Effect of mega floral booster addition on carcass characteristics of quail meat

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Abstract. This study evaluated the effect of Mega Floral Booster (MFB) as probiotic supplement on the carcass yield and physicochemical properties of quail meat. The treatment is divided to four treatments based on percentage of MFB include MFB-0.00 (control), MFB-0.05 (0.05% of MFB), MFB-0.20 (0.20% of MFB) and MFB-0.35 (0.35% of MFB). The 18 of quail species ***Cortunix japonica*** (Japanese quail) used as the main material in the study for each treatments. For the first until fourteen days, the quails are supplied with commercial feed only. After fifteen days, the quails begin provided with the MFB-0.00, MFB-0.05, MFB-0.20 and MFB-0.35 mixed with commercial feed. The quails for 42nd days slaughtered and deboned of breast and whole leg separated from the bone for analysis. Probiotic supplement (Mega Floral Booster) had no influence on body weight, and carcass characteristics (breast, whole leg muscle and carcass yield) (p>0.05). MFB-0.20 had influence on color parameter (L\(^*\), a\(^*\) and b\(^*\)), pH and WHC of quail meats compared to MFB-0.00 (p<0.05). MFB show cooking loss, juiciness and Warner-Bratzler shear force not affected by treatment. Thus, Mega Floral Booster is not affecting the quality of quail meats.

Keywords – mega floral, carcass, quail meat.

1. Introduction

The quail is not an established branch, but occupies a relevant place in poultry breeding and contributes to the variety in poultry meat production according to [1]. Along the increase of the chicken meat production, there is also increase of the production meat from quails and other non-commercial bird species, reared under industrial conditions. The highest consumption of quail meats tends to encourage the quail farming thus increase of the feed additive or supplement usage.

Dietary supplementations of probiotic have been proposed to antibiotics in the poultry industry that can improve animal production performance, regulate intestinal micro-flora imbalance, and enhance immune function that stated by [2]. In a limited study, the meat quality attributes of probiotic-fed have been evaluated to ensure natural and wholesome characteristics. Some of studies reported that probiotic supplements to poultry able to improve meat quality attributes such as water holding capacity (WHC), tenderness, lipid oxidation stability, sensory properties, and microbial safety [3, 4, 5]. On the other studies were stated that no synergistic effect of probiotics on meat quality [2, 6]. Postmortem aging leads to considerable biochemical and physical changes in skeletal muscles through endogenous proteolytic system, results in an improvement in meat quality attributes such as tenderness, WHC, juiciness and flavor [2].
The objectives of this study was to determine the carcass yield of quail, evaluate physicochemical properties include color, pH, water holding capacity, cooking loss, juiciness, texture profile analysis and Warner-Bratzler shear force between four treatments with different concentration of Mega flora booster in feed intake.

2. Materials and methods

The Coturnix japonica quails (1st day) were obtained from commercial hatchery in Terengganu, Malaysia (Surada Jaya Kemaman). For quail growth process compose to two phase, brooding process (1st until 14th days) and growing process (15th until 42nd days). During brooding process, the quails were weighed and divided for four group, and supplied with commercial feed (Permula Ayam Daging 201C by Gold Coin Feedmills (M) Sdn Bhd) in brooding room. At growing process, pens were randomly assigned to four treatment of Mega Floral Booster (MFB) with different percentage 0.0% (MFB-0.00), 0.05% (MFB-0.05), 0.20% (MFB-0.20) and 0.35% (MFB-0.35) mixed with 100%, 99.95%, 99.98% and 99.65% of commercial feed. MFB was the commercial advanced probiotic formula, fortified with multi strain of microbes (Bacillus natto, Lactobacillus and yeast) and methionine, organic acid, enzyme protease and amylase manufacture by CPEX (Japan) Group. The proper design of building area required to avoid any infection that may occur along the experiment. The quails (in large amounts) was separate to three different part (in small amount) for each treatment; part A, part B and part C with twelve of quails for each part to minimize the rate of mortality. The 20g of feed was given two times morning and evening.

At the end of the feeding (42nd days), the six of quails per pen were randomly taken for each treatments (totally 18 for each treatments). The quails were slaughtered, scalded (60-65 °C for 15 seconds), de-feathered, eviscerated and packed in blast freezer (overnight) according [1]. Then, the quails were deboned for breast and whole leg for carried out yield analysis, physicochemical properties analysis include pH, color, juiciness water holding capacity, texture profile analysis and shear force and the nutritional composition includes chemical composition, and amino acid composition.

The colour of raw meat was measured by the Konica Minolta CR-400 Chroma meter to determine the colorimetric index of chromaticity. The color assessed by L* (lightness), a*(redness) and b*(yellowness) system. According to [1] show L*, a* and b* colorimetric coordinates as followed: L* - a value 100 corresponded to absolute white; a*, a+ corresponded to red spectrum; a- corresponded to green spectrum and b*, b+ corresponded to yellow spectrum; b- corresponded to blue spectrum.

The value of pH was examined by using electrode pH meter. The pH meter calibrated as follow the instruction in the manufacturer manual before used with 6.88 or 4.00 buffers every 2 or 3 hours. A sample (5 g) was homogenized with distilled water (50ml), transferred into beaker and along electrode with temperature electrode. The constant value appeared on screen of pH meter base and recorded of different samples refers to [7] with modifications. After each of the measurement, the electrode was rinsed with distilled water.

Water holding capacity was determined as follow the methods interpreted by [8] with modifications. 20 g sample was homogenized with 40 ml of distilled water in a waring blender at low speed setting for 30 s. 20 g of aliquot of the homogenate was weighed into 50ml centrifuge tube and centrifuged by setting at 5°C, 1000xg for 15min (low speed) of Sigma 3-16K - Mid bench centrifuges. Water holding capacity was calculated by using the following equation:

$$WHC(\%) = \frac{\text{before centrifuged} - \text{after centrifuged}}{\text{before centrifuged}} \times 100$$

Cooked quail meat was conducted according to [9] Method to prepare cooked quail meat was a piece breast muscles then placed on the beaker and cooked in an 80°C water bath until achieve the core temperature 72°C. The cooked samples were cooled to room temperature for 3 hours, before undergo analysis.
Method of quail meat sausage preparation with modification on ingredient as follows [10]. Quail meat sausage was prepared by mixing 6.5% cold water, 6.5% ice, 3% salt and 84% quail meat for 2 min by using wiring blender to homogenize sample. The samples were stuffed into 2.5 cm diameter sausage casings. The stuffed samples were cooked at 36°C for 30 min, followed by heating at 90°C for 10 min in a Memmert water bath. Quail meat gel were cooled in ice water for 30 min and stored in a chiller overnight prior analysis.

Cooking loss was determined by taken a piece of meat from the breast muscle, weighed, placed in beaker and cooked in 80°C of water bath for one hour until core temperature achieve above 72°C. The cooked samples were cooled to room temperature for 3 hours and re-weighed. Percentage of cooking loss was calculated according to [2] with modifications as follow:

\[
\text{Cooking loss (\%)} = \frac{\text{weight after cook} - \text{weight before cook}}{\text{weight before cook}} \times 100
\]

Juiciness measurement was conducted according to [11] with modifications. The sample was cut into 3 mm pieces with a knife. The sample was placed between a pair of pre-weighed Whatman No. 40 filter paper covered with aluminum foil and press for 2 minute by 5 kg force. The residue was weighed and recorded. Percentage of juiciness was determined as follows:

\[
\text{Juiciness (\%)} = \frac{\text{weight of filter after pressing-weight of filter paper}}{\text{weight of sample before processing}} \times 100
\]

The folding test was conducted to analyze the gel strength of the cooked fish sausages and was determined according to [12] with modifications. Cooked samples were cut into three-millimeter thick portions. The slices were held between the thumb and the forefinger and folded to observe the way that they broke. The scale used was as follows: 1 = breaks by finger pressure, 2 = cracks immediately when folded in half, 3 = cracks gradually when folded in half, 4 = no cracks showing after folding in half and 5 = no cracks showing after folding.

Shear force of cooked meat and quail meat sausage were examined according to [2] with slightly modifications by using Warner-Bratzler (WB) shear attachment on texture analyzer (Double Arm TA.XT Plus Texture Analyser, Stable Micro System Ltd., Survey, UK) with the blade set (HDP/BS*) comprises a Warner Bratzler blade with blade holder by attach with 30 kg load cell. According to [13], Warner-Bratzler method was better when samples are made on cooked meat, although it is not very accurate for the prediction of meat texture. The sample was cut to 1 cm×1 cm× 2.5 cm-strips. The test cell consist of 3 mm thick steel blade which fit through a 4 mm wide slit in a small table, the blade move down with a constant speed-pre-test speed 3.0 mm s⁻¹, test speed 1.0 mm s⁻¹, post-speed 3.0 mm s⁻¹ and down stroke distance 30.0 mm. For every 0.01 second, the resistance of the meat sample to shearing was recorded and plotted by a computer in a force-deformation plot.

Texture profile analysis (TPA) of quail meat sausage was test for hardness (tenderness), cohesiveness, springiness and chewiness by using Double Arm TA.XT Plus Texture Analyser, Stable Micro System Ltd., Survey, UK with 30 kg load cell. TPA was measure the compression force (Newton) when compressing a piece of meat by texturometer. The cooked sample of meat sliced for 1 cm x 1 cm x 1 cm strips was placed under the cylindrical probe that move downwards at a constant speed of pre-test 3.0 mm s⁻¹, test 1.0 mm s⁻¹ and post-test 3.0 mm s⁻¹. According to [13] when the probe first came in contact with the sample, the thickness of the sample was automatically recorded by the software. The probe was continued downwards a pre-fixed percentage of the sample thickness (75%), return to the initial point of contact with the sample and stop for a set period of time (2 second), before the second compression cycle is start. The resistance of the sample was recorded every 0.01 second and plot in a force-time (grams-seconds).

The statistical analysis from this experiment was conducted by using SPSS statistic 17.0 software. Data was analyzed by using analysis of variance (ANOVA). The software was used to calculate the
overall mean and standard deviation of the data and to determine the significant different of the carcass yield and physicochemical analysis. Besides that, SPSS is use to form the graph and find the liner equation for certain graph. Turkey test was used to determine significance of difference (p<0.05) of four samples.

3. Results and discussions

Table 1 shows the slaughter characteristics of 42-day old of Japanese quails on different treatments. No significant differences (p>0.05) were observed for the treatments of Mega Floral Booster (MFB) with body weight, carcass yield, breast with bone, breast meat, whole leg with bone and whole leg meat the treatments.

| Indications               | Treatments      |
|--------------------------|-----------------|
|                          | MFB-0.00 | MFB-0.05 | MFB-0.20 | MFB-0.35 |
| Live weight (g)          | M        | F        | M        | F        |
|                          | 254.17±19.85 | 254.00±19.24 | 258.33±9.31 | 256.67±22.29 |
| Carcass yield (%)        | M        | F        | M        | F        |
|                          | 64.93±1.62 | 64.85±0.90 | 65.48±1.60 | 64.94±2.97 |
| Breast with bone (%)     | M        | F        | M        | F        |
|                          | 27.61±0.67 | 27.55±0.76 | 28.30±0.62 | 27.65±0.34 |
| Breast meat (%)          | M        | F        | M        | F        |
|                          | 23.92±0.70 | 23.64±0.56 | 24.04±0.66 | 23.93±0.48 |
| Whole leg with bone (%)  | M        | F        | M        | F        |
|                          | 16.11±0.21 | 15.92±0.51 | 16.13±0.50 | 15.87±0.68 |
| Whole leg meat (%)       | M        | F        | M        | F        |
|                          | 14.24±0.27 | 14.63±1.71 | 14.74±1.02 | 13.29±0.77 |

Each value is expressed as mean ± SD.
*Means with same small letters within same row are significantly different (p<0.05).

Carcass characteristics and body weights are major determinants of profitability and sustainability of any animal enterprise [1]. Although the treatments were not shown the significance difference but on the treatment MFB-0.20 (Mega floral booster 0.20 %) shown the body weight, carcass yield, breast, breast meat, whole leg and whole leg meat were the highest value than others treatment (MFB-0.00, MFB-0.05 and MFB-0.35). Slaughter characteristics of treatment 0.20% were highest of both male and female 258.33 g and 260.00 g of body weight and 65.48 % and 67.83 % of carcass yield.

After six weeks, weight of female bird had a higher mean than male had been interpreted [14] [15]. Female quail birds had a higher mean value than the male counterpart (163.0 g and 148.0 g) was stated by [15]. The growth pattern and carcass weight in male and female quails could be due to feed metabolism or onset of fattening and differences in hormonal profile, aggressiveness and dominance especially when both sexes are reared together respectively [16]. Carcass yield of quails in range 64-71% after six weeks old and Genhev et al. (2008) reported carcass yield without skin of Japanese quails of 35-day for male was 60.13% and female 58.97% [17].

The breast, which was economically important and valuable part of the carcass, was determined by [18] to be 27.45 % of the body weight. It was reported breast with bones had 25.35-25.42 %, breast meat in range 20.3-20.80 %, thigh with bones were 15.97-16.63 % and leg meat 12.06-12.62 % [1]. Breast with bone yield and breast meat were higher on the treatment MFB-0.20 for male and female (28.30 %, 29.04 %, 24.04 % and 24.94 %) than MFB-0.35 (27.65 %, 28.90 %, 23.93 % and 24.70 %), MFB-0.00 (27.61 %, 28.75 %, 23.92 % and 24.74 %) and MFB-0.05 (27.55 %, 28.6 %, 23.64 % and 24.68 %).

On the treatment of probiotic tend to improve the health of broiler chickens referred to [19] and [20]. Probiotic like Bacillus natto, Lactobacillus and Bacillus subtilis, spore forming probiotic, were
metabolically dormant to face extreme environments, such as lowering pH through acid fermentation, extreme high and temperatures in intestine tend to improve intestinal health and body health. Reference [5] illustrated that probiotics could improve broiler performance by enhancing the immunomodulation capacity of broilers. By treating with 0.20 % and 0.35 % were showed a little difference with the control treatment of body weight and carcass characteristics.

The averages of L*, a* and b* values of breast meat and whole leg meat were presented in Table 2. The color parameters L*, a* and b* of breast meat on treatment MFB-0.20 had high significant than treatments MFB-0.00, MFB-0.05 and MFB-0.35. For whole leg muscle, L* value on treatment MFB-0.20 had significant with other treatments while a* value for MFB-0.20 and MFB-0.35 high significant than treatment MFB-0.00. But for b* value, there are no significant different between the treatments. L* value was show the lightness and darkness of breast and whole leg muscles on post slaughter after 3 days. From the research, the mean values of L* on breast muscles was lower and no significant (p>0.05) on treatment MFB-0.20 (46.46) followed by MFB-0.35 (47.36), MFB-0.05 (48.34) and had significant (p<0.05) with MFB-0.00 (49.93).

| Parameters | Parts          | Treatments                  |
|------------|----------------|-----------------------------|
| L*         | Breast         | MFB-0.00 (49.93±2.12)       |
|            | Whole leg      | MFB-0.05 (48.34±1.42)       |
|            |                | MFB-0.20 (46.46±2.45)       |
|            |                | MFB-0.35 (47.36±1.54)       |
| a*         | Breast         | MFB-0.00 (6.33±0.44)        |
|            | Whole leg      | MFB-0.05 (7.62±1.87)        |
|            |                | MFB-0.20 (8.10±0.65)        |
|            |                | MFB-0.35 (7.36±0.78)        |
| b*         | Breast         | MFB-0.00 (7.36±0.41)        |
|            | Whole leg      | MFB-0.05 (7.86±0.33)        |
|            |                | MFB-0.20 (8.23±0.40)        |
|            |                | MFB-0.35 (7.98±0.37)        |

For whole leg muscles, the mean of L* value on the treatment MFB-0.20 (42.43) had significant with other treatments but MFB-0.00 (44.92) not significance with treatments MFB-0.05 (44.23) and MFB-0.35 (43.89). L* value of whole leg meat lower than breast meat for all treatments means more dark. For a* value (redness), MFB-0.00 (6.33) shows no significant with MFB-0.05 (7.26) and MFB-0.35 (7.36) while had significant with MFB-0.20 (8.10) but a* value for whole leg on treatment MFB-0.00 also hadn’t difference with MFB-0.05 (7.86) but it shows significance with MFB-0.20 (8.23) and MFB-0.35 (7.98). Whole leg muscle showed a* value higher than breast muscle, shows the redness was higher. Reference [11] was state that dark meat contains myoglobin, an oxygen binding protein that related to hemoglobin in red blood cells, which makes dark muscle appear red. Dark muscles are suited for durability activity and slow to fatigue because they use oxygen to generate energy. The color parameter for b* value (yellowness) in this study show MFB-0.00 had similar with treatments MFB-0.05 and MFB-0.35 but highly significance on treatment MFB-0.20 for breast muscle of Japanese quails. Whole leg muscles show b* value of the treatments no have significant.

According to [1], L*, a* and b* values of muscle pectoralis of Japanese quails were 45.67, 11.68 and 14.48, respectively after 7th days storage after slaughter. They also stated in their studies, the pectoral muscle composed of muscle, connective tissue and fat. The muscle bundles of the pectoral muscle were composed of dark muscle fibers and the ratio between dark and light fibers was 95.1-96.7 % to 3.7-4.9 %. In the study by [21] that carried out on broiler chicken meat quality, the ideal L* must be between 46 and 53, and meats with L* value below 46 were called to be dark, firm, dry, which shows they had a dark color, high water holding capacity and short shelf life. Reference [22] reported the meat quality was significantly improved (p<0.05) in Bacillus subtilis group supplement compared with that in control group during storage. At 8 days storage, a* (7.9-5.0) value was significantly decreased (p<0.05), while, L* (43-49) and b* (14-19) value were significantly increased (p<0.05) in Bacillus subtilis group supplement compared with the control group.
Table 3. pH and % WHC values of breast meat (B) and whole leg meat (W) on different treatments.

| Characteristics | Treatments         | MFB-0.00 | MFB-0.05 | MFB-0.20 | MFB-0.35 |
|----------------|--------------------|----------|----------|----------|----------|
| pH             | B                  | 5.78±0.05| 5.83±0.04| 5.98±0.05| 5.87±0.04|
| pH             | W                  | 6.39±0.05| 6.44±0.04| 6.50±0.04| 6.46±0.07|
| WHC (%)        | B                  | 32.22±2.31| 31.89±2.14| 40.49±6.20| 31.89±2.14|
| WHC (%)        | W                  | 117.25±17.79| 106.42±12.09| 109.06±17.53| 110.28±6.67|

Each value is expressed as mean ± SD.
*Means with different small letters within same row are significantly different (p<0.05).

For whole leg meat of sample MFB-0.20 (6.50) showed higher compared to sample MFB-0.00 (6.39). The pH value of breast meat shows lower than whole leg meat because of the different morphological structure that determines the functional affiliation of both muscles. The oxidative muscle (dark muscle) fibers in thigh muscles was higher compared to that in pectoral muscle and thus, a precondition for slower depletion of glycogen stores. According to [9], decreased ultimate pH, could reduce protein functionalities of chicken breast muscle such as WHC, protein solubility and gel formation ability. WHC was the ability of meat to hold all or part of its own water. Reference [1] reported water retention capacity of pectoral muscles for male 22.39 % and female 21.68 % while for legs muscles of male were 26.91 % and for female 25.08 %. Water holding capacity of whole leg muscle was higher than breast meat for all treatments in range 106.25-117.42 %. The mechanism is influenced by both the pH of the tissue and by the amount of space in the muscle cell and particularly the myofibril that exists for water to reside according to [24]. The percentage of water holding capacity is also influenced by the different pressure or speed of centrifuge machine.

By treatment with probiotics like *Bacillus subtilis* and *Bacillus natto*, the connective tissues among muscle fibers were significantly less than without treatment with probiotics but breast muscle fibers under the treatment showed neat muscle arrangement. The cross-section of breast muscle fibers was significantly larger than without probiotic treatment. The water holding capacity of breast muscle under treatments MFB-0.20 was higher than MFB-0.00 similar to research by [6] that reported WHC of breast muscle under the treatment probiotic (49.15-52.35 %) higher than without treatment (43.30 %). The increase of water-holding capacity and improve meat color, so it is a good alternative for antibiotics in their feed. On the physicochemical characteristics of quail leg and breast meat from five week show leg meat had higher moisture content, ether extract, collagen level, water-holding capacity, pH and shear force values, with lower myofibrillar and total protein than breast meat [25]. Connective
tissue in whole leg was more than in breast muscle. The components in connective tissue were collagen and elastin able to hold the water [6]

Quail breast meats were cooked in an 80 °C water bath to measure the cooking loss, juiciness and shear force of cooked meat like in Table 4. Cooking loss, juiciness and shear force were shows no significant difference between the treatments. By treatment with MFB supplement was show the decrease of cooking loss and juiciness but higher the shear force. In the treatments, MFB-0.20 presented the lower percentage of cooking loss (19.16 %) and juiciness (16.78 %) but higher the shear force (11.92) compared to MFB-0.00, MFB-0.05 and MFB-0.35.

Table 4. Cooking loss, juiciness and shear force of cooked quail meat.

| Treatment     | MFB-0.00 | MFB-0.05 | MFB-0.20 | MFB-0.35 |
|---------------|----------|----------|----------|----------|
| Cooking loss (%) | 19.86±0.04 | 19.52±0.16 | 19.16±0.35 | 19.30±0.49 |
| Juiciness (%)   | 17.62±0.38 | 17.42±0.30 | 16.78±0.07 | 17.25±0.08 |
| Shear force (N) | 10.62±0.44 | 11.09±0.06 | 11.92±0.79 | 10.67±0.50 |

Each value is expressed as mean ± SD.
*Means with the same letter in same row is not significantly different (p<0.05).

In a few studies, the meat quality attributes of probiotic-fed chicken have been evaluated to ensure natural and wholesome characteristics [2]. In a similar result it was reported no difference in percentage of cooking loss from broilers fed probiotics (19.41 %) compared to non-probiotics fed chicken counterpart (19.48 %). Reference [9] found that the cooking loss also no difference of cooking loss (18.2-18.7 %) in chicken breast muscles of probiotic feeding levels. Reference [20] reported cooking loss by treatment Bacillus subtilis lower than control along 8 days of storage.

Shear force by Warner-Bratzler shearing knife was used to determine the toughness of breast meat but some studies was run by identify the tenderness of meat. The reading of shear force was similar with percentage cooking loss that no significant from the treatment with probiotics. Reference [6] were analyzed the shear force of breast quail meat by treat with probiotics (Bacillus subtilis, Bacillus natto and Bacillus licheniformis) were 1.49-1.58 kg (14.61-15.49 N) hadn’t difference with no treated with probiotics (1.69 kg or 16.57 N). They explained that the different results of shear force compared to other studies could be related to different probiotics feeding. References [20] and [9] were reported shear force (tenderness) not influence among the treatments with the value 1.41-1.57 kg (13.83-15.40 N) and 14.4-16.7 N (1.47-1.70 kg). The lower of tenderness value of meat means the meat was tough that were similar with this study. The fast growing of probiotic-fed chicken could influence meat tenderness due to the presence of large diameter fibers and an increase in glycolytic fibers.

Table 5 was presented about the percentage of cooking loss, juiciness, folding test and shear force of quail meat sausage. No significant different (p>0.05) of the parameters with the treatment of Mega Floral Booster (MFB). By application of treated quail meat in sausage making could determine the quality of quail meat. Cooking loss and juiciness percentage of MFB-0.20 were 4.82% and 15.79 %, receptively showed lower than other treatment (MFB-0.00, MFB-0.05 and MFB-0.35). According to [26] reported percentage of cooking loss of chicken sausage was 4.32 % lower than quail meat sausage it is because the variety of ingredients was improve the structure of sausage. Folding test is a simple method used to measure the textural quality of sausages. Generally, all commercial chicken sausages samples showed good gel strength because their folding test scores were more than 4.0. The folding test of the sausages had no significant difference between the treatments had 3.00 means the slices of sausage crack gradually when folded in half. Folding test upper 3.00 was declared as good texture of sausage.

By the lower cooking loss and juiciness were tend to high the shear force of breast quail meat of MFB-0.20 was 4.12 N. Shear force of commercial chicken sausage and duck chicken sausage were 0.38-1.31 kg (3.73-12.84 N) and 0.09-2.89kg (0.88-28.34 N) while quail meat sausage in range 2.72-4.12 N. Moisture, water holding capacity and fat content were influenced the texture of sausage. The
lower moisture content tends to high shear force. Chicken sausage added with more water tends to reduce fat content and had low shear force.

Table 5. Cooking loss, juiciness and folding test and shear force of quail meat sausage.

| Treatment    | MFB-0.00 | MFB-0.05 | MFB-0.20 | MFB-0.35 |
|--------------|----------|----------|----------|----------|
| Cooking loss (%) | 5.97±0.07 | 5.75±0.08 | 4.82±0.61 | 5.07±0.28 |
| Juiciness (%)  | 16.99±0.35 | 17.72±2.83 | 15.79±2.62 | 17.33±1.43 |
| Folding test   | 3.00±0.00 | 3.00±0.00 | 3.00±0.00 | 3.00±0.00 |
| Shear force (N) | 3.12±0.02 | 2.72±0.42 | 4.28±1.78 | 3.44±0.78 |

Each value is expressed as mean ± SD.

The higher hardness value within the sample was related to the higher protein content and lower content of fat. Meat type (young or old meat), meat part (breast or thigh), deboning method (hand or mechanically), water added and additives could also influence the hardness of the samples sausage. Among texture attributes, hardness was the most important to the consumers as it determine the commercial value of a meat according to [27].

Second parameters, springiness, gumminess, cohesiveness and chewiness behave similarly on which depend on the hardness parameters. Springiness of quail meats were in range (0.66-0.78 mm) and gumminess (544.31-1043.96 g). Quail meat from MFB-0.20 had higher springiness, gumminess, cohesiveness and chewiness were 0.78 mm, 1043.96 g, 0.35 and 865.66 gmm, respectively than other treatments. Commercial chicken sausage was show springiness, gumminess, cohesiveness and chewiness in range 12-15 mm, 1043.96-2300 g, 0.2-0.4 and 1600-3300 gmm, respectively while fish surimi sausage show the springiness was 0.59 mm, cohesiveness 0.20 and chewiness 129.45 gmm lower than chicken sausage.

The differences could be due to the ingredients used for example salt. Salt significantly increased meat product cohesiveness. Mixture of duck and chicken meat sausage show the hardness 1200-4000 g, springiness 7.3-11 mm, gumminess 200-1000 g, cohesiveness 0.23-0.32 and chewiness in range 2910-9290 gmm. In term of protein content, the variety and high protein content resulted hard of texture and low fat content tend to increase the harder, gummier, cohesive, high chewiness and lower springiness of meat [28].
4. Conclusions

In conclusion, this study indicated that Mega Floral Booster (dietary probiotic supplement) had little or noticeable effect on carcass characteristics include live bird weight, carcass yield, breast with bone yield, breast meat yield, whole leg with bone yield and whole leg meat yield but MFB-0.20 was show a little impact on carcass characteristics. Mega Floral Booster-supplemented-0.20% diets show a little differ in color of breast muscle and whole leg muscle (L*, a* and b*), pH and WHC, cooking loss, juiciness and shear force compared with MFB-0.00, MFB-0.05 and MFB-0.35. In addition, usage of quail meat in sausage production not shows a large differs in sausage quality but still acceptable as good quality. Although the treatments not show the large improvement on meat quality but it not gives a bad effect.

5. Reference

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