quite a lot at a very affordable price. Lipid components in duck meat are easily damaged due to oxidation and caused by pathogenic bacteria, so it is necessary to maintain the quality with the addition of turmeric which is encapsulated in modified cassava flour. The research process was carried out by marinating duck meat with turmeric coated in modified cassava flour as an encapsulant (TMC), then the meat was stored at a chilling temperature of 36°F for 8 days. The test parameters including moisture, pH value, peroxide value (PV), and sensory. The treatments observed consisted of control (SA), duck meat marinated with 2% TMC (SB), duck meat marinated with 4% TMC (SC), duck meat marinated with 6% TMC (SD). The results observed that moisture, pH value, peroxide value (PV) with a shelf life of up to 8 days had a significant interaction (P<0.05). This study concluded that TMC was able to inhibit oxidative damage without degrading the sensory quality in duck meat stored for 8 days at chilling temperature 36°F.

Keywords: *Duck meat; encapsulation; marination; modified cassava flour and turmeric.*

I. INTRODUCTION

Meat in particular consists of a wide variety of highly bioavailable nutrients. Currently, most of the people consume duck meat because of the advantages it has, such as high nutritional value so that it is able to meet the nutritional needs of the body, and is available in large quantities [1]. Duck meat products need to be considered for quality and safety. Duck meat when stored for more than 2 days at chilling temperatures will easily experience a decrease in quality [2]. The decline in the quality of duck meat includes lipid oxidation [3].The quality decrease of duck meat can be inhibited by the addition of antioxidant compounds, the antioxidant used in this study was a natural antioxidant, namely turmeric. It has curcumin compounds which have the potential as antioxidants to inhibit lipid oxidation [4]. Curcumin is also known to have the ability as an antibacterial and it is expected to be able to inhibit the population of pathogenic bacteria in duck meat.

The turmeric used received special treatment in the form of encapsulation, the purpose of encapsulation was to prevent degradation of curcumin compounds due to the processing of turmeric when it was dried and floured. The encapsulation material used was modified cassava flour. It is a modified product of cassava flour whose manufacturing process is carried out by the fermentation method by lactic acid bacteria. The characteristics of modified cassava flour are very suitable to be used as encapsulation material because it undergoes a fermentation process so that it can reduce the viscosity of the emulsion [5].In the encapsulation technique, it is necessary to pay attention to the type of coating material used. The criteria for the coating material used is the material must have good oxidation resistance and it can reduce the viscosity of the emulsion [6]. Considerations in choosing a coating material must have high watersoluble properties, and have a strong binding capacity. The use of modified cassava flour as an encapsulant for turmeric as a marination compounds is expected to reduce the level of oxidative damage to duck meat when stored for 8 days at chilling temperature 36°F, so that the duck meat products obtained can be safe for consumption and have a longer shelf life.

II. METHODS

To make encapsulated turmeric, first, peel the skin, then grind it using a food processor, then extract the turmeric by maceration. A total of 500 g of turmeric powder was macerated for 2×24 hours using 5 L of 70% ethanol. The obtained maserate was filtered, then the residue was macerated again with the same amount of 70% ethanol and the treatment was repeated three times. Then, the macerate was evaporated using a rotary vacuum evaporator (RE-301) at a speed of 120 rpm at 40°C until concentrated (1/10 of the initial volume). The turmeric extract formed then mixed with 8% of modified cassava flour as a coating material. The 725 mL of samples mixture was dried with a freeze dryer (MN-12E) with -46°C of condenser temperature and 244 µmHg of the pressure. The modified cassava flour as an encapsulant of turmeric was given the code (TMC) then used for marination compounds. The duck meat used in this study was the thigh, then the TMC was used as a marinade compound for the duck meat, marinated evenly and waited until TMC was completely absorbed into the duck meat. The treatments consisted of control (SA), duck meat marinated with 2% TMC (SB), duck meat marinated with 4% TMC (SC), duck meat marinated with 6% TMC (SD). Marinated duck meat samples were then covered with aluminum foil and observed on the 0, 2nd, 4th, 6th, 8th days with test parameters including moisture, pH value, peroxide value (PV), and sensory.

pH and moisture

The measurement of pH was using the instrument that was calibrated with a buffer at pH 4 and pH 7. The electrodes of pH meter (MW-101) were rinsed with distilled water for 3 mins and then dried. The number of 0.5 g of meat sample was mashed with a mortar and put in 1 mL of distilled water, then the electrode was dipped into the sample and the pH value could be read on the pH meter screen. The first step in the analysis of the moisture content was drying the porcelain dish in an oven (UN-55 Memmert) at a temperature of 105°C for 1 h. The cup was then placed in a desiccator for 15 mins then weighed. The number of 2 g sample was weighed, then the cup containing the sample was then placed in an oven at 105°C for 3 h. After finishing the drying process, the cup was put into a desiccator and then weighed again. Sample drying was carried out until a constant weight was obtained [7].

Peroxide Value (PV)

The peroxide value was determined by the following procedure: A sample of 10 g was put into an Erlenmeyer and 30 mL of the mixed solvent glacial acetic acid: chloroform (3:2 v/v) was added. After the sample was completely dissolved, 0.5 mL of saturated KI solution and 30 mL of distilled water was added. Iodine liberated by peroxide is titrated with standard solution ($Na_2S_2O_3$) sodium thiosulfate 0.1015 N with starch indicator until the blue color disappears. Peroxide number was expressed by meq peroxide/kg fat [8].

Sensory

Sensory assessment of duck meat marinated with TMC was performed by 35 semi-trained panellists. The rating scale used (7 = extremely desirable, 1 = extremely undesirable). Sensory attributes assessed in this study were appearance, odor, taste, texture, and overall acceptability [9].

Statistic analysis

The data obtained for different parameters were analyzed statistically using SPSS 16.0. Levels of significance ($p<0.05$) using two-factor factorial under completely randomized design (CRD) were determined by ANOVA. The means were compared using DMRT. Three replicates were used for all parameters except in sensory, there were performed by 35 semi-trained panellists.

III. RESULT AND DISCUSSION

Moisture

Moisture content is the total amount of water contained in the material. Water is a covalent bond formed from two hydrogen atoms with an oxygen atom and both have very strong cohesiveness. The results showed that there was an interaction ($P<0.05$) between the level of TMC and storage time at chilling temperature on the water content of duck meat. The two treatments synergized to affect the water content, the higher level of TMC, followed by an increase in the water content of duck meat. This is presumably because the content of modified cassava flour as a turmeric coating material is able to bind water in the duck meat, it is useful to maintain the water content in duck meat. In accordance with the research of [10] which

stated that modified cassava flour has the ability to bind water because it has a low molecular weight so that it can maintain the physical quality of the product.

pH value

The results of pH measurements on duck meat marinated with TMC and stored at chilling temperature for 0, 2nd, 4th, 6th, and 8th days showed a significant interaction (P<0.05). The increase in the level of TMC in duck meat caused a decrease in the pH value of the meat when compared to the control. The content of vitamin C in turmeric, which tends to be acidic, is thought to cause a decrease in the pH value of meat. This is in accordance with the research of [11] which stated that duck meat that was treated with the addition of turmeric paste caused a decrease in the pH value of the meat. The decrease in pH value also affects the number of microbes, with a low pH can reduce the number of microbes.

Peroxide value

The results in Table 1 show that there is an interaction (P<0.05) between the level of TMC and storage time at chilling temperature on the peroxide value of duck meat. The higher level of TMC showed significantly different results (P<0.05) in reducing the peroxide value of duck meat in this study. In the SD treatment with the level of TMC was 6%, it showed the lowest peroxide value compared to other treatments. Curcumin is a secondary metabolite compound, and chemically belongs to the phenolic group which is a potential inhibitor of fat oxidation which acts as a metal catalyst in meat [12].

Table 1. Effect of TMC on moisture, pH, and PV of duck meat at different storage periods (0, 2nd, 4th, 6th, and 8th days)

Treatment	Storage period (day)					
	0	2	4	6	8	Treatment mean
Moisture (%)						
SA	69.13±0.11^{bcd}	68.76±0.07^{cde}	67.83±0.21^{g}	66.82±0.22^{hi}	64.57±0.32^{j}	67.42±0.34^{Z}
SB	69.34±0.07^{abc}	68.84±0.07^{bcd}	68.22±0.15^{ef}	66.97±0.25^{gh}	64.88±0.24^{i}	67.65±0.41^{Y}
SC	69.51±0.18^{abc}	68.97±0.02^{abc}	68.56±0.14^{cd}	67.45±0.17^{fg}	65.37±0.26^{h}	67.97±0.55^{X}
SD	69.68±0.15^{a}	69.11±0.11^{ab}	68.75±0.11^{ab}	67.82±0.14^{bcd}	66.93±0.31^{def}	68.46±0.27^{W}
Storage mean	69.42±0.36^{A}	68.92±0.27^{B}	68.34±0.39^{B}	67.27±0.41^{C}	65.44±0.48^{D}	-
pH						
SA	6.15±0.05^{hij}	6.23±0.08^{fg}	6.28±0.04^{bc}	6.33±0.03^{a}	6.42±0.04^{a}	6.28±0.12^{W}
SB	6.12±0.03^{jk}	6.20±0.05^{fgh}	6.22±0.06^{f}	6.25±0.05^{de}	6.40±0.06^{b}	6.24±0.09^{X}
SC	6.04±0.04^{kl}	6.14±0.05^{ghi}	6.18±0.02^{fgh}	6.21±0.06^{ef}	6.33±0.07^{bc}	6.18±0.35^{Y}
SD	6.01±0.03^{l}	6.11±0.03^{jk}	6.15 ±0.05^{ij}	6.19 ±0.04^{fgh}	6.28±0.04^{cd}	6.15±0.15^{Z}
Storage mean	6.08± 0.08^{D}	6.17± 0.15^{C}	6.21±0.08^{C}	6.25±0.18^{B}	6.36±0.21^{A}	-
PV (meq kg^{-1})						
SA	0.43±0.13^{h}	0.46±0.08^{fg}	0.49±0.17^{c}	0.52±0.24^{b}	0.55±0.21^{a}	0.49±0.43^{W}
SB	0.42±0.18^{i}	0.46±0.15^{gh}	0.48±0.04^{e}	0.51±0.16^{c}	0.54±0.15^{b}	0.48±0.27^{X}
SC	0.42±0.09^{i}	0.45±0.07^{i}	0.47±0.46^{f}	0.48±0.05^{d}	0.52±0.18^{c}	0.47±0.31^{Y}
SD	0.41±0.11^{ij}	0.43 ± 0.14^{j}	0.45±0.32^{h}	0.47±0.25^{e}	0.49±0.14^{d}	0.45±0.56^{Z}
Storage mean	0.42±0.24^{E}	0.45± 0.18^{D}	0.47±0.21^{C}	0.50±0.26^{B}	0.53±0.33^{A}	-

$^{abcdef\ldots}$ Interaction means without common letter are different at p<0.05. ^{ABCD} Overall means between columns and ^{WXYZ} Overall means between rows without common letter are different at p<0.05.

Sensory

The results obtained in the sensory test, if observed in appearance, showed that duck meat marinated with TMC got a lower sensory score than control duck meat (SA), this is presumably because the panelists were less interested in the dominant yellow color of the marinated duck meat due to turmeric curcuminoid pigment. The dominant yellow pigment in turmeric is curcuminoids. Significant results (P<0.05) were obtained from the odor value which showed the highest score in SD. This indicates that TMC can reduce the rancid aroma of duck meat due to the long shelf life, the longer the shelf life has the potential to increase oxidative damage to lipid. This is in accordance with the statement of [13] that the polyphenol content in turmeric is able to degrade oxidative rancidity of lipid. The texture of duck meat in all treatments SA, SB, SC, and SD showed non-significant results, this indicates that TMC as a marinade in duck meat was not reduce the quality of the texture of the meat. The overall acceptability score showed the SD treatment is the highest among the others, it showed that duck meat with the addition of TMC can improve the sensory quality.

Table 2. Effect of TMC on sensory of duck meat at different storage periods (0, 2nd, 4th, 6th, and 8th days)

Treatment	Storage period (day)				
	0	2	4	6	8
Appearance					
SA	5.87±0.44^{a}	5.54±0.21^{ab}	5.36±0.61^{a}	5.12±0.87^{ab}	4.96±0.74^{ab}
SB	5.91±0.56^{a}	5.82±0.88^{a}	5.59±0.84^{a}	5.43±0.61^{a}	5.37±0.46^{a}
SC	5.38±0.69^{b}	5.22±0.48^{b}	5.10±0.43^{b}	4.95±0.38^{b}	4.82±1.05^{ab}
SD	5.12±0.71^{c}	5.03±0.69^{c}	4.82±0.60^{c}	4.77±0.68^{c}	4.60±0.95^{b}
Odor					
SA	5.66±0.33^{c}	5.38±0.79^{b}	5.17±0.82^{b}	4.94±0.77^{b}	4.79±0.96^{c}
SB	6.31±0.76^{bc}	6.27±0.85^{ab}	6.09±0.94^{ab}	5.82±1.12^{ab}	5.65±1.14^{b}
SC	6.42±0.84^{b}	6.33±0.92^{ab}	6.11±1.03^{ab}	5.97±1.05^{ab}	5.77±1.08^{b}
SD	6.68±0.55^{a}	6.50±0.49^{a}	6.26±0.80^{a}	6.05±0.84^{a}	5.92±0.78^{a}
Taste					
SA	6.05±0.56^{a}	5.81±0.68^{a}	5.60±0.77^{a}	5.43±0.85^{a}	5.21±0.81^{a}
SB	5.95±0.83^{a}	5.76±0.37^{ab}	5.51±0.89^{ab}	5.35±0.69^{ab}	5.15±1.03^{ab}
SC	5.66±1.03^{b}	5.51±0.78^{b}	5.43±0.55^{ab}	5.20±1.15^{ab}	5.11±1.12^{ab}
SD	5.57±0.48^{b}	5.40±0.94^{b}	5.27±1.04^{b}	5.09±1.08^{b}	5.02±1.15^{b}
Texture					
SA	6.43±0.41^{a}	6.27±0.68^{ab}	6.09±0.82^{a}	5.92±0.49^{a}	5.78±0.85^{a}
SB	6.31±0.78^{b}	6.25±0.44^{ab}	6.02±0.93^{a}	5.87±0.94^{a}	5.61±0.93^{a}
SC	6.38±0.80^{ab}	6.11±0.39^{b}	5.95±1.02^{a}	5.78±1.13^{a}	5.54±1.19^{a}
SD	6.40±0.63^{a}	6.33±0.80^{a}	6.11±1.14^{a}	5.96±1.05^{a}	5.80±1.07^{a}
Overall acceptability					
SA	6.11±0.37^{a}	5.90±0.86^{a}	5.74±0.93^{a}	5.51±0.85^{a}	5.23±0.60^{b}
SB	5.93±0.42^{ab}	5.85±0.48^{ab}	5.69±0.88^{ab}	5.55±0.47^{a}	5.34±0.77^{ab}
SC	5.86±0.81^{b}	5.70±0.79^{b}	5.53±0.80^{b}	5.48±1.01^{a}	5.30±1.14^{ab}
SD	5.95±0.93^{a}	5.88±0.96^{ab}	5.76±1.08^{a}	5.59±1.13^{a}	5.36±1.21^{a}

^{abc} Means in the same rows without common letter are different at $p < 0.05$

IV. CONCLUSION

Turmeric encapsulated with modified cassava flour (TMC) is able to inhibit oxidative stress, and improve the sensory quality in duck meat stored for 8 days at chilling temperature (36°F). The best quality of duck meat is obtained from the addition of 6% TMC as a marination compound.

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