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ARTICLE

Effect of Mixing Ratio between Pork Loin and Chicken Breast on Textural and Sensory Properties of Emulsion Sausages

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Abstract

This study is conducted to evaluate the effects of the mixing ratio between pork loin and chicken breast for textural and sensory properties of emulsion sausages. Meat homogenates are prepared by using five mixing ratios between pork loin and chicken breast (100:0, 70:30, 50:50, 30:70, and 0:100), and the emulsion sausages are also formulated with five mixing ratios. The additions of chicken breast increase the salt soluble protein solubility due to high pH levels of chicken breast, thereby resulting in the reduction of cooking losses. In addition, the apparent viscosity of meat homogenates increase with increasing amounts of chicken breast. In terms of emulsion sausages formulated with pork loin and chicken breast, the addition of chicken breast above 50% may contribute to a softer and more flexible texture of emulsion sausages. For sensory evaluations, an increase in the added amount of chicken breast contributes to a rich umami taste and deeper flavor within the emulsion sausages, resulting in the high overall acceptance score for the formulation of 0-30% pork loin and 70-100% chicken breast. Therefore, the optimal mixing ratios between pork loin and chicken breast are 0-30% and 70-100% for enhancing the textural and sensory properties of emulsion sausages.

Key words: chicken breast, emulsion sausage, pork loin, sensory characteristics

Introduction

The skeletal muscle, which has been widely used to manufacture several meat products, can be largely classified as red, intermediate and white muscle, depending on their muscle composition (Klont *et al*., 1998). Hämäläinen and Pette (1995) observed four different types of myosin heavy chain (MHC), including MHC type I, MHC type IIA, MHC type IIB and MHC type IIX, based on myofibrillar ATPase activity. Differences in the combination of these myofibrillar isoforms determined the muscle characteristics affecting meat quality, such as color, sensory satisfaction, tenderness and water holding capacity (Klont *et al*., 1998).

Chicken breast has received much attention from meat consumers and the meat industry as a healthy white meat serving low fat content. Further, pork loin, which is an intermediate muscle between red and white muscles, contains low fat content as compared to other pork parts (Dorado *et al*., 1999). According to Smith and Fletcher (1987), MHC type II or white fibers are the most fiber in chicken breast muscle (*Musculus pectoralis major*) regardless of age and sex. Meanwhile, pork loin (*M. longissimus dorsi*) consists of a high degree of MHC type IIB compared to MHC type I and IIA fibers (Karlsson *et al*., 1999). Although the two muscles similarly contain a high degree of MHC type II, there were great differences in the processing quality between the two muscles. For technologically manufacturing meat products, such as emulsion sausage, patty and restructured ham, the degree of myofibrillar protein solubility is the most important factor affecting gel formation in the final product (Asghar *et al*., 1985). The solubility of myofibrillar proteins, known as salt soluble protein due to its solubility in salt solution, was affected by the pH of raw material (Lesiów and Xiong, 2003), ionic strength and the condition of extraction (Gillett *et al*., 1977). Myosin, actin and actomyosin are major myofibrillar proteins in the skeletal muscle. Tsai *et al*. (1972) reported that myosin has an important role for the formation of emulsion stability compared to actin or sarcoplasmic protein. In addition, Lan *et al*. (1995) noted that the myofibrillar protein contents of pork, beef, chicken breast, chicken thigh and turkey breast were 11.41%, 12.65%, 12.57%, 10.87%, and 13.01%, respectively, and suggested

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that the myofibrillar protein content was different from animal species and parts.

Recently, Zorba and Kurt (2006) reported that the addition of chicken and turkey breasts improved the processing quality of beef and therefore suggested that the optimal level of beef (*M. semimembranosus*), chicken and turkey was 0-23%, 9-30% and 53-91%, respectively. Additionally, chicken breast increased the pH value of emulsion, resulting in the improvement of myofibrillar protein solubility. Thus, the use of chicken breast for manufacturing meat products is expected to result in physicochemical and textural properties. In terms of the sensory aspect, the taste and flavor of chicken were associated with being juicy, sour, sweet and umami (Maughan and Martini, 2012). Although both the pork loin and chicken breast have a lower fat content, there is little information available in the literature related to the effect of mixing ratio between pork loin and chicken breast on meat product.

Therefore, the objective of this study was to determine the changes in the processing quality using meat homogenates prepared with various mixing ratio between pork loin and chicken breast, based on the obtained best result, as well as to evaluate the textural and sensory properties of emulsion sausages formulated with pork loin and chicken breast.

Materials and Methods

Preparation of raw materials

Pork loin (*M. longissimus dorsi*) and chicken breast (*M. pectoralis major*) in fresh broilers (Arbor acre strain, 5 wk of age, approximately 1.5-2.0 kg live weight) muscles after post-mortem 24 h were obtained from a local market. Pork back fat was also collected. All subcutaneous and inter-muscular fat were removed from the fresh pork loinand chicken breast. The pork loin, chicken breast, and back fat were initially ground using a meat grinder (PM-70, Mainca, Spain) equipped with 8 mm plate. The ground chicken breast, pork loin, and pork back fat were packaged with Nylon/PE film, and used on the day.

Experiment 1 (meat homogenates)

All meat homogenates were composed by 80% raw meat, 20% ice, and 1.5% NaCl. And each sample batch consisted of five mixing ratio between ground pork loin and chicken breast as 100:0 (based on total sample composition 80% and 0%), 70:30 (56% and 24%), 50:50 (40% and 40%), 30:70 (24% and 56%), and 0:100 (0% and 80%).The mixture from each batch was homogenized using a meat blender for 3 min. All meat homogenates were then placed in Nylon/PE film, and stored at 4°C during analysis. To evaluate the effect of mixing ratio between pork loin and chicken breast on processing quality, the pH value, color, salt soluble protein solubility, and cooking loss were determined.

Experiment 2 (emulsion sausages)

Emulsion sausages were produced with the formulation are given in Table 1. Total five mixing ratio between ground pork loin and chicken breast was used as 100:0 (based on total sample weight 70% and 0%), 70:30 (49% and 21%), 50:50 (35% and 35%), 30:70 (21% and 49%), and 0:100 (0% and 70%). For each batch (3 kg) of the sausage, meat, fat, ice, and other ingredients were emulsified by using a bowl cutter (Nr-963009, Scharfen, Germany). After emulsification, all batters were stuffed into collagen casings (#240, NIPPI Inc., Japan; approximate 25 mm diameter) by using a stuffer (IS-8, Sirman, Italy). The sausages were heated at 80°C until the core temperature of 75°C. The emulsion sausages were used to analysis textural and sensory properties on the day.

pH measurements

The pH values of sample were determined with a pH

Table 1. Formulation of emulsion sausages prepared with pork loin and chicken breast

Ingredients (%, w/w)	Mixing ratio (pork loin / chicken breast)				
	100 / 0	70 / 30	50 / 50	30 / 70	0 / 100
Pork loin	70	49	35	21	0
Chicken breast	0	21	35	49	70
Back fat	15	15	15	15	15
Ice	15	15	15	15	15
Total	100	100	100	100	100
NPS[1)]	1.5	1.5	1.5	1.5	1.5
Sodium tri-polyphosphate	0.3	0.3	0.3	0.3	0.3
Ascorbic acid	0.05	0.05	0.05	0.05	0.05

[1)]NPS: nitrite pickled salt (99.4:0.6).

meter (Model 340, Mettler-Toledo GmbH, Switzerland). The pH values of samples were measured by blending a 5 g sample with 50 mL distilled water for 60 s in a homogenizer at 8,000 rpm (Ultra-Turrax SK15, Janke & Kunkel, Germany).

Instrumental color evaluation

Instrumental color were determined using a colorimeter (Minolta Chroma meter CR-210, Japan; illuminate C, calibrated with a white plate, CIE L*=+97.83, CIE a*=-0.43, CIE b*=+1.98). Five measurements for each sampleon surface of meat homogenates and emulsions sausages were taken. CIE L* (lightness), CIE a* (redness), and CIE b* (yellowness) values were recorded.

Cooking loss

Allmeat homogenates were cooked using a water bathat 80°C for until the targeted core temperature reached 75°C. Cooking loss was determined by calculating the weight differences before and after cooking.

Salt soluble protein solubility

The solubility of the salt soluble (myofibrillar) protein was determined following the modification of procedures described by Saffle and Galbreath (1964). A 5 g sample was blended with 50 mL 3% sodium chloride solution at 14,000 rpm for 2 min using homogenizer (AM-7, Nihonseiki Kaisha, Japan). The mixture was centrifuged at 3,000 rpm for 15 min. The protein concentration of supernatant was determined using the biuret method (Gornall *et al.*, 1949) and using bovine serum albumin (Sigma Chemical Co., USA).

Apparent viscosity

Apparent viscosity of meat emulsion was measured in triplicate with a rotational viscometer (HAKKE Viscotester® 550, Thermo Electron Corporation, Karlsruhe, Germany) at 10 rpm. The standard cylinder sensor (SV-2) was positioned in a 25 mL metal cup filled with batter and allowed to rotate under a constant shear rate (1/s) for 60 s before each reading was taken. The temperature of each sample at the time (18±1°C) of testing was also recorded (Choi *et al.*, 2010).

Texture profile analysis (TPA)

Texture profile analysis was performed at room temperaturewith a texture analyzer (TA-XT2*i*, Stable Micro Systems Ltd., England). The cooked samples under above mentioned condition were cooled to room temperature at 25°C for 3 h. Before analysis, the cooked sausages were allowed to equilibrate to room temperature. Samples were taken from the central portion of each emulsion sausage. The conditions of texture analysis were as follows: pre-test speed 2.0 mm/s, post-test speed 5.0 mm/s, maximum load 2 kg, head speed 2.0 mm/s, distance 8.0 mm, force 5 g (Choi *et al.*, 2010). Value for hardness, springiness (ratio), cohesiveness, gumminess, and chewiness were determined as described by Bourne (1978).

Sensory evaluation

Each treatment was evaluated in three sessions (replications) conducted on different days. Emulsion sausages formulated with various mixing ratio between pork loin and chicken breast were assessed for sensory properties by a 12 member trained panel (ASTM, 1981), between the ages 20 and 35. Each samples heated by microwave for 15 s, cut into 2.5 cm cubes, were served to the panelists in random order, and the sensory evaluations were performed by the panelists under fluorescence lighting. Panelists were instructed to cleanse their palates between samples using warm water. The appearance, color, flavor, tenderness, fatness, and overall acceptance (1=extremely undesirable, 9=extremely desirable), juiciness (1=extremely dry, 9=extremely juicy), residual flavor and umami (1=much too weak, 9=much too intense) of the samples were evaluated.

Statistical analysis

The experiments were replicated three times, and values represent the mean and standard deviation. Analysis of variance was conducted using the general linear model (GLM) procedure of the SPSS 18.0 software (SPSS Inc, USA). Also, the linear regression equations among pH value, salt soluble protein solubility, and cooking loss were calculated with SPSS.For sensory evaluation data, the principle component analysis (PCA) was performed on the recorded data to categorize the sensory properties of emulsion sausages. SPSS 18.0 software was also used for PCA analysis. Duncan's multiple range test was used to compare the mean values ($p<0.05$).

Results and Discussion

pH value and color parameters of meat homogenates

The effect of mixing ratio between pork loin and chicken breast on pH value and color parameters of meat homogenates is shown in Table 2. In this study, the pH values

Table 2. Effect of mixing ratio between pork loin and chicken breast on pH value and color parameters of meat homogenates

Type	Traits	Mixing ratio (pork loin / chicken breast)				
		100 / 0	70 / 30	50 / 50	30 / 70	0 / 100
Raw	pH	5.79±0.06$^{1)c,y}$	5.82±0.05^{c,y}	5.90±0.04^{b,y}	5.93±0.04^{b,y}	6.01±0.03^{a,y}
	CIE L*	66.88±2.43^{b,x}	61.94±1.58^{b,y}	60.22±3.10^{ab,y}	59.98±1.91^{ab,y}	71.65±1.37^{a,y}
	CIE a*	11.71±0.21^{a,x}	9.48±0.64^{b,x}	8.79±0.93^{b,x}	6.04±1.15^{c,x}	2.59±0.27^{d,x}
	CIE b*	12.88±0.97^{a,x}	12.60±1.33^{a,x}	12.76±1.24^{a,x}	10.91±1.43^{b}	10.15±1.65^{b}
Cooked	pH	6.01±0.02^{d,x}	6.03±0.01^{c,x}	6.10±0.02^{b,x}	6.11±0.02^{b,x}	6.15±0.04^{a,x}
	CIE L*	77.05±0.25^{e,x}	78.95±0.29^{d,x}	79.59±0.35^{c,x}	81.83±0.19^{b,x}	84.31±0.35^{a,x}
	CIE a*	7.14±0.25^{a,y}	5.52±0.10^{by}	4.19±0.15^{c,y}	3.22±0.50^{d,y}	2.15±0.53^{e,y}
	CIE b*	9.36±0.25^{d,y}	9.66±0.19^{c,y}	10.16±0.06^{b,y}	10.28±0.23^{a}	10.32±0.16^{a}

$^{1)}$All values are mean±standard deviation of three replicates.
$^{a-e}$Means within a row (among treatments) with different letters are significantly different (p<0.05).
^{x,y}Means between raw and cooked sample within each treatment different letters are significantly different (p<0.05).

of pork loin and chicken breast were 5.73 and 6.00, respectively. In previous studies, the pH value of normal pork loin was 5.74 (Joo *et al*., 1999), and the pH value of normal chicken breast was 6.02 (Barbut *et al*., 2005). In both meat homogenates after or before cooking, the pH value increased with increasing the added levels of chicken breast in meat homogenates. Further, the meat homogenates formulated with only pork loin showed the lowest pH value among all treatments (p<0.05). Similarly, Zorba and Kurt (2006) reported that the increase in chicken breast of meat homogenates prepared with beef resulted in an increased pH value. In addition, the pH value increased after cooking in all treatments (p<0.05). The pH range of raw meat homogenates was 5.79-6.01, whereas that after cooking was 6.01-6.15. According to Forrest *et al*. (1975), the reason for the increased pH value in meat emulsion due to cooking is related to the exposure of imidazolium, which is an alkaline-residue in histidine amino acid. The pH of meat is greatly associated with water retention and textural properties of the final product (Tornberg, 2005); thus, our result is expected to cause an improvement in the technological properties of meat homogenates with added chicken breast due to the high pH value of chicken breast.

Color characteristics of the muscle, or reddish color, primarily depend on the myoglobin content and chemical state of the myoglobin molecule (Lawrie, 1998). In addition, King and Whyte (2006) concluded that the formation of cooked color in meat products was affected by pH, animal species, meat parts, packaging method, cooking method, fat content and additives. Kranene *et al*. (1999) reported that myoglobin was not detected in the *pectoralis* broiler muscle, whereas Newcom *et al*. (2004) noted that pork loin contains 0.62-0.95 mg/g of soluble myoglobin. In this study, the CIE L* value (lightness) increased with increasing the added level of chicken breast in meat homogenates; however, the CIE a* (redness) and CIE b* (yellowness) values decreased. The result of the redness is greatly related to the lower myoglobin content of chicken breast muscle as compared to that of pork loin. In cooked meat homogenates, there was a similar tendency in the color characteristics of raw meat homogenates among each mixing ratio. Similarly, Fletcher *et al*. (2000) reported that increased lightness and yellowness and decreased redness were observed for chicken breast after thermal treatment and therefore, suggested that the color of cooked chicken breast highly correlated with the pH value of raw meat. However, thermal processing, a form of cooking, is the most greatest factor affecting the differences between the color of raw and cooked chicken breast. Thus, increased lightness and decreased redness of meat homogenates due to cooking were observed for all treatments regardless of the mixing ratio between pork loin and chicken breast.

Cooking loss and salt soluble protein solubility of meat homogenates

The effect of mixing ratio between pork loin and chicken breast on cooking loss and salt soluble protein solubility of meat homogenates is presented in Table 3. An increase in chicken breast added in meat homogenates improved the cooking loss. The addition of chicken breast above 50% showed a lower cooking loss than the control, which is formulated with only pork loin (p<0.05). Moreover, the meat homogenate prepared with only chicken breast showed the lowest cooking loss among all treatments (p<0.05). The structure of the restructured meat is formed with an extraction of muscle protein along with the addition of salt, and the stable meat structure could minimize the release of moisture and fat during thermal treatment (Asghar *et al*., 1985). Thus, moisture and fat retention in meat homogenates is affected by the solubility

Table 3. Effect of mixing ratio between pork loin and chicken breast on cooking loss and salt soluble protein solubility of meat homogenates

Traits	Mixing ratio (pork loin / chicken breast)				
	100 / 0	70 / 30	50 / 50	30 / 70	0 / 100
Cooking loss (%)	20.38±0.87[1)a]	20.16±0.75[a]	18.21±0.54[b]	17.62±0.73[b]	16.44±1.73[c]
Salt soluble protein solubility (mg/g)	18.14±0.36[c]	18.57±0.20[b]	18.57±0.32[b]	18.74±0.23[b]	19.54±0.12[a]

[1)]All values are mean±standard deviation of three replicates.
[a-c]Means within a row(among treatments) with different letters are significantly different (p<0.05).

of muscle proteins. In this study, it is clear that the pH value of meat homogenates correlates with that of salt soluble protein solubility (Fig. 1a). Additionally, by increasing the amounts of chicken breast, salt soluble protein solubility increased (Fig. 1b). The solubility of myofibrillar proteins is the most important factor affecting cooking loss and textural properties. In previous studies, the pH value, salt level and extracting condition influenced the solubility of myofibrillar proteins (Gillett *et al*., 1977; Tornberg, 2005). According to Lesiów and Xiong (2003), the ability to form chicken muscle protein was maximized at pH 6.0. The gel formation with muscle protein is related to the pH value of raw meat, animal species and part, the characteristics of muscle fiber, ionic strength, type and level of added salt, and thermal condition (Lan *et al*., 1995; Samejima *et al*., 1992; Tornberg, 2005). Thus, our result suggested that the improvement of salt soluble protein solubility due to a high pH of chicken breast added could contribute to the formation of more stable structured cooked meat homogenates. Similarly, Zorba and Kurt (2006) indicated that the high pH of chicken breast led to an improvement of emulsion functionality, such as emulsion stability and capacity.

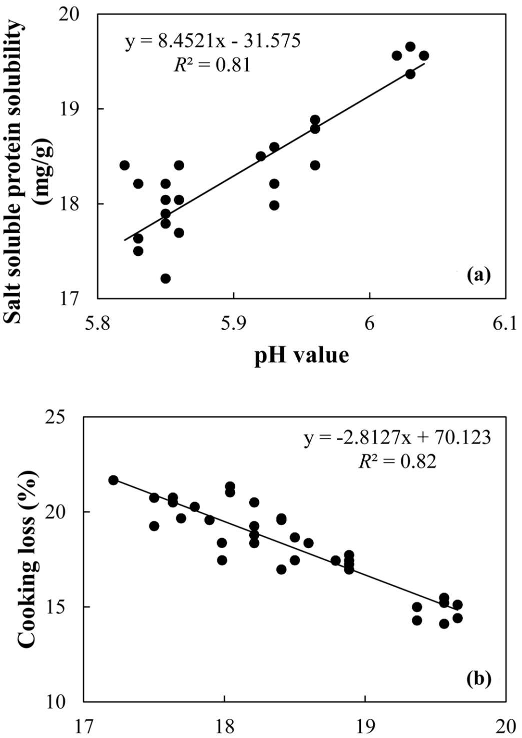

Fig. 1. Relationship between salt soluble protein solubility and cooking loss of meat homogenates formulated with various mixing ratio between pork loin and chicken breast.

Apparent viscosity

The apparent viscosity of meat homogenates formulated with various mixing ratios between pork loin and chicken breast is shown in Fig. 2. The meat homogenates prepared with only pork loin showed a lower apparent viscosity compared to the meat homogenates containing chicken breast. Moreover, the increase in the added amount of chicken breast clearly increased the apparent viscosity

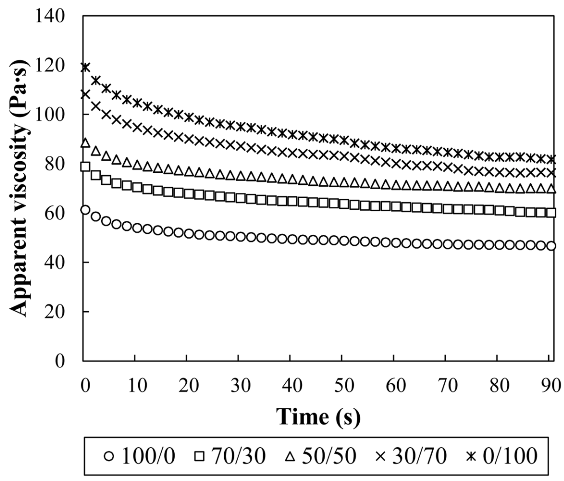

Fig. 2. Changes in apparent viscosity of meat homogenates formulated with various mixing ratio between pork loin and chicken breast stirred for 90 sec. (○), meat homogenates formulated with 100% pork loin; (□), meat homogenates formulated with 70% pork loin and 30% chicken breast; (△), meat homogenates formulated with 50% pork loin and 50% chicken breast; (×), meat homogenates formulated with 30% pork loin and 70% chicken breast; and (*) meat homogenates formulated with 100% chicken breast.

of meat homogenates. Cofrades *et al*. (1993) suggested that the increase in protein content and pH value increased the viscosity of actomyosin extracted from pork loin and chicken breast regardless of animal species. Apparent viscosity, which means the emulsion stability composed of moisture, protein and lipid, is a useful factor predicting the textural properties of the final product. Thus, the improvement of textural properties due to the addition of chicken breast is expected with increased apparent viscosity.

Textural properties of emulsion sausages

The effect of mixing ratio between pork loin and chicken breast on the textural properties of emulsion sausages is presented in Table 4. Increasing the added amount of chicken breast led to a decrease in hardness, gumminess and chewiness of emulsion sausages. In Table 3, the meat homogenates formulated with chicken breast above 50% showed a significantly lower cooking loss than that prepared with only pork loin. The significant decrease in hardness resulted from the addition of chicken breast above 50%. In terms of springiness, however, emulsion sausages prepared with 50% pork loin and 50% chicken breast showed a higher springiness than emulsion sausages formulated with 100% pork loin ($p<0.05$). According to Ziegler *et al*. (1987), a decrease in moisture level resulted in increased hardness and fracturability, but decreased springiness. The addition of chicken breast contributing to a decrease in cooking loss resulted from a high amount of moisture in emulsion sausages. However, there were no differences in cohesiveness among all treatments ($p>0.05$). Farouk *et al*. (2002) suggested that the solubility of sarcoplasmic proteins greatly affected cohesiveness. In this study, all treatments showed a similar sarcoplasmic protein solubility (data not shown). Further, Ziegler *et al*. (1987) suggested that the moisture content had no influence on cohesiveness. Consequently, the addition of chicken breast above 50% could contribute to a more soft and flexible texture of emulsion sausage, and such effect might be related to the improvement of cooking loss owing to the addition of chicken breast.

Sensory properties of emulsion sausages

The sensory properties of emulsion sausages formulated with various mixing ratios between pork loin and chicken breast are portrayed in Table 5. The statistical results indicated that the mixing ratio between pork loin and chicken breast had no influence on appearance, flavor and fatness

Table 4. Effect of mixing ratio between pork loin and chicken breast on textural properties of emulsion sausages

Traits	Mixing ratio (pork loin / chicken breast)				
	100 / 0	70 / 30	50 / 50	30 / 70	0 / 100
Hardness	1.02±0.08[1)a]	0.98±0.03[a]	0.89±0.08[b]	0.81±0.07[c]	0.52±0.04[d]
Springiness	0.72±0.02[c]	0.73±0.02[c]	0.76±0.02[b]	0.76±0.03[b]	0.80±0.02[a]
Cohesiveness	0.49±0.05	0.49±0.04	0.47±0.06	0.46±0.03	0.46±0.07
Gumminess	0.50±0.06[a]	0.48±0.06[a]	0.42±0.06[b]	0.37±0.04[b]	0.24±0.03[c]
Chewiness	0.36±0.04[a]	0.35±0.05[a]	0.32±0.05[ab]	0.28±0.03[b]	0.19±0.02[c]

[1)]All values are mean±standard deviation of three replicates.
[a-d]Means within a row(among treatments) with different letters are significantly different ($p<0.05$).

Table 5. Effect of mixing ratio between pork loin and chicken breast on sensory properties of emulsion sausages

Traits[1)]	Mixing ratio (pork loin / chicken breast)				
	100 / 0	70 / 30	50 / 50	30 / 70	0 / 100
Appearance	8.50±0.67[2)]	8.42±0.79	8.17±0.39	8.33±0.65	8.33±0.65
Color	8.42±0.79[a]	8.25±0.75[ab]	7.95±0.75[b]	7.88±0.47[bc]	7.58±0.67[c]
Flavor	7.50±1.09	7.67±0.89	8.17±0.94	8.25±0.75	8.25±0.87
Juiciness	6.83±0.94[b]	7.17±0.94[ab]	7.58±1.00[ab]	7.92±0.79[a]	7.92±0.79[a]
Tenderness	6.83±0.94[b]	7.33±0.89[ab]	7.75±0.62[a]	7.67±0.65[a]	7.67±0.78[a]
Residual flavor	7.00±0.85[b]	7.17±0.58[ab]	7.67±0.89[ab]	7.67±0.65[ab]	7.83±0.83[a]
Fatness	7.75±1.14	7.67±1.07	7.58±1.08	7.50±1.17	7.42±1.44
Umami	6.75±1.29[b]	7.00±1.28[ab]	7.33±1.37[ab]	7.42±1.24[a]	7.67±1.30[a]
Overall acceptance	7.17±0.83[c]	7.50±0.80[bc]	8.25±0.87[a]	8.25±0.75[a]	8.08±0.67[ab]

[1)]Traits: appearance, color, flavor, tenderness, fatness, and overall acceptance (1=extremely undesirable, 9=extremely desirable), juiciness (1=extremely dry, 9=extremely juicy), residual flavor and umami (1=much too weak, 9=much to intense).
[2)]All values are mean±standard deviation of three replicates.
[a-c]Means within a row(among treatments) with different letters are significantly different ($p<0.05$).

(p>0.05). In color satisfaction, the increase in the added level of chicken breast in emulsion sausages resulted in a decline in color score. This result might be associated with the decreased redness following the addition of chicken breast, which was observed with an instrument color evaluation (Table 2). The emulsion sausages containing chicken breast above 70% showed significantly higher sensory scores for juiciness, tenderness and umami than those of emulsion sausage formulated with only pork loin (p<0.05). Also, the addition of chicken breast in emulsion sausage led to an increase in the score for residual flavor. As a related study, Whiting and Jenkins (1981) reported that frankfurters prepared with chicken showed the highest sensory satisfaction as compared to those made with rabbit or beef. In order to determine the main component for explaining the sensory properties of emulsion sausages, a principle component analysis (PCA) was performed (Fig. 3). As a result, the overall acceptance of emulsion sausages highly correlated with tenderness, umami taste and residual flavor (p<0.05). Recently, according to Maughan and Martini (2012), the sensory characteristics of chicken meat in meat homogenates containing beef and chicken were brothy, juicy, salt, sour, sweet and umami. In this study, an increase in the added amount of chicken breast contributed to a rich umami taste and deeper flavor in emulsion sausages, thereby resulting in a high overall acceptance score in the formulation of 0-30% pork loin and 70-100% chicken breast.

In conclusion, the addition of chicken breast in mixed meat homogenates with pork loin decreased the cooking loss resulting from an increased salt soluble protein solubility due to a high pH value of chicken breast. Moreover, the effect greatly depended on the added levels of chicken breast. For these reasons, emulsion sausages formulated with chicken breast above 50% could provide a more soft and flexible texture. The sensory characteristics of chicken breast in emulsion sausages might be associated with residual flavor, tenderness and umami taste. Considering the color aspect, the optimal mixing ratio between pork loin and chicken breast for enhancing the technological and sensory properties of meat product was 0-30% and 70-100%, respectively.

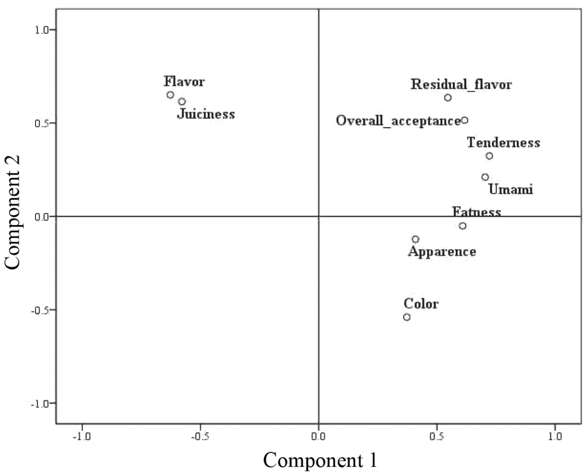

Fig. 3. Principle component analysis (PCA) for plot based on sensory properties of emulsion sausages formulated with pork loin and chicken breast.

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