

## Physical and Sensory Characteristics of Broiler Chicken Sausages with Addition of *Spirulina* (*Arthrospira Platensis*)

Edi Suryanto, Jamhari, Rio Olympias Sujarwanta, Endy Triyannanto, Setiyono, Rusman, Friska Putri Sumajava, and Addi Jaler Mukhshon

Department of Animal Products Technology, Faculty of Animal Science, Universitas Gadjah Mada  
Yogyakarta, Indonesia

Corresponding author: edi\_ugm@ugm.ac.id

### ABSTRACT

This study aims to determine the physical and sensory characteristics of broiler chicken sausage with the addition of *Spirulina* (*Arthrospira platensis*). The main ingredients of sausage were broiler chicken meat, tapioca flour, skim milk powder, angkak, *Spirulina*, tapioca flour, and spices. The additions levels of *Spirulina* were: 0, 250, and 500 ppm. The observed variables were physical characteristics including pH, water holding capacity, and tenderness, and sensory characteristics including color, taste, aroma, texture, firmness, and acceptability. The pH test of sausage was performed with pH meter. The water holding capacity was analyzed by using the modification of Hamm method, while the tenderness test of sausage was measured by penetrometer. The sensory characteristics test of sausage was performed by panelist method. The data of physical characteristics were analyzed statistically using analysis of variance. The data of sensory characteristics were analyzed by using nonparametric test with Kruskal-Wallis test. The addition of *Spirulina* at the levels of 250 and 500 ppm increased significantly the water holding capacity and tenderness of broiler chicken sausage, but it did not effect on the pH, taste, aroma, and texture of broiler chicken sausage. The conclusions of this study were the addition of *Spirulina* influenced physical characteristics (water holding capacity and tenderness) and sensory characteristics (color, firmness, and acceptability) of broiler chicken sausage.

**Keywords:** Broiler chicken sausage, *Spirulina*, Physical characteristics, Sensory characteristics.

### INTRODUCTION

Functional foods can be produced by addition of some special ingredients for health reason, into food products (Niva, 2007). With increasing attention to functional foods, people's awareness of healthy living also increases (Kotilainen, *et al.*, 2006). Humans need about 1 g protein/kg of body weight per day. In order to meet protein needs, an alternative way used was to produce functional foods or supplements containing high protein such as from *Spirulina sp.* algae. *Spirulina* is a blue-green photo-autotroph algae, has chlorophyll, and contains protein about 50 to 70% of the dry weight, some vitamins and minerals. In terms of safety and health factors, it is freely consumed by humans (Angka and Suhartono, 2000; Christwardana *et al.*, 2013).

The dried *Spirulina* protein can reach 72% with fairly balanced amino acid content. One of *Spirulina* species is *Spirulina platensis* can be cultivated in freshwater media, brackish or sea water. For the medicine needs and human foods, *Spirulina platensis* can be cultivated in fresh water better because it has a high protein and low sodium content.

*Spirulina platensis* cultivated in seawater media has high phycocyanin and carbohydrates, and has low production costs (Angka and Suhartono, 2000; Christwardana *et al.*, 2013).

This study aims to determine the physical and sensory characteristics of broiler chicken sausage with the addition of *Spirulina* (*Arthrospira platensis*).

## MATERIALS AND METHODS

### Materials

The ingredients used in this study were broiler chicken meat, *Spirulina* flour, angkak, tapioca flour, skim milk powder, spices (salt, fresh garlic, coriander powder, and pepper powder), sodium tripolyphosphate (STPP), ice water, cooking oil, distilled water, and phosphate buffer

Materials used in this study were grinder, meat chopper, penetrometer, electric (digital) scale, analytical scales, stuffer, basin, stainless steel pan and knife, cutting board, measuring cup, thermometer, filter paper, cooking glove, stove, blender, pH meter, stirrer, sausage casing, glass, mica plastic, 35 kg barbell, millimeter block paper, permanent markers, and stopwatch.

### Methods

Ingredients such as broiler chicken meat, tapioca flour, skim milk powder, garlic, salt, pepper powder, coriander powder, sodium tripolyphosphate (STPP), angkak, ice water, cooking oil and *Spirulina* flour with different levels, i.e. 0, 250, and 500 ppm were prepared and weighed. Chicken broiler meat cut into small pieces, grinded using a grinder. Ground broiler chicken meat was then mixed with filler and binder. The filler used was tapioca flour and the binder was skim milk powder. The dough was then added with salt, pepper powder, coriander powder, garlic, and STPP, mixed until homogeneous. The dough was then put into the meat chopper. Angkak and *Spirulina* were dissolved in ice water and put into the meat chopper and chopped for 15 minutes. The dough was then put into sausage casing using a stuffer. The sausage was then steamed for 30 minutes at 85°C. The sausage was analyzed for the physical and sensory characteristics.

### Physical characteristics

The pH test was performed by pH meter which had been calibrated with pH 7 of buffer solution and washed with distilled water. Measurements were made 3 times and then the results were averaged (Bouton *et al.*, 1971). The tenderness was observed by sausage sample placed under the penetrometer needle, then measured the value of tenderness at three different places (Candogan and Kolsarici, 2003). The water holding capacity test was performed by the modification of Hamm method (1986), by pressing 0.3 g of sausage sample with 35 kg barbell on a filter paper between two glasses for 5 minutes (Soeparno, 2005).

### Sensory characteristics

The variables of the sensory characteristics including the color, taste, aroma, texture, firmness, and acceptability were tested by using the scoring method by the panelists (Kartika, 1988).

### Data analysis

The data of physical characteristics were analyzed statistically by using analysis of variance (ANOVA) and the differences between means were tested by Duncan's New Multiple Ranges Test (Steel and Torrie, 1993). The data of sensory characteristics were analyzed by using nonparametric test (Kruskal-Wallis test) (Saleh, 1996).

## RESULTS AND DISCUSSION

### Physical Characteristics

**Table 1.** Average of pH value, water holding capacity, and tenderness of broiler chicken sausage with addition of *Spirulina*

Variable	Level of <i>Spirulina</i> (ppm)		
	S0 (0)	S1 (250)	S2 (500)
pH value <sup>ns</sup>	6.43±0.57	6.33±0.57	6.33±0.33
Water holding capacity (%)	57.66±0.33 <sup>a</sup>	58.66±0.33 <sup>b</sup>	58.68±0.33 <sup>c</sup>
Tenderness (mm/50g)	7.03±0.58 <sup>a</sup>	10.03±0.77 <sup>b</sup>	12.56±0.38 <sup>c</sup>

<sup>abc</sup>Different superscripts at the same row indicated indicate significant differences (P<0.05)

<sup>ns</sup>Not significant

### pH value

The pH value of broiler chicken sausages with the addition of *Spirulina* 0, 250, and 500 ppm were 6.43±0.57, 6.33±0.57, and 6.33±0.33, respectively. Based on the analysis of variance, pH values of the three treatment levels showed no significant difference (P>0.05). According to Aberle *et al.* (2001), the pH value or the degree of acidity of meat will affect the quality/characteristic of processed meat. Forrest *et al.* (1975) stated that the treatment during the meat processing can change the pH value. The grinding process will cause damage to the protein bonds of the meat which will facilitate the change in the position of H<sup>+</sup> and OH<sup>-</sup> ions when ripening, this change of isoelectric point causes the pH to change. The average pH value of the study results is still within normal limits.

### Water holding capacity

Water holding capacity is the ability of meat to bind water or water added during the influence of external forces (Soeparno, 2005). The water holding capacity (WHC) of broiler chicken sausage with the addition of *Spirulina* 0, 250, and 500 ppm were 57.66±0.33, 58.66±0.33, and 58.68±0.33%, respectively. Based on the analysis of variance, the WHC of these three levels showed significantly different results (P<0.05). According to Aberle *et al.*, (2001), water holding capacity is affected by pH. A good pH value for WHC is between 5.1 to 6.1. The result showed that the pH value was between 5.66 and 5.77 which still showed good pH value. Swatland (1984) stated that the ability to bind water to meat is affected by pH. Increase of WHC was linear with increase of pH value from 5.4 to 6.0. The most influential factor for WHC in chicken sausage is the destruction of meat during processing. Damage of the structure of the meat results in reduced WHC (Lawrie, 1979). Aberle *et al.* (2001) suggested that the presence of connective tissue (collagen) may increase the water binding power during mixing in the sausage-making process. It was also added that during heating formed a very good gelatin in water binding.

### Tenderness

Tenderness is one of the determinants of the quality/characteristic of processed meat products that are critical of the acceptance of consumers and consumers usually want processed meat products are tender. The tenderness value of broiler chicken sausage with the addition of *Spirulina* at the levels of 0, 250, and 500 ppm were 7.03±0.58, 10.03±0.77, and 12.56±0.38 mm/50g . These three levels showed significantly different result (P<0,05). Suryaningsih (2011) stated that the decrease of protein content in sausage dough results more water loss, and reduces the tenderness of sausage products. Sausage tenderness was not influenced by the addition of *Spirulina* because the difference of *Spirulina* concentration at each level of this study was only 250 ppm.

According to Anshori (2002), the elasticity of processed meat products was influenced by fillers. Fillers in the form of flour in addition to being able to bind water when heated had a rubbery property such as gelatin so that the resulting processed products will be suppler.

### Sensory Characteristics

**Table 2.** Average of sensory scores of broiler chicken sausage with addition of *Spirulina*

Variable	Level of <i>Spirulina</i> (ppm)		
	S0 (0)	S1 (250)	S2 (500)
Color	5.00±0.31 <sup>c</sup>	3.20±0.20 <sup>b</sup>	2.40±0.24 <sup>a</sup>
Taste <sup>ns</sup>	4.40±0.89	3.80±0.44	3.80±0.83
Aroma <sup>ns</sup>	3.60±0.24	3.00±0.31	3.60±0.24
Texture <sup>ns</sup>	4.00±0.31	4.00±0.40	3.60±0.24
Firmness	4.20±0.37 <sup>b</sup>	3.60±0.40 <sup>a</sup>	3.40±0.50 <sup>a</sup>
Acceptability	4.60±0.24 <sup>c</sup>	3.80±0.20 <sup>a,b</sup>	3.60±0.40 <sup>a</sup>

<sup>abc</sup>Different superscripts at the same row indicated significant differences (P<0.05).

<sup>ns</sup>Not significant

### Color

The color of the meat is one of the main features of meat sensory. The results showed that the addition of *Spirulina* in the broiler chicken sausage changed the color significantly. Higher level of *Spirulina* made chicken sausages become more greeny. In this study the color changed significantly due to the increase of *Spirulina* concentration. The contents of pigment or dyes presented in *Spirulina* were chlorophyll a, carotenoid, beta-carotene, phycocyanin, and xanthofil. Pigments also function as detoxification, bind free particles, antioxidants, boost immunity, increase the amount of intestinal bacteria, and increase hemoglobin (Kabinawa, 2006).

### Taste

Taste is sensory quality/characteristic of meat that closely related with taste bud. Results of study showed that addition of *Spirulina* did not influence the taste of broiler chicken sausage. Soeparno (2005) stated that taste of cooked meat mostly determined by the precursor that solved in water and fat.

### Aroma and texture

Aroma is a complex and inter-related sensation of meat products. Aroma involved the smell, taste, texture, temperature, and pH of meat products. There was not any different in the aroma of broiler chicken sausage with addition of *Spirulina* and the control. Texture is meat characteristics that related to the coarseness of meat fiber. There was not any different in the texture of sausage with addition of *Spirulina* and the control. Guritno (1992) stated that several things might affect the texture of sausage such as method of processing, state of aging time and post harvest handling.

### Firmness

The results of study showed that firmness of broiler chicken sausage with addition of *Spirulina* was 3.4 to 4.2. *Spirulina* decreased the firmness of sausage. Judge *et al.* (1989) stated type of meat, food additives, and spices added during meat processing influenced the firmness of sausage.

### Acceptability

Acceptability is one of sensory parameter of animal products related to the consumer. The results of study showed that acceptability of broiler chicken sausage with addition of *Spirulina* was 3.6 to 4.6. Soeparno (2005) stated that meat is valued based on the consumer acceptability since satisfaction of consumer depends on the physiological and sensory responses of the panelists.

## CONCLUSIONS

The conclusions of this study were addition of *Spirulina* influenced physical characteristics (water holding capacity and tenderness) and sensory characteristics (color, firmness, and acceptability) of broiler chicken sausage.

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