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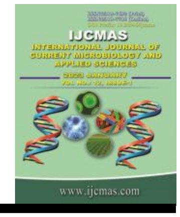

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The Effect of Protein Isolate Substitution in Winged Bean (*Psophocapus tetragonolobus* L.) Seed towards the Characteristics of Chicken Meat Balls

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A B S T R A C T

This study is aimed to analyze the effect of protein isolate concentration in winged bean seed on the application of chicken meatball products and to determine the correct and proper protein isolate concentration in winged bean seed to produce the best characteristics of chicken meat balls. This study applied experimental methodwith a completely randomized design (CRD). The treatment in this study was the substitution of chicken meat and winged bean seed isolates with a concentration of 100%:0%; 95%:5%; 90%:10%; 85%:15%; 80%:20 %; and 75%:25%. All treatments were repeated 3 times to obtain 18 experimental units. The data were analyzed by means of variance and if the treatment had a significant effect, the data were further analyzed with the Duncan Multiple Range Test. The result of thisstudyshows that substitution treatment of 95% chicken meat: 5% winged bean seed protein isolate produces the best characteristics of chicken meat balls with 62.66% water content, 1.12% ash content, 12.12% protein content, 0.63% cholesterol content, firmness level of 7.58 N, color (L value of 58.69; a value of -3.04; b value of 20.02), sensory evaluation consisting of a scoring test and hedonic test including preferred color, preferred aroma, preferred chewy texture, and preferred distinctive taste of chicken meat balls.

Keywords

Chicken Meat balls, Winged Bean Protein Isolate, Winged Bean Seeds

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Introduction

Meatball is a processed product composed of ground meat integrated with tapioca and other spices (Effendi, 2009). It is the food loved by Indonesian communities. Various kinds of ingredients and forms of meatballs are found on the market. The most common kind of meatball known by Indonesians is chicken meatball. The large number of people who consume chicken meatballs provides a great opportunity to develop the product. The continuous use of chicken meat can lead to an increase in the number of chicken meat needs. According to Anonymous (2021), in 2020 it is exhibited that the average per capita consumption of chicken meat has escalated compared to before. An increase in demand for chicken meat can cause the availability of chicken meat to decrease, thus the price of chicken meat is expected to increase as well. Excessive consumption of chicken meat can have a negative impact on the body due to the high fat content, which is 18.82% per 100 grams

(Anonymous, 2010). This can cause an increase of blood cholesterol. High cholesterol is a risk factor for degenerative diseases such as coronary heart disease. An effort that can be performed to reduce the risk of degenerative diseases is to consume vegetable protein. Vegetable protein can be obtained from winged bean seeds. Winged bean seed productivity is greater in figure than peanut or soybean plants (Rasmunandar, 1986). The protein content of old winged bean seeds is around 33.3 - 38.3% (Amoo *et al.,* 2006), whereas the protein content of soybean seeds is around 39.8 - 41.8% (Gross, 1983).

One method to utilize protein from winged bean seeds is by conducting isolation. Protein isolate is a product isolated from legume seed protein with absolute limitation of having minimum 90% protein. Winged bean seed protein isolate has the advantage of containing lower saturated fatty acids, longer shelf life, and more affordable price. The use of winged bean seed protein isolate can help increase consumption of vegetable protein and is beneficial for people with degenerative diseases.

Another advantage of protein isolate is that in the manufacture of meat products such as meatballs, it can act as a dough emulsion and increase water holding capacity (Aberle *et al.,* 2001). Protein isolate is made by using the functional properties of protein, namely its solubility. Broadly speaking, the manufacture of protein isolates begins with the extraction or dissolution of the protein. In the extraction process with water and also base, resulting filtrate is then utilized. The next process is precipitation using acid.

The use of winged bean seed isolate in the manufacture of chicken meatballs is expected to produce products that are good for health, able to reduce the need for chicken meat, able to make meatball products more economical, and able to increase the economic value of winged bean. Based on the foregoing, this study aims to determine the effect of the type of acid and pH value during the protein isolation process on the characteristics of winged bean seed protein isolate, and to determine the best characteristics of chicken meatballs with winged bean seed protein isolate substitution.

Materials and Methods

This research was conducted at the Food Processing Laboratory, Food Analysis Laboratory, and Sensory Laboratory of Faculty of Agricultural Technology, Udayana University. This research was completed in 3 months, from June to August 2022.

The material used in this study was winged bean seed protein isolate obtained from the Faculty of Agricultural Technology, Udayana University. The other ingredients were chicken breast, tapioca flour, eggs, shallots, garlic, salt, pepper and ice water which were obtained from the Badung market, Denpasar, Bali.

The chemicals employed in this study were distilled water (Rofa, Indonesia), NaOH (Merck, Germany), sulfuric acid (Merck, Germany), boric acid (Merck, Germany), benzene (Merck, Germany) (Merck, Germany), and hexane (Merck, Germany).

The equipment utilized in this study were: pan, baking sheet, aluminum foil (Klin Pak), oven (Blue M), centrifuge, centrifuge tube, filter cloth, test tube, cup, spatula, beaker glass, water bath, stirrer, stirrer rod, analytical balance, vortex (Maxi Mix II Type 367000), spectrophotometer (Genesys 10S UV-Vis), desiccator, measuring cup, soxhlet, fat flask, erlenmeyer, porcelain cup, cup, kjeldahl flask, food processor, refrigerator, spoon, Texture Analyzer (TA. XTplus, England), and color reader.

Completely Randomized Design (CRD) was applied in designing this study and was repeated 3 times. This research conducted 5 treatment levels of the winged bean seed protein isolate substitution on chicken meatballs as follows.

P0: 100% chicken meat: 0% winged bean seed protein isolate.

P1: 95% chicken meat: 5% winged bean seed protein isolate.

P2: 90% chicken meat: 10% winged bean seed protein isolate.

P3: 85% chicken meat: 15% winged bean seed protein isolate.

P4: 80% chicken meat: 20% winged bean seed protein isolate.

P5: 75% chicken meat: 25% winged bean seed protein isolate.

The making of chicken meatballs with winged bean seed protein isolate substitution started by washing the chicken breast and then cutting it into about 8 parts. Next step was mixing it with winged bean seed protein isolate according to the treatment, 2% salt, 1% white pepper, 4% garlic, 15% tapioca flour, 2% baking powder, 6% egg white and 20% ice cubes by weight of the chicken used using a food processor. The smooth dough mixture was subsequently formed into small balls. The small balls were soaked in warm water (40-45°C, for 20-30 minutes), then boiled at 85-100°C until the meatballs floated on the surface. Lastly, they were drained and chicken meatballs were obtained.

Variables observed in this study were cholesterol levels (Kleiner Dotti, 1962), texture analyzer (Lukman *et al.*, 2009), color test (Hutching, 1990), water content (Sudarmadji *et al.*, 1997), ash content (AOAC, 2005), protein content (Sudarmadji *et al.*, 1997), and sensory properties (hedonic test and scoring test) (Soekarto, 1985).

Results and Discussion

The average values of water content, ash content, protein content, cholesterol content, firmness level, color test, and sensory properties (hedonic test and scoring test) in chicken meatballs with winged bean seed protein isolate substitution that have the best characteristics can be seen in Table 1.

Water Content

The results of variance exhibited that the incorporation of winged bean seed protein isolate had a significant (P<0.05) effect on the water content of chicken meatballs. The average value of chicken meatball water content ranges from 60.32% - 66.88%. The lowest water content was obtained in P0 treatment which was 60.32%, not significantly different from treatment of P1. The highest water content was obtained in P5 treatment which was 66.88%, not significantly different from P2, P3 and P4. The average value of the water content can be seen in Table 2.

Table 2 provides information that the water content in chicken meatballs with substitution of winged bean seed protein isolate increased. This is in accordance with Miswadi's research (2011) that stated there was an increase in the water content of chicken meatballs as the soy protein isolate substitution increased due to the improve in protein content in chicken meatballs. Budijanto *et al.*, (2011) stated that the winged bean seed protein isolate is dominated by globular protein. Globular proteins are proteins that are spherical in shape and are generally water soluble (Rauf, 2015). In addition, Haryasyah (2009) stated that the amino acid constituents in winged bean seed protein isolate are dominated by ionic amino acids that have good water absorption, such as glutamic acid, aspartic acid and lysine. Glutamic acid and aspartic acid have aliphatic chain functional groups that bind to carboxyl acids which provide hydrophilic properties; thus, they easily absorb water (Rauf, 2015). The results showed that the average value of water content in all treatments met the quality requirements for SNI 3818: 2014 meatballs, which is a maximum of 70%.

Ash Content

The results of variance denoted that the incorporation of winged bean seed protein isolate had a significant (P<0.05) effect on the ash content of chicken meatballs. The average value of chicken meatball ash content ranges from 0.89% - 1.88%. The lowest ash content was obtained in P0 treatment which was 0.89%, not significantly different from treatment of P1. The highest ash content was found in the P5 treatment, which was 1.88 %, not significantly different from the P3 and P4 treatments. The average value of ash content can be seen in Table 3.

Table 3 shows that the ash content of chicken meatballs with substitution of winged bean seed protein isolate increased. This was influenced by the ash content in winged bean seed protein isolate. In the first phase of the study, the ash content of winged bean seed protein isolate was 3.60%. Adegbeyoga *et al.,* (2019) suggested that the ash content indicates the mineral content of a food ingredient. Furthermore, Lepcha *et al.*, (2017) stated that the minerals contained in winged bean seeds are potassium, phosphorus, sulfur, calcium,, sodium, iron, magnesium, manganese, zinc, boron, barium, strontium, chromium, and copper. The results showed that the average value of ash content in all treatments met the quality requirements of SNI 3818: 2014 meatballs, which is a maximum of 3%.

Protein Content

The results of variance showed that the incorporation of winged bean seed protein isolate had a significant (P<0.05) effect on the protein content of chicken meatballs. The average value of chicken meatball protein content ranges from 10.67% - 31.25%. The lowest protein content was obtained in P0 treatment which was 10.67%, not significantly different from P1 treatment. The highest protein content was obtained in P5 treatment which was 31.25%. The average value of protein content in chicken meatballs can be seen in Table 4.

The protein content in chicken meatballs increased as substitution of winged bean seed protein isolate for chicken meat increased as well. This is in accordance with Miswadi's research (2011) which stated that there was an increase in the protein content of analogue meatballs as the substitution of winged bean seed isolate towards soy protein isolate increased. This is because winged bean seed protein isolate has a high protein content. In the first phase of the study, the protein content of winged bean seed protein isolate was 90.04%.

The protein content in chicken meatballs acts as a texture improver. This is because proteins can interact with other proteins because of hydrogen bonds and changes in sulfhydryl and disulfide groups. These molecular interactions will form a three-dimensional network which results in a compact protein texture. With this three-dimensional texture, the protein can trap a large amount of water (Dana, 2012). This is also supported by the statement of Lucia *et al.,* (2021) which stated that the increase of protein levels had an effect on higher water absorption. The ability of proteins to bind water is caused by the presence of hydrophilic carboxyl and amino groups. Falahudin (2013) stated that protein content plays a role in the gelatinization process through increasing water holding capacity which influences the texture of the meatballs. The results showed that the average value of protein content in P1, P2, P3, P4, and P5 treatments met the SNI 3818: 2014 meatball quality requirements, which is at least 11%.

Cholesterol Content (*In Vitro*)

The results of variance denoted that the incorporation of winged bean seed protein isolate had a significant (P<0.05) effect on cholesterol level of chicken meatballs. The average value of the cholesterol levels ranges from 0.39% - 0.66%. The lowest cholesterol level was obtained in the P5 treatment, which was 0.39%, not significantly different from the P4 treatment. The highest cholesterol level was obtained in P0 treatment which was 0.66%, not significantly different from P1, P2 and P3. The average value of the cholesterol levels can be seen in Table 5.

Table 5 shows that cholesterol levels in chicken meatballs with winged bean seed protein isolate substitute decreased due to the incorporation of winged bean seed isolate in chicken meatballs. Winged bean seed protein isolate contains isoflavone compounds that can lower cholesterol levels. According to Goldberg (1996) in Miswadi (2011), isoflavone is one of the flavonoid compounds that is abundant in winged bean seeds. Isoflavones can increase HDL (High Density Lipoprotein), lower LDL (Low Density Lipoprotein), and triglycerides in the blood (Gruber, 2002). The incorporation of winged bean seed protein isolate to chicken meatballs will increase isoflavone compounds; thus, the cholesterol level can decrease as there is an increase in the percentage of winged bean seed protein isolate. The potential of winged bean seed protein isolate as an anti-cholesterol agent is also supported by the research of Slamet and Kanetro (2017) who claimed that yogurt made of winged bean seed protein isolate can reduce cholesterol. Furthermore, Harwadi's research (2019) stated that winged bean seeds have a role in reducing LDL cholesterol and increasing HDL cholesterol. Mackey's research (2002) stated that the isoflavones consumption in the form of protein isolates resulted in significant improvements in the sums of cholesterol levels in postmenopausal, normoklesterolemia, and moderate hypercholesterolemia women.

Firmness Level

The results of variance showed that the incorporation of winged bean seed protein isolate had a significant ($P<0.05$) effect on the firmness of chicken meatballs. The average value of the firmness level ranges from 7.05 N - 11.38 N. The lowest firmness level was obtained in P0 treatment, which was 7.05 N and the highest level was obtained in P5 treatment, which was 11.38 N. The average firmness level of chicken meatballs can be seen in Table 6.

The firmness level of chicken meatballs increased following the increase of winged bean seed protein isolate substitution for chicken meat (Table 6). This could be caused by the incorporation of winged bean seed protein isolate which resulted in the dough absorbing more water. The results of this study are in correspondence with the one conducted by Astuti *et al.*, (2014) claiming the more soy protein isolate added, the higher the firmness level of *swangi* fish meatballs was. Protein isolate has an important role in forming the meatball texture as it has the ability to absorb and hold water. Excess water in the meatball mixture can cause the gelatinization process to be imperfect, resulted in the increase of firmness level of chicken meatballs. This is conforming to the statement of Hattunisa (2011) claiming that the presence of high water can increase the cohesiveness value of the product; thus, it can withstand stronger pressure.

Color Testing

The results of the analysis of variance provided an information that the incorporation of winged bean seed protein isolate had a significant ($P<0.05$) effect on the L and a value. However, it had no significant effect on the b value in chicken meatballs. The L value has an average range of 45.73 - 31.25.The a value has an average range of (-3.43) - 2.56.The b value has an average range of 17.19 - 23, 30. The average value of the chicken meatball color test can be seen in Table 7.

The results of Duncan's advanced test at a significance level of 95% showed that the L value of chicken meatballs increased following the increase of winged bean seed protein isolate substitution for chicken meat (Table 7). The L value shows brightness level, therefore, the higher L value indicates higher brightness in the chicken meatballs. Chicken meatballs with control treatment or without the incorporation of winged bean seed protein isolate had the highest L value due to the absence of the incorporation of winged bean seed protein isolate which can cause the color of the chicken meatballs to become drabber or darker. Winged bean protein isolate has a brownish white color, which can reduce the brightness of the chicken meatballs. This was also conveyed by Haryasyah (2009) that winged bean seed pigment has the potential to produce a brown color in the concentrate. According to Astuti *et al.,* (2014) the incorporation of soy protein isolate to *swangi* fish meatballs in large quantities can change the color of the product becoming brown.

Based on Table 7, the value of a has increased along with the increasing substitution of winged bean seed protein isolate for chicken meat in the meatballs. The value of a is the tendency of reddish (+) and greenish (-) values. The incorporation of winged bean seed protein isolate tends to give the chicken meatballs a reddish color. This shows that there is a change in color after adding winged bean seed protein isolate. The b value indicates a color with a tendency to be bluish (-) and yellowish (+). The b value with the highest value is in the P5 treatment, which indicates that the meatballs tend to be yellowish in color. This is happened because of the protein isolate of winged bean seeds which plays a role in giving the chicken meatballs a yellowish color.

Sensory Evaluation

Sensory evaluation of chicken meatballs with winged bean seed protein isolate substitution in this study included a scoring test and a hedonic test. The scoring test was performed towards texture and taste, whereas the hedonic test was performed on aroma, color, taste and overall acceptance. The average value of the scoring test is provided in Table 8 and the average value of the hedonic test is provided in Table 9.

Color

The results of variance showed that substitution of winged bean seed protein isolate had a significant ($P<0.05$) effect on the hedonic test of chicken meatball color. The average value of the hedonic test for the color ranges from 3.55 to 6.25. The lowest hedonic test was obtained in P5 treatment, which was 2.80, whereas the highest was in P1 and P0, which was 6.40, not significantly different from P0, P2, and P3. The average value of the chicken meatball color hedonic test can be seen in Table 9. Based on Table 9, it shows that the hedonic value of color decreases as the protein isolate substitution increases. This is caused by the original color of winged bean seed protein isolate which is brownish white. The basic color of winged bean seed protein isolate makes the color of the chicken meatballs drabber. This is also in accordance with research conducted by Utama (2016) that stated the higher the level of soy protein isolate substitution, the darker the red bean analog meat color produced.

Aroma

The results of the analysis of variance showed that the substitution of winged bean seed protein isolate had a significant ($P<0.05$) effect on the chicken meatball hedonic aroma test. The average value of the chicken meatball aroma hedonic test ranges from 2.40 to 3.55. The lowest hedonic test was obtained in P5 treatment, which was 2.40, whereas the highest was in P1 treatment, which was 6.40, not significantly different from P0 and P2. The average value of the chicken meatball hedonic aroma test is displayed in Table 9.

The results of the hedonic aroma test show a decrease in hedonic value in the 15% substitution treatment of winged bean seed protein isolate. It is resulted due to the higher amount concentration of winged bean seed protein isolate can cover the aroma of the spices and the distinctive smell of the meat contained in the chicken meatballs. According to Lewis (1984), the aroma smelled from the product can be caused by spices such as garlic and shallots which provide a strong aroma that comes from volatile components. According to SNI 01-3818-1995 for test criteria, the normal aroma on meatballs is typical aroma for meat. As there were fillers in this study, namely winged bean seed protein isolates with different concentrations between treatments, therefore, the hedonic value of the aroma of chicken meatballs can be affected.

Table.1 Average values of water content, ash content, protein content, cholesterol content, firmness level, color test, and sensory properties (hedonic test and scoring test) in chicken meat balls substituted with winged bean seed protein isolate.

Component	Result
Water Content (%)	62,66
Ash Content (%)	1,12
Protein Content (%)	12,22
Cholesterol Content (%)	0,63
Firmness Level(N)	7,58
Color Test • L Value • a Value • b Value	 58,69 -3,04 20,02
Sensory Properties(Hedonic Test) • Aroma • Color • Texture • Taste • Overall Acceptability	 Preferred Preferred Preferred Preferred Preferred
Sensory Properties (Scoring Test) • Texture • Taste	 Chewy Texture Distinctive taste of chicken meatballs

Table.2 The average value of water content in chicken meat balls

Perlakuan (DA : IPBK) (%)	Kadar Air (%)
P0 (100 : 0)	$60,32 \pm 1,60^{c}$
P1 (95 : 5)	$62,66 \pm 1,90^{bc}$
P2 (90 : 10)	$64,07 \pm 1,40^{ab}$
P3 (85 : 15)	$65,26 \pm 2,10^{ab}$
P4 (80 : 20)	$66,04 \pm 1,50^{a}$
P5 (75 : 25)	$66,88 \pm 0,70^{a}$

Note: The average value accompanied by the same letter in the same column denotes no significant effect (P>0.05).
DA: Chicken meat
IPBK: Winged bean seed protein isolate

Table.3 The average value of ash content in chicken meat balls

Perlakuan (DA : IPBK) (%)	Kadar Abu (%)
P0 (100 : 0)	0,89 ± 2,23[d]
P1 (95 : 5)	1,12 ± 0,16[cd]
P2 (90 : 10)	1,32 ± 0,25[bc]
P3 (85 : 15)	1,50 ± 0,38[abc]
P4 (80 : 20)	1,72 ± 0,11[ab]
P5 (75 : 25)	1,88 ± 0,09[a]

Note: The average value accompanied by the same letter in the same column denotes no significant effect (P>0.05).
DA: Chicken meat; IPBK: Winged bean seed protein isolate

Table.4 The average value of protein content in chicken meat balls

Perlakuan (DA : IPBK) (%)	Kadar Protein (%)
P0 (100 : 0)	10,67 ± 1,63[e]
P1 (95 : 5)	12,12 ± 0,65[e]
P2 (90 : 10)	17,86 ± 1,29[d]
P3 (85 : 15)	24,11 ± 1,58[c]
P4 (80 : 20)	27,07 ± 0,39[b]
P5 (75 : 25)	31,25 ± 0,45[a]

Note: The average value accompanied by the same letter in the same column denotes no significant effect (P>0.05).
DA: Chicken meat; IPBK: Winged bean seed protein isolate

Table.5 The average value of Cholesterol content in chicken meat balls

Perlakuan (DA : IPBK) (%)	Kadar Kolesterol (%)
P0 (100 : 0)	0,66 ± 0,08[a]
P1 (95 : 5)	0,63 ± 0,07[a]
P2 (90 : 10)	0,60 ± 0,06[a]
P3 (85 : 15)	0,56 ± 0,05[ab]
P4 (80 : 20)	0,47 ± 0,08[bc]
P5 (75 : 25)	0,39 ± 0,06[c]

Note: The average value accompanied by the same letter in the same column denotes no significant effect (P>0.05).
DA: Chicken meat; IPBK: Winged bean seed protein isolate

Table.6 The average value of firmness level in chicken meat balls

Perlakuan (DA : IPBK) (%)	Tingkat Kekerasan (N)
P0 (100 : 0)	7,05 ± 0,55[d]
P1 (95 : 5)	7,58 ± 1,39[cd]
P2 (90 : 10)	9,53 ± 0,23[b]
P3 (85 : 15)	9,15 ± 0,78[bc]
P4 (80 : 20)	9,97 ± 0,72[ab]
P5 (75 : 25)	11,38 ± 1,38[a]

Note: The average value accompanied by the same letter in the same column denotes no significant effect (P>0.05).
DA: Chicken meat; IPBK: Winged bean seed protein isolate

Table.7 The average value of color test in chicken meat balls

Perlakuan (DA : IPBK) (%)	Uji Warna		
	Nilai L	Nilai a	Nilai b
P0 (100 : 0)	78,11± 3,16[a]	-3,43± 0,35[c]	17,19± 2,19[b]
P1 (95 : 5)	58,69± 7,58[b]	-3,04± 0,61[c]	20,02± 2,76[ab]
P2 (90 : 10)	57,38± 1,89[b]	-0,87± 0,56[bc]	20,35± 3,57[ab]
P3 (85 : 15)	51,77± 1,88[bc]	0,48± 0,50[b]	20,46± 0,16[ab]
P4 (80 : 20)	48,31± 1,15[c]	1,32± 0,65[ab]	22,34± 2,29[a]
P5 (75 : 25)	45,73± 3,08[c]	2,56± 1,18[a]	23,30± 1,95[a]

Note: The average value accompanied by the same letter in the same column denotes no significant effect (P>0.05).
DA: Chicken meat; IPBK: Winged bean seed protein isolate

Table.8 The average value of scoring test in chicken meat balls

Perlakuan (DA : IPBK) (%)	Uji Skoring	
	Tekstur	Rasa
P0 (100 : 0)	3,65 ± 0,88[ab]	4,70 ± 0,47[a]
P1 (95 : 5)	3,75 ± 0,85[a]	4,20 ± 0,41[b]
P2 (90 : 10)	4,15 ± 1,18[a]	3,75 ± 0,55[c]
P3 (85 : 15)	3,95 ± 1,39[a]	3,10 ± 0,55[d]
P4 (80 : 20)	3,05 ± 1,23[b]	2,50 ± 0,69[e]
P5 (75 : 25)	2,40 ± 0,60[c]	2,25 ± 0,44[e]

Note: The average value accompanied by the same letter in the same column denotes no significant effect (P>0.05).
DA: Chicken meat; IPBK: Winged bean seed protein isolate

Table.9 The average value of hedonic test in chicken meat balls

Perlakuan (DA : IPBK) (%)	Uji Hedonik				
	Aroma	Warna	Tekstur	Rasa	Penerimaan Keseluruhan
P0 (100 : 0)	6,25 ± 0,55[a]	6,15 ± 0,67[a]	6,00 ± 0,65[a]	6,10 ± 0,64[a]	6,20 ± 0,62
P1 (95 : 5)	6,40 ± 0,75[a]	6,25 ± 0,79[a]	6,10 ± 0,91[a]	6,40 ± 0,68[a]	6,35 ± 0,67
P2 (90 : 10)	5,85 ± 0,75[a]	6,20 ± 0,95[a]	6,25 ± 0,79[a]	5,60 ± 0,68[b]	5,80 ± 0,83
P3 (85 : 15)	5,15 ± 1,04[b]	5,80 ± 1,15[a]	5,65 ± 1,27[a]	4,40 ± 1,23[c]	4,10 ± 1,45
P4 (80 : 20)	4,30 ± 1,26[c]	4,45 ± 1,39[b]	3,35 ± 1,04[b]	3,85 ± 1,09[d]	2,85 ± 0,88
P5 (75 : 25)	3,65 ± 1,04[d]	3,55 ± 1,28[c]	2,60 ± 0,94[c]	3,30 ± 1,08[e]	2,45 ± 0,76

Note: The average value accompanied by the same letter in the same column denotes no significant effect (P>0.05).
DA: Chicken meat; IPBK: Winged bean seed protein isolate

Texture

The results of variance denoted that the substitution of winged bean seed protein isolate had a significant effect (P<0.05) on the texture score of chicken meatballs. The average value of the texture scores ranges from 4.15 – 2.40. The lowest score was obtained in the P5 treatment, which was 2.40, whereas the highest in the P2 treatment, which was 4.15. The average texture value (scoring test) of chicken meatballs is shown in Table 8.

The results of the texture scoring test show that the higher the substitution of winged bean seed protein isolate for chicken meat in the making of chicken meatballs, the higher the score is, however, the score decreases in the P4 and P5 treatments. This can be caused by the water content contained in the chicken meatballs. Winged bean protein isolate is able to bind water in the chicken meatball mixture, therefore it can make the texture chewier.

According to Soeparno (2005), water holding capacity can affect the elasticity, juiciness and tenderness of a product. Too many substitutions of winged bean seed protein isolate also causes a decrease in the texture value of chicken meatballs. This is because too much water is absorbed, resulting in disruption of the function of protein in binding fat or oil in chicken meatballs, thus the elasticity of the meatballs is reduced.

The results of variance showed that the substitution of winged bean seed protein isolate had a significant ($P<0.05$) effect on the hedonic test of chicken meatball texture. The average value of the texture hedonic test ranges from 2.60 to 6.25. The lowest hedonic result was obtained in the P5 treatment which was 2.60, whereas the highest in the P2 treatment which was 6.25. The average value of the hedonic texture test can be seen in Table 9.

The results of the hedonic texture test show that the higher the substitution of winged bean seed protein isolate for chicken meat, the more favorable the hedonic value is, however the value decreases in treatments P3 to P5. This is because the texture of chicken meatballs with winged bean seed protein isolate substitution has a chewier texture compared to chicken meatballs without winged seed protein isolate substitution. Excessive winged seed protein isolate substitutions make the texture of the chicken meatballs tends to be too firm. This makes the hedonic value in the P3, P4, and P5 treatments decrease.

Taste

The results of the analysis of variance showed that the substitution of winged bean seed protein isolate had a significant effect ($P<0.05$) on the chicken meatball taste score. The average value of the chicken meatball taste score ranges from 2.25 to 4.70. The lowest score was obtained in the P5 treatment which was 2.25. The highest was in the P0 treatment with 4.75. The average taste value (scoring test) of chicken meatballs can be seen in Table 8.

Based on Table 8, it shows that the higher the substitution of winged bean seed protein isolate in chicken meatballs, the taste score decreases. This shows that the high substitution of winged bean seed isolates can cause a reduction in the distinctive taste of chicken meatballs. According to Andayani (1999), there are 3 kinds of meatball flavors that greatly determine consumer acceptance, namely savory, salty, and meaty taste. Excessive use of winged bean seed protein isolate can reduce the distinctive taste of chicken meat balls; therefore, the taste scoring value is decreased.

The results of variance showed that the substitution of winged bean seed protein isolate had a significant ($P<0.05$) effect on the hedonic test of chicken meatball taste. The average value of the hedonic flavor test ranges from 3.30 to 6.40. The lowest preference value for taste was obtained in the P5 treatment, which was 3.30, whereas the highest was in the P1 treatment, which was 6.40 and not significantly different from the P0 treatment, which was 6.10. The average value of the chicken meatball hedonic texture test can be seen in Table 9.

Based on Table 9, it shows that the higher the substitution of winged bean seed protein isolate in the making of chicken meatballs, the hedonic value of taste decreases. This is due to the increasing number of winged seed protein isolate substitutions that can eliminate the distinctive taste of meat in the meatballs, thus, the panelists dislike it. According to Winarno (1992), taste is influenced by chemical compounds that composes the food, such as protein, fat, vitamins, and other components.

Overall Acceptability

Overall acceptability is a test that includes panelists' preferences for color, aroma, texture, and taste of chicken meatball products with winged bean seed protein isolate substitution. The results of variance showed that the substitution of winged bean seed protein isolate had a significant (P<0.05) effect on the overall acceptance of chicken meatballs tested hedonically. Based on Table 9 the median value of the hedonic test for the overall acceptance of chicken meatballs ranges from 2.45 to 6.35.

Based on the foregoing discussion, it can be concluded that the substitution of winged bean seed protein isolate in its application to chicken meat balls has a significant effect on water content, ash content, protein content, cholesterol content, firmness level, colortest, color (hedonic test), aroma (hedonic test), texture (scoring test and hedonic test), taste (scoring test and hedonic test), and overall acceptability (hedonic test). Treatment of 95 % chicken meat: 5% protein isolate winged bean seed produced the best characteristics chicken meat balls with the criteria of 62.66 % water content, 1.12 % ash content, 12.12 % protein content, 0.63 % cholesterol content, 7.58 N firmness level, colortest (L value 58.69; a value -3.04; b value 20.02), with sensory values for preferred aroma, preferred color, preferred chewy texture, preferred distinctive taste of chicken meat balls, and preferred overall acceptance.

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