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Quality Characteristics of Meatball Prepared from Different Ratios of Chicken and Duck Meat

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Abstract- The aim of this study was to determine the effects of different ratios of chicken and duck meat on the quality (proximate composition and physicochemical characteristics) of meatball. Meatball was produced by using 5 different ratios of duck and chicken meat (A = 0:100, B = 25:75, C = 50:50, D = 75:25, and E = 100:0). Increase in the ratio of duck meat caused increases in moisture, ash, and carbohydrate (by difference), but decreases in protein and fat. The range of moisture, protein, fat, ash and carbohydrate content of meat ball in this study were 68.26 – 73.42 %, 10.45 – 5.88 %, 10.88 – 8.50 %, 1.84 – 2.86 %, 8.56 – 10.99 %, respectively. Mineral analysis showed that increase in the duck meat ratio caused increasing trends in Ca, Na, Fe, P, Zn and Mg contents. The range of Ca, K, Na, Fe, P, Zn, and Mg was 0.6393 – 1.9973 mg/g, 0.0013 – 0.0016mg/g, 0.2912 – 0.6040 mg/g, 0.0187 – 0.0411 mg/g, 0.0884 – 0.4113 mg/g, 0.0025 – 0.1010 mg/g, and 0.2090 – 0.4848 mg/g, respectively. Physicochemical, juiciness showed increasing values by increasing duck meat ratio in meatball, meanwhile folding test showed decreasing values. The range for juiciness and folding test values were 6.09 – 11.24 % and 4.79 – 2.20 % respectively. Determination of texture and colour by instrument showed significant differences ($P<0.05$) among samples, whereby the L* value decreased, but the* and b* values increased with the increase in duck meat ratio. The highest L* value (lightness) (65.89) was observed in formulation A which contained 100% chicken meat, while the lowest L* value (55.65) was observed in formulation E containing 100% duck meat. The addition of duck meat thus contributed to a darker colour product. Texture analysis showed decreasing values of shear stress (253.31 – 541.50) with the increase of duck meat ratio.

Keywords- Meatball, proximate composition, physicochemical characteristics, chicken meat, duck meat.

INTRODUCTION

Meatball is a popular meat product and is found in the category of chicken ball, fish ball, beef ball, squid ball, and also prawn ball, but the common meatball which are found easily in the market are chicken ball, fish ball, and beef ball. Meatball based on poultry product except chicken is still not commonly found. The development of meatball based on duck meat will add variety to the meatballs available in the market, and indirectly it can help develop the duck meat industry. Putra, Huda, and Ahmad (2008) said that innovation in duck meat production, for example in producing ready to eat duck meat products is needed to improve duck meat consumption and thus boost up the duck meat industry.

Duck has been appreciated for its taste and nutritional qualities during periods of history when food was plentiful as well as when it was in short supply. Today, duck meat is still very popular and in strong demand in many areas of the world, especially in Asia. Preferences with regard to breed of duck and method of preparation vary widely. The use of duck meat in easy to eat food is not easy to find although there are many traditional food which were developed using duct meat.

This project was carried out to determine the effect of chicken and duck meat combination on quality (proximate composition and physicochemical characteristics) of the finished meatball product.

MATERIALS AND METHODS

Meatball preparation

Five different ratios of chicken and duck balls were used in this research where A = 0 :100, B = 25 : 75, C = 50 : 50, D = 75 : 25, and E = 100 : 0. The total amount of meat in meat ball formulation is 65%. Other ingredients used were cassava flour (10%), water (21.2%), salt (2.2%) and spices (1.6%). Meat, cassava flour, spices, salt, and iced water were mixed together into a mixer cutter (Roboutcoup, US) for 4 minutes. The blend was shaped into balls manually, and the balls were set at 40°C for 20 min to retain its shape. The meat balls were cooked at 90°C for 20 min and then were cooled in cold-water.

Proximate composition

The proximate composition was determined according to AOAC (1990) methods. Moisture content was determined by drying samples overnight at 105 oC in an oven (Memmert UL 40, Germany) until constant weight was achieved. Crude protein content was determined using the Kjeldahl method (Kjeltec System 1002, Sweden). Crude lipid content was determined by the Soxhlet method. Ash content was determined by ashing samples overnight at 550oC in furnace (Thermolyne Sybranm 6000, USA). Carbohydrate content was calculated by difference.

Mineral analysis

Mineral contents (Ca, Mg, P, Zn, Na, Fe, and K) were determined by first treating the samples by Microwave Digester (Millestone Ethos 900) followed by analysis by Flame Atomic Absorption Spectroscopy (FAAS) (Perkin Elmer, Analyst 100, USA). The mineral determination was done in triplicates for all the samples.

Physicochemical analysis

Cooking yield was determined according to Serdaroglu (2006). The diameter reduction was determined by measuring the uncooked diameter minus the cooked diameter divided by uncooked diameter and multiplied hundred. Juiciness was determined according to Gujral, Kaur, Singh, and Sodhi (2002). pH was determined according to Ronal et al (2006). Folding test was determined according to Yu (1994). Texture (shear test which used a knife blade to determine shear force required to cut through sample) was determined using Texture Analyzer TA-XT (Stable Micro Systems, UK). Colour (L*=Lightness, a*=redness and b*=yellowness) was determined using Minolta Spectrophotometer CM-3500d, Japan.

Data analysis

The data obtained was analyzed using SPSS (Statistical Package for Social Science) software version 12.0 (SPSS Inc., Illinois, USA). Duncan test was used to determine differences between means at P<0.05 significance level.

RESULTS AND DISCUSSIONS

Proximate composition

The data obtained by proximate composition of meatball are presented in Table 1. Statistical analysis showed that there are significant differences (P<0.05) among meatballs A, B, C, D, and E whereby increasing duck meat tend to increase ash and carbohydrate contents while decreasing of moisture, protein, and fat contents. Moisture contents of meatball were in the range of 68.26 – 73.42 %, where meatball E had the highest moisture content and meatball A had the lowest. Protein content of meatballs decreased from meatball A to meatball E from 10.88 to 5.88 %. Meatball A had the highest content of fat (10.88 %) whereas meatball D had the lowest (8.5 %). Ash content increased from meatball A (1.84%) to meatball E (2.86 %). The carbohydrate content (by difference) of meatballs showed that meatball A (8.56 %) was the lowest and meatball E (10.99 %) was the highest.

Table 1. Proximate analysis of meatballs with different ratios of chicken and duck meat

Proximate	Treatment				
	A (0:100)	B (25:75)	C (50:50)	D (75:25)	E (100:0)
Moisture (%)	$68.26^{d}\pm0.50$	$71.60^{c}\pm0.56$	$72.78^{bc}\pm0.15$	$72.67^{b}\pm0.06$	$73.42^{a}\pm0.14$
Protein (%)	$10.45^{a}\pm0.15$	$9.54^{b}\pm0.15$	$7.37^{c}\pm0.18$	$6.69^{d}\pm0.07$	$5.88^{e}\pm0.07$
Fat (%)	$10.88^{a}\pm0.07$	$10.29^{b}\pm0.08$	$9.12^{c}\pm0.07$	$8.28^{d}\pm0.08$	$8.50^{e}\pm0.04$
Ash (%)	$1.84^{e}\pm0.05$	$1.97^{d}\pm0.05$	$2.16^{c}\pm0.06$	$2.62^{b}\pm0.09$	$2.86^{a}\pm0.05$
Carbohydrate (%)	$8.56^{c}\pm0.07$	$6.57^{d}\pm0.57$	$9.18^{bc}\pm0.26$	$9.72^{b}\pm0.19$	$10.99^{a}\pm0.24$

Values are mean of each triplicate of three repeated samples with ± standard deviation. Different letters in the same row indicate significant differences (p<0.05).

The moisture content of meatballs in this study is comparable to those reported by Huda et al (2007), whereby balls in the market chicken contained 60.14 – 72.81 % of moisture. Protein content of commercial chicken ball was between 9.93 to 15.06 %; the protein content of meatballs in this study, which in the range of range 10.45 – 5.88 % was lower than commercial chicken balls. On the other hand, the fat content of these meatballs (4.26 -14.00 %) are in the range of commercial chicken balls. The ash and carbohydrate contents are also within the range of commercial chicken balls with values ranging from 1.92 – 2.82 % and 5.54 – 20.85 %, respectively.

Mineral analysis

The content of some minerals in meatballs are presented in Table 2. Statistical analysis showed that there are significant differences (P<0.05) among each treatment where the mineral content tend to increase with the increase of duck meat in meatballs.

From the data in Table 2, Ca contributed the highest amount of mineral in meatballs while P contributed the least. The total Ca content of meatball was in the range of 0.64 – 1.99 mg/g followed by Mg (0.20 – 0.48 mg/g), P (0.090.41 mg/g), Zn (0.10 mg/g), Na (0.29 – 0.61 mg/g), Fe (0.02 – 0.04 mg/g), K (0.01 mg/g). Pearson and Gillet (1999) reported that Ca is essential for the activity of a number of enzyme system, including those necessary for the transmission of nerve impulses. Generally, all minerals increased as the ratio of duck meat increased. This shows that duck meat contains higher minerals than chicken meat. The use of duck meat will improve the fulfilment of mineral needs of human.

Table 2. Mineral analysis of meatballs with different ratios of chicken and duck meat

Mineral (mg/100g)	Treatment				
	A (0:100)	B (25:75)	C (50:50)	D (75:25)	E (100:0)
Ca	0.6393[c]±0.01	0.6475[c]±0.01	0.6906[c]±0.01	1.1668[b]±0.05	1.9973[a]±0.08
K	0.0016[a]±0.01	0.0013[b]±0.01	0.0013[b]±0.01	0.0015[a]±0.0	0.0016[a]±0.01
Na	0.2912[d]±0.01	0.3319[c]±0.01	0.3622[c]±0.01	0.4668[b]±0.03	0.6040[a]±0.01
Fe	0.0187[c]±0.01	0.0241[c]±0.01	0.0224[c]±0.01	0.0332[b]±0.01	0.0411[a]±0.01
P	0.0930[c]±0.01	0.0884[c]±0.01	0.0894[c]±0.01	0.1184[b]±0.01	0.4113[a]±0.01
Zn	0.0025[e]±0.01	0.0034[d]±0.01	0.0045[c]±0.01	0.0080[b]±0.01	0.1010[a]±0.01
Mg	0.2090[c]±0.01	0.2283[c]±0.01	0.4113[b]±0.03	0.4677[a]±0.01	0.4848[a]±0.01

Values are mean of each triplicate of three repeated samples with ± standard deviation. Different letters in the same row indicate significant differences ($p<0.05$).

Physicochemical analysis

Cooking yield of samples was done to determine percentage of cooking loss from meatball after cooking. The data of cooking yield are presented in Table 3. Statistical analysis showed that there are significant differences ($P<0.05$) among each treatment where cooking loss will increase with the increase of duck meat in meatballs. From Table 3, it can be seen that increasing duck meat will decrease the cooking yield (A= 102.30% and E = 102.30%) moisture retention (A = 98.4% and E = 100.40 %), juiciness (A =6.09% and E =11.24 %), and folding test values (A = 4.79% and E = 2.20 %). These results are related to the quality and quantity of protein in meatballs. Serdaroglu (2006), reported that reduced cooking loss (higher cooking yield) may be attributed to the water holding and fat binding capacity of protein. Meanwhile fat retention increased with the increase of duck meat in samples. The result showed that there were no significant differences ($P>0.05$) for diameter reduction. Generally, the increase of duck meat will decrease the physicochemical characteristic of meatball.

Table 3. Physicochemical analysis of meatballs with different ratios of chicken and duck meat

Physicochemical Analysis (%)	Treatment				
	A (0:100)	B (25:75)	C (50:50)	D (75:25)	E (100:0)
Cooking Yield	102.30[a]±0.66	102.34[b]±0.46	102.35[c]±0.80	104.71[d]±0.59	104.94[e]±1.15
Moisture retention	98.43[d]±0.51	99.23[c]±0.54	99.70[bc]±0.43	100.12[ab]±0.13	100.40[a]±0.09
Fat retention	86.81[a]±0.98	70.73[b]±0.88	65.04[c]±0.52	56.12[d]±0.83	41.44[e]±0.83
Diameter reduction	-0.04[a]±0.01	-0.17[a]±0.25	-0.13[a]±0.02	-0.14[a]±0.01	-0.15[a]±0.01
Juiciness	6.09[e]±0.56	7.05[d]±0.79	8.27[c]±0.42	9.87[b]±0.63	11.24[a]±0.57
Folding test	4.79[a]±0.48	4.60[a]±0.52	4.80[b]±0.42	2.80[b]±0.42	2.20[b]±0.42

Values are mean of each triplicate of three repeated samples with ± standard deviation. Different letters in the same row indicate significant differences ($p<0.05$).

Colour and Texture

The data for colour and texture are presented in Table 4. Statistical analysis showed that there are significant differences ($P<0.05$) among each treatment. All colour coordination showed significant differences ($P<0.05$) among meatballs. The result showed that meatball A had the highest L* value while meatball E had the lowest. On the other hand, for a* and b* values of meatball, the A was the lowest and both the values increased onwards from A to E. Sample A was the lightest in colour (lowest L value) because it had the lowest amount of duck meat (duck meat has a darker colour compared to chicken meat. The texture of meatball was analyzed using the Warner-Bratzler shearing device according to the method of Brenda and Clyde (2001). The texture of meatball showed that increasing duck meat increases the tenderness of meatballs.

Table 4. Colour and texture of meatballs with different ratios of chicken and duck meat

Properties		Treatment				
		A (0:100)	B (25:75)	C (50:50)	D (75:25)	E (100:0)
Color	L*	65.89[a]±0.85	63.17[b]±0.56	61.12[c]±0.22	59.21[d]±0.43	55.65[e]±0.34
	a*	2.67[e]±0.18	3.14[d]±0.13	4.47[c]±0.25	5.90[b]±0.25	6.30[a]±0.33
	b*	19.54[b]±0.27	21.13[a]±0.40	21.02[a]±0.40	20.95[a]±0.33	20.77[a]±0.17
Shear Stress	(Kg)	535.94[a] ±21.09	541.50[b]±17.2	421.75[c]±13.94	310.49[d]±10.28	253.31[e]±20.8

Values are mean of each triplicate of three repeated samples with ± standard deviation. Different letters in the same row indicate significant differences ($p<0.05$).

CONCLUSIONS

Based on the analysis results, proximate composition and physicochemical characteristics of meatball with different ratios of chicken and duck meat were different in proximate composition and physicochemical composition. The differences in meat balls properties were mainly due to the different types of raw materials used in the formulation.

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