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Proximate Composition, Colour, Texture Profile of Malaysian Chicken Balls

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Abstract: The results of the analyses of six brands of commercial chicken balls showed significant differences ($p<0.05$) in chemical composition, colour and texture among all samples. Most of the samples contained high moisture content (between 60.14-72.81%), with protein content ranging from a low of 9.93% to moderately high of 15.06%. However, the fat content displayed an inverse relationship as compared to protein, ranging from 4.26-14.00%. The low ash content ranging from 1.92-2.82%, could be contributed by the presence of salts and flavoring ingredients in the chicken balls. The difference in carbohydrate content ranging from 5.54-20.85%, indicated high usage of meat substitute in certain brands tested. The L, a and b values of cooked chicken balls ranged between 69.61-77.96, -2.02 to 0.33 and 15.66-19.70 respectively. The hardness, cohesiveness, springiness and shear force ranged between 3.73-5.73, 0.55-0.69, 11.40-13.71, 31.27-53.77 and 0.51-1.28, respectively. Chewiness readings obtained were between 31.27-53.77, possibly contributed by the different thickeners used in the formulations. The research result shows that Malaysian commercial chicken balls are significantly different in their chemical composition, colour and textural properties.

Key words: Processed meat products, chicken balls, physico-chemical properties

INTRODUCTION

Meatballs are classified as finely comminuted meat products, sometimes referred to as meat emulsions (Hsu and Sun, 2006). Commonly meatballs are consumed with noodles in the Southeast Asian region. Various types of factors can affect the quality of meatballs significantly, either in terms of nutritional value or overall acceptability of the meatballs among its consumers. Only those meatballs with high nutritional value, good textural properties, acceptable flavor and taste profiles will be preferred by consumers. Studies have shown that texture appears to be the most important characteristic of 'Kung-wan' (Taiwanese emulsified meatball) and consumers prefer harder texture (Hsu and Chung, 1998). Whey protein concentrate and soy protein isolate were reported to be able to improve textural properties and to suppress lipid oxidation of meat meatballs as compared to toasted bread-crumb which was traditionally used in the production of meatballs in Turkey (Ulu, 2004). In order to produce low fat emulsified meatballs, oat bran and rice bran were used as replacement for fat (Yilmaz and Daglioglu, 2003; Huang *et al.*, 2005). They found that meatballs containing oat and rice bran have lower concentration of total fat and total trans fatty acid as compared to the control. Previously, Hsu and Yu (2002) have studied the effect of substituting animal fat with vegetable oil on the quality of meatballs. They found that vegetable oil have minor effects on the quality of Kung-wan.

Currently, there are many varieties of meatballs available in the Malaysian market, mainly produced from chicken, beef or fish. In Malaysia, chicken is the primary source of meat and is used in most meat-based products such as meatballs, nugget and sausages. Statistics have shown that per capita consumption of chicken meat is about 37.7 kg, followed by 5.06 kg for beef (Ministry of Agriculture, 2005). In the past, meatballs production originated from small family-based enterprises. However, increasing demand for meatballs products in recent year have changed the meatballs manufacturing into large-scale production. Many factories have been developed in Malaysia to increase output and to fulfill the increasing demand for meatballs in the country. Due to the increasing competition among manufacturers, more advanced technologies have been imported from other countries and fully-automated machineries have been invested to produce high quality products. This study was carried out to determine the physico-chemical properties associated with chicken balls available in Malaysian markets currently.

MATERIALS AND METHODS

Chicken balls: Six frozen commercial chicken balls (CB1 -CB6) from different brands or manufacturers were collected from supermarkets located in Penang, Northern Malaysia. Two packets of each brand were picked randomly and brought to the laboratory for analysis. The chicken balls were prepared by cooking in the boiling water (95°C) for 4 min.

Proximate analysis: The proximate composition was determined according to the AOAC (2000) methods. Moisture content was determined by drying samples overnight at 105°C until constant weight was achieved (Memmert UL 40, Germany). Crude protein content was determined using the Kjeldahl method (Kjeltec System 1002, Sweden). Crude lipid content was determined using the Soxhlet method. Ash content was determined by ashing samples overnight at 550°C (Thermolyne Sybranm model: 6000, USA). Carbohydrate content was calculated by difference.

Colour: The colour of chicken balls samples was measured using a colorimeter (Minolta spectrophotometer CM 3500d, Japan). The colour reading includes lightness (L), redness (a) and yellowness (b). The equipment was standardized with a white colour standard. The mean of five measurements was taken for each L, a and b values.

Texture profile: Texture measurement on meatballs was conducted using a computer-assisted TA-XT2i Texture Analyzer (Stable Micro Systems, UK). Two types of test were carried out in order to compare the texture profile of the meatballs obtained from different tests. First, Texture Profile Analysis (TPA) was used to determine hardness, cohesiveness, chewiness and springiness (Bourne, 1978). This test was carried out by using compression platen with 75 mm diameter. Second, shear test which used a knife blade to determine shear force required to cut through sample. The TA-XT2i setting for tests was load cell 25 kg; pre-test speed 2.0 mm/s; post-test speed 5.0 mm/s; distance 50% and trigger type, auto. The mean of five measurements was taken for each hardness, cohesiveness, chewiness, springiness and shear force values.

Statistical analysis: Data obtained from all the analysis were analyzed using the statistical one-way analysis of variance (ANOVA), followed by Duncan multiple range test of Statistical Package for Social Science version 12.0 (SPSS inc., Chicago, Illinois, U.S.A). Statistical significance was indicated at 95% confidence level.

RESULTS AND DISCUSSION

There are various kinds of meatballs available in Malaysian market today. A total of six samples of commercial chicken balls were collected for this project in order to analyze their chemical composition and physicochemical properties. Collected samples with relevant information are shown in Table 1. Based on the products label, the main ingredients commonly used in Malaysian chicken balls are quite similar. They include chicken meat, starch, sugar, salt, flavour enhancer and permitted food conditioner. Types of flavour and food conditioner used in meatballs usually are not clearly stated in the label. The ingredients used are not much different compared to Taiwan chicken balls or Brazilian turkey balls (Baggio *et al*., 2005; Tseng *et al*., 2000). However, Malaysian chicken balls do not contain any fat as an ingredient as compared to pork fat in Taiwan chicken balls or hydrogenated vegetable oil in Brazilian turkey balls.

Table 2 shows the proximate composition results of the six brands of chicken balls tested. All six chicken balls produced by different manufacturers were different in their proximate composition. Moisture content was highest in CB 4 (72.81 %) and lowest in CB 6 (60.14 %). All types of chicken balls showed big differences in their fat and carbohydrate content. Lowest fat content was 4.26% in CB 4 as compared to highest of 14.00 % in CB3. Carbohydrate content was lowest in CB 4 with only 5.54% while CB 5 has the highest carbohydrate of 20.85%. Based on table below, all chicken balls varied slightly in protein and ash content. Generally, current

Table 1: Ingredient information on the package of commercial chicken balls

Sample	Ingredients
CB 1	Chicken meat, soy protein, food starch, sugar, salt, permitted food conditioner and monosodium glutamate as flavour enhancer
CB 2	Chicken meat, sugar, salt, soy protein, spices, chicken flavour. Contains monosodium glutamate, disodium inosinate, guanylate as permitted flavour enhancer. Contains food permitted conditioner
CB 3	Chicken meat, food starch, sugar, salt, spices, containing permitted food conditioners and monosodium glutamate, disodium inosinate, guanylnate as permitted flavour enhancer
CB 4	Chicken meat, food starch, sugar, salt, spices, permitted food conditioner and natural protein extract
CB 5	Chicken meat, wheat starch, salt, permitted food conditioner, flavour and without preservatives
CB 6	Chicken meat, food starch, sugar, salt and seasoning, permitted food conditioner, monosodium glutamate as flavour and enhancer

Table 2: Proximate composition of commercial chicken balls (%)

Sample	Moisture	Protein	Fat	Ash	Carbohydrate
CB1	$64.33^{b}\pm1.73$	$15.06^{a}\pm0.19$	$10.00^{c}\pm0.44$	$2.30^{b}\pm0.05$	$8.43^{d}\pm0.13$
CB2	$64.68^{b}\pm1.30$	$9.94^{c}\pm0.22$	$12.12^{b}\pm0.51$	$2.79^{a}\pm0.32$	$10.08^{c}\pm0.67$
CB3	$63.98^{b}\pm1.16$	$9.93^{c}\pm0.18$	$14.00^{a}\pm0.48$	$2.26^{b}\pm0.07$	$9.43^{c}\pm0.08$
CB4	$72.81^{a}\pm2.44$	$14.96^{a}\pm0.09$	$4.26^{e}\pm0.19$	$2.14^{bc}\pm0.08$	$5.54^{e}\pm0.30$
CB5	$60.19^{c}\pm0.98$	$10.30^{bc}\pm0.94$	$7.01^{d}\pm0.41$	$1.92^{c}\pm0.07$	$20.85^{a}\pm0.36$
CB6	$60.14^{c}\pm1.13$	$11.08^{b}\pm0.44$	$13.32^{a}\pm0.94$	$2.82^{a}\pm0.05$	$13.44^{b}\pm0.72$

$^{a-e}$Means within a column with different letters are significantly different ($p<0.05$)

Table 3: Colour properties of commercial chicken balls

Sample	L	a	b
CB1	$77.28^{ab}\pm0.46$	$-0.90^{c}\pm0.13$	$15.53^{c}\pm0.30$
CB2	$73.88^{cd}\pm0.57$	$-0.08^{b}\pm0.09$	$18.91^{a}\pm0.33$
CB3	$75.25^{ab}\pm0.60$	$-0.96^{c}\pm0.09$	$16.77^{b}\pm0.40$
CB4	$71.81^{d}\pm3.70$	$-2.12^{d}\pm0.17$	$15.22^{c}\pm0.33$
CB5	$73.24^{cd}\pm0.52$	$0.27^{a}\pm0.10$	$15.12^{c}\pm0.24$
CB6	$77.59^{a}\pm0.38$	$-0.93^{c}\pm0.12$	$17.06^{b}\pm0.40$

$^{a-d}$Means within a column with different letters are significantly different ($p<0.05$)

commercial chicken balls have lower protein content and higher carbohydrate content as compared to data collected by Huda (2000) which has a value of protein and carbohydrate ranging from 12.83-13.71% and 5.23-8.25% respectively. The decrease in protein content and the increase in carbohydrate content in chicken balls presently could be due to the increase in starch content (as extender) as substitute for raw meat in the manufacturing of chicken balls. The main reason behind this is to reduce the processing cost in order to increase the profit margin.

The varying proximate composition of chicken balls among brands was mainly due to the different formulations used for the production of these products. Protein content in meatballs mainly comes from meat. Generally, the protein content present in chicken meat is not significantly different. The amount and the type of meat used in each formulation make the protein content in the products different. Fat present in meatballs may come from the meat naturally or from oil/fats added into the meatballs to serve several functions. The higher range fat content may indicate higher usage of fatty material in some brands in place of chicken meat. Vegetables oil is often added in meatball formulation to improved mouth feel and gives a lubrication effect in meat emulsions. The carbohydrate content in meatballs varied greatly among the brands of chicken balls, indicating higher usage of meat substitute in some brands. Starch is added to act as a source of carbohydrate and to thicken the texture of meatballs in the past. Today, starch is extensively used as stabilizers, texturisers, water or fat binders and emulsifier. Apart from these, starch can also increase gel strength and freeze-thaw stability of meatballs if appropriate starch are added in proper level (Serdaroglu *et al*., 2005).

Table 3 shows the colour measurement results of chicken balls. The highest lightness was seen in CB 6 (77.59) and the lowest in CB 4 (71.81). All chicken balls varied slightly in their a and b values. According to the data by Huda (2000), the L, a and b values of chicken balls varied between 72.42-75.34; -1.62 to -1.02 and 13.77-20.95 respectively. These results shows that the colour properties of chicken balls marketed in Malaysia do not vary much even after seven years (since the research done by Huda in 2000). The colour properties of current commercial chicken balls showed higher L and b value and lower a value compared to the colour properties of Taiwanese chicken balls reported by Tseng *et al*. (2000), which has a value of 72.52, 11.00 and 2.32 respectively.

The difference in colour properties of chicken balls among brands could be due to non-meat ingredients added or treatment used in the processing. According to Yilmaz and Daglioglu (2003), meatballs with added oat bran will have higher L and b values but lower a values compared to the control. The same result was also reported by Serdaroglu (2006) where meatballs with added whey powder resulted in higher L values compared to the control.

Texture analysis results for chicken balls are shown as in Table 4. Based on the table, all chicken balls showed similar results in hardness (ranged from 4.59-5.73 kg) except CB 3 where its hardness was much lower (3.73 kg). Cohesiveness of chicken balls were quite similar (ranged from 0.64-0.69) except CB 1 (0.55). All chicken balls showed slight differences in springiness but varied much in chewiness. The highest chewiness was 53.77 kg mm in CB 5 while the lowest was only 31.27 kg mm in CB 3.

According to Serdaroglu *et al*. (2005), factors responsible for textural properties in comminuted meat proteins are degree of myofibrillar proteins extracted, stromal protein content, degree of comminuting and type and level of non-meat ingredients. Apart from amount of protein content, types and amount of extenders such as starch will play a decisive role on hardness of meatballs as well. As an example, addition of legumes flour can slightly increase toughness of meatballs. Hsu and Chung (1998) indicated positive correlation between hardness and overall acceptance which means that consumers generally prefer harder texture. However, higher values for parameters measured in TPA (hardness, cohesiveness, springiness and chewiness) do not necessary mean better quality. There is a cut-off point above which the texture of meatballs would be unacceptable (Yu and Yeang, 1993). Therefore,

Table 4: Textural properties of commercial chicken balls

Sample	Hardness (kg)	Cohesiveness	Springiness (mm)	Chewiness (kg mm)	Shear Force (kg)
CB1	$5.54^{a}\pm0.29$	$0.55^{d}\pm0.01$	$11.40^{d}\pm0.28$	$35.08^{dc}\pm2.37$	$1.12^{ba}\pm0.21$
CB2	$5.30^{a}\pm0.27$	$0.65^{bc}\pm0.00$	$11.88^{c}\pm0.35$	$40.72^{bc}\pm2.32$	$0.51^{c}\pm0.09$
CB3	$3.73^{c}\pm0.23$	$0.67^{ab}\pm0.00$	$12.56^{b}\pm0.44$	$31.27^{d}\pm2.13$	$0.77^{bc}\pm0.34$
CB4	$4.59^{b}\pm0.49$	$0.65^{bc}\pm0.01$	$12.93^{b}\pm0.48$	$38.44^{bc}\pm4.36$	$1.28^{a}\pm0.15$
CB5	$5.67^{a}\pm0.10$	$0.69^{a}\pm0.00$	$13.71^{a}\pm0.29$	$53.77^{a}\pm1.86$	$0.97^{ab}\pm0.27$
CB6	$5.73^{a}\pm0.84$	$0.64^{c}\pm0.04$	$12.07^{c}\pm0.27$	$44.56^{b}\pm9.06$	$0.98^{ab}\pm0.30$

$^{a-d}$Means within a column with different letters are significantly different ($p<0.05$)

determination of good textural qualities of meatballs should be done together with sensory test in order to find out the most suitable range preferred by consumers.

Conclusion: Based on the analysis results, proximate composition, colour and textural properties are generally quite different among different brands of Malaysian commercial chicken balls. The differences in chicken balls properties are mainly due to the type and amount of ingredients added and the different processing methods.

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